MARINE ENERGY WALES

MARINE ENERGY TEST AREA (META)

Environmental Impact Assessment

Chapter 10:
Marine Ornithology

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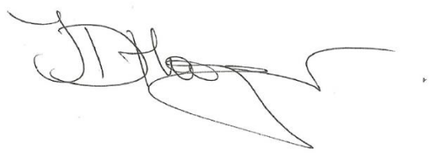
Jessica Hooper  2019-12-05

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Table of Contents

Table of Tables

Table of Figures

Acronyms

Acronym	Description
BoCC	Birds of Conservation Concern
BTO	British Trust for Ornithology
CIA	Cumulative Impact Assessment
EIA	Environmental Impact Assessment
ESAS	European Seabirds at Sea
FAME	Future of the Atlantic Marine Environmentl
HRA	Habitats Regulations Appraisal
IMO	International Maritime Organisation
MCA	Maritime and Coastguard Agency
META	Marine Energy Test Areas
MHWESG	Milford Haven Waterway Environmentl Steering Group
MPCP	Marine Pollution Contigency Plan
NPS	National Policy Statement
NRW Advisory	Natural Resources Wales Advisory Services
NRW PS	Natural Resources Wales Permitting Services
NSIP	Nationally Significant Infrastructure Project
RIAA	Report to Inform Appropriate Assessment
RSPB	Royal Society for the Protection of Birds
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
STAR	Seabird Tracking and Research
VER	Valued Ecological Receptor
WCA	Wildlife and Countryside Act
WeBS	Wetland Bird Survey
WWBIC	West Wales Biodiversity Information Centre
ZoI	Zone of Impact

Units

Unit	Description
%	**percentage**
km	Kilometre
Km^2	Kilometres squared
m	metre
m/s	metre per second
n	Number

10. MARINE ORNITHOLOGY

10.1 Introduction

10.1.1.1 This chapter of the Environmental Statement presents the results of the Environmental Impact Assessment (EIA) for the potential impacts of the META project on marine ornithology. Specifically, this chapter considers the potential impacts of the META project during its installation, operation and maintenance, and decommissioning phases.

10.1.1.2 The assessment presented is informed by the following technical chapters:

- Chapter 8: Fish and Shellfish.

10.2 Purpose of this chapter

10.2.1.1 The primary purpose of the Environmental Statement is to support the marine consent and licence applications for the META project, which are outlined in chapter 1: Introduction.

10.2.1.2 It is intended that the Environmental Statement will provide statutory and non-statutory consultees with sufficient information to determine the potential significant impacts of the META project on the receiving environment and will inform the issue of appropriate consent and/or licences by the regulatory authorities. It will also inform any consent conditions.

10.2.1.3 In particular, this Environmental Statement chapter:

- Presents the existing environmental baseline established from desk studies, and consultation;
- Presents the potential environmental effects on marine ornithology arising from the META project, based on the information gathered and the analysis and assessments undertaken;
- Identify any assumptions and limitations encountered in compiling the environmental information; and
- Highlight any necessary monitoring and/or mitigation measures which could prevent, minimise, reduce or offset the possible environmental effects identified in the EIA process.

10.3 Study area

10.3.1.1 The marine ornithology data search study area consists of a five km buffer (Figure 10.1) around the development, considered sufficient to encompass the zone of influence (ZoI) of the development on seabirds, taking account of the limited scale and duration of the works.

10.3.1.2 Where Annex I, migratory species, and those species potentially associated with important assemblages are identified within the marine ornithology desk search study area, mean maximum foraging ranges of these species will be used to identify potentially connected designated sites for which they are qualifying species. This search area will be referred to as the marine ornithology search area and will be 400 km based on fulmar mean-maximum foraging distance (Thaxter *et al*., 2012) (Figure 10.1).

10.3.1.3 In addition, a search for any Sites of Special Scientific Interest (SSSIs) within 10 km of the development was carried out to identify any SSSIs that have coastal ornithological features. This was considered a precautionary search area based upon the ZoI of the development.

10.4 Policy context

10.4.1 National Policy Statements

10.4.1.1 While it is recognised that the META project does not constitute a Nationally Significant Infrastructure project (NSIP), the National Policy Statements (NPS) available to support NSIPs are considered to provide useful context to the production of marine ornithology environmental assessments.

10.4.1.2 Planning policy on renewable energy infrastructure, specifically in relation to marine ornithology, is contained in the Overarching National Policy Statement (NPS) for Energy (EN-1; DECC, 2011a) and the NPS for Renewable Energy Infrastructure (EN-3, DECC, 2011b).

10.4.1.3 NPS EN-1 and NPS EN-3 include guidance on what matters are to be considered in the marine ornithology assessment. These are summarised in Table 10.1 and Table 10.2 respectively.

10.4.1.4 NPS EN-3 also highlights several factors relating to the determination of an application and in relation to mitigation. These are summarised in Table 10.3.

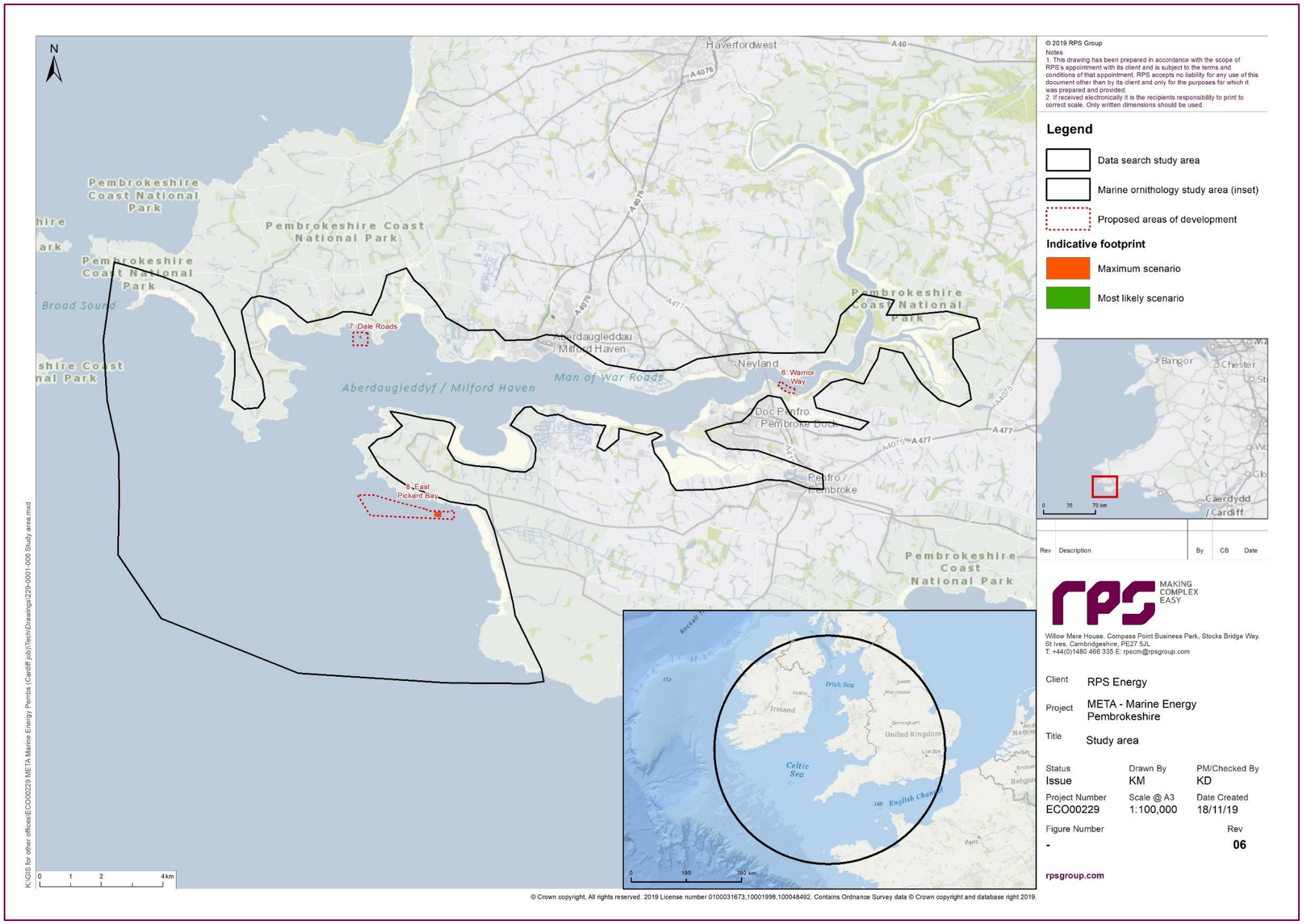

Figure 10.1: Marine ornithology data search study area and marine ornithology study area.

Table 10.1: Summary of NPS EN-1 policy relevant to marine ornithology.

Summary of relevant policy framework	How and where considered in the Environmental Statement
Biodiversity	
Where the development is subject to EIA the applicant should ensure that the Environmental Statement clearly sets out any effects on internationally, nationally and locally designated sites of ecological or geological conservation importance, on protected species and on habitats and other species identified as being of principal importance for the conservation of biodiversity (paragraph 5.3.3 in NPS EN-1).	Effects on marine ornithology, including species of conservation importance, including those listed as features of designated sites, are fully considered in the assessment section. Baseline information on these receptors is presented with an evaluation of these receptors in the context of their conservation importance considered.
The most important sites for biodiversity are those identified through international conventions and European Directives. The Habitats Regulations provide statutory protection for these sites (paragraph 5.3.9 in NPS EN-1).	Effects of marine ornithology features have been assessed within the Report to Inform the Appropriate Assessment for Natura 2000 sites.
Marine Conservation Zones (MCZs) introduced under the Marine and Coastal Access Act (MCAA) 2009 are areas that have been designated for the purpose of conserving marine flora and fauna, marine habitat or features of geological or geomorphological interest (paragraph 5.3.12 in NPS EN-1).	Skomer MCZ is the only MCZ in Wales (Figure 2) and can be found within the vicinity of the META project marine ornithology study area. This is designated primarily for marine features including grey seal, pink seafan, sponge communities, eelgrass and algal communities. These are discussed further in the benthic ecology chapter (Ch 7: Benthic Subtidal and intertidal Ecology)
Other species and habitats have been identified as being of principal importance for the conservation of biodiversity in England and Wales and thereby requiring conservation action (paragraph 5.3.17 in NPS EN-1).	All species receptors, including those of principal importance for the conservation of biodiversity in Wales are summarised, with evaluation of these receptors in the context of their conservation importance.
The applicant should include appropriate mitigation measures as an integral part of the proposed development. In particular, the applicant should demonstrate that: During installation, they will seek to ensure that activities will be confined to the minimum areas required for the works; and During installation and operation best practice will be followed to ensure that risk of disturbance or damage to species or habitats is minimised, including as a consequence of transport access arrangements.	Mitigation measures proposed for the META project are presented in section 10.12.2.

Table 10.2: Summary of NPS EN-3 policy relevant to marine ornithology.

Summary of relevant policy framework	How and where considered in the Environmental Statement
Biodiversity	
Applicants should assess the effects on the offshore ecology and biodiversity for all stages of the lifespan of the proposed project (paragraph 2.6.64 of NPS EN-3).	Installation, operation and maintenance, and decommissioning phases of the META project have been assessed (see section 10.12).
Consultation on the assessment methodologies should be undertaken at early stages with the statutory consultees as appropriate (paragraph 2.6.65 of NPS EN-3).	Consultation has been sought on the marine ornithology baseline via a baseline data report. MEW will seek to agree that existing baseline desk study data sources are sufficient for the assessment.
Applicants should assess the potential for the scheme to have both positive and negative effects on marine ecology and biodiversity (paragraph 2.6.67 of NPS EN-3).	Both the potential positive and negative effects of the META project have been assessed (see section 10.12).

Table 10.3: Summary of NPS EN-3 policy on decision making with regards to marine ornithology and consideration of the META project assessment.

Summary of relevant policy framework	How and where considered in the Environmental Statement
Biodiversity	
The regulatory authority should consider the effects of a proposal on marine ecology and biodiversity taking into account all relevant information made available to it (paragraph 2.6.68 of NPS EN-3).	This marine ornithology impact assessment provides the information for the regulatory authority to consider the effects of the META project on marine ornithology.
The designation of an area as a European site does not necessarily restrict the construction or operation of a project in or near that area (paragraph 2.6.69 of NPS EN-3).	European sites have been considered during the assessment set out in this chapter, and full consideration of potential impacts on European Sites is set out in the META Report to Inform Appropriate Assessment (RIAA)
Ecological monitoring is likely to be appropriate during the installation and operation and maintenance phases to identify the actual impact so that, where appropriate, adverse effects can then be mitigated and to enable further useful information to be published relevant to future projects (paragraph 2.6.71 of NPS EN-3).	The requirement for marine ornithology monitoring has been considered within each impact assessment. .

10.5 Consultation

10.5.1.1 Consultation on marine ornithology has been carried out via the META Habitats Regulations Assessment (HRA) screening report (January 2019), the META Scoping report (November 2018), and via a marine ornithology baseline data report (May 2019).

10.5.1.2 A site meeting was held 10 October 2018 to discuss coastal aspects of marine ornithology. This meeting was attended by Jon Hudson from Natural Resources Wales (NRW) Advisory Services who provided no specific feedback on these elements.

Table 10.4: Summary of key issues raised during consultation activities undertaken for the META project relevant to Marine Ornithology.

Date	Consultee and type of response	Issues raised	Response to issue raised and/or where considered in this chapter
21/01/2019	NRW advisory (ABPmer)	Potential disturbance effects on seabirds as a result of increased underwater noise due to vessels involved in installation, operation and maintenance activities are proposed to be scoped into the EIA. The proposed approach for further assessment is to determine the potential increase in baseline levels of vessel traffic during these activities and to undertake a desk-based review of the types of vessels to be utilised and the potential for noise disturbance. Considering the scale and nature of the proposed activities, the proposed approach is considered appropriate.	Approach agreed (section 10.12)
21/02/2019	NRW advisory (ABPmer)	The potential for transboundary impacts has not been considered in the Scoping Report. The nearest other Member State to the META Sites is the Republic of Ireland14. There are unlikely to be any transboundary effects in relation to marine ornithology given the scale and nature of the activities proposed at the Phase 2 sites. The potential for cross-border impacts with England is also considered unlikely.	Approach agreed – no potential transboundary impacts identified (section 10.15)
28/03/2019	NRW	NRW agreed with the description of the baseline environment	Baseline environment described in section10.7
28/03/2019	NRW	NRW agreed that the evidence that has been supplied is appropriate (i.e. proportionate and targeted) and is it sufficient to inform the Environmental Statement	Baseline environment is described in section 10.7
28/03/2019	NRW	NRW agreed that the proposed data sources for defining the baseline environment where appropriate, sufficient and up to date	Baseline environment is described in section 10.7 Data sources used to inform the baseline are detailed in Table 10.5 and Table 10.6
28/03/2019	NRW	On the whole the data sources the applicant intends to use seems reasonable and they may wish to also consider historical at sea surveys for birds such as the ESAS and WWT combined seabird data for Welsh waters. In addition, we recommend the use of local record centre and BirdTrack data.	ESAS data and local record centre data utilised (Table 10.5 and Table 10.6)
28/03/2019	NRW	We note that 1 year of site-specific ornithology surveys are planned to be undertaken. We anticipate that this should be sufficient to inform the EIA but note that further operational surveys may be required in future if deemed appropriate following review of the survey data and additional information.	Section 5.1 of the scoping report states: Ornithology surveys, including over-wintering red-billed chough survey (to be undertaken Winter 2018/19). As the META project design envelope now encompasses only offshore works (as discussed and agreed with NRW PS) and has no onshore component, the scope of any onshore surveys are no longer within the scope of the META project and are therefore no longer within the remit of Marine Energy Wales. No chough surveys have therefore been undertaken as part of the META project. No other ornithology surveys were proposed as part of the META Scoping Report.
28/03/2019	NRW	In addition to bird surveys, a desk study should be completed. On the whole, the data sources proposed to be used appear reasonable. The following data sources should be considered in the EIA: • Historical at sea surveys for birds such as the ESAS and WWT combined seabird data for Welsh waters; • BirdTrack data; • Bird data from the Pembrokeshire county recorder13 • Terrestrial bird data for the general vicinity, including chough data is available from the RSPB.	Table 10.5 and Table 10.6 detail the data sets used to inform the assessment.
28/03/2019	NRW	NRW agreed that the proposed methodologies for assessment to be appropriate?	Approach to assessment set out in section 10.10
28/03/2019	NRW	Impacts of lighting need to be considered.	Impacts of lighting have been considered in the report to inform appropriate assessment (RIAA) and within Table 10.11 and section 10.9.2.
28/03/2019	NRW	The list of species and sites currently in scope for assessment is incomplete. For example, Grassholm SSSI/SPA is not included despite the proposed scheme being within the foraging range of gannets. The applicant therefore needs to revise the list of species and sites included within scope. This list should include all sites for which the foraging range of their designated feature intersects the proposed site boundaries.	Grassholm, Carmarthen Bay and North Ceredigion Coast SPA's considered (see Table 10.7). Also considered within the META RIAA.
28/03/2019	NRW	The list of species and sites currently in scope for assessment is incomplete. All sites for which the foraging range of their designated feature intersects the proposed site boundaries should be included. For example, the following sites have been omitted and must be included in the EIA:	All sites listed are considered within this assessment (see Table 10.7) and within the META HRA screening report and RIAA. Any sites scoped out from further assessment are justified within Table 10.7.

Date	Consultee and type of response	Issues raised	Response to issue raised and/or where considered in this chapter
		• Carmarthen Bay / Bae Caerfyrddin SPA (designated for wintering common scoter) • Northern Cardigan Bay / Gogledd Bae Ceredigion (designated for wintering red-throated diver) • Grassholm SSSI/SPA	
28/03/2019	NRW	The nature of the marine ornithological surveys identified in Section 5.1 are not clear (see comments above)	No marine ornithological surveys are proposed. The data utilised are described in section 10.6
19/01/2019	RSPB	Overall, we consider that the scoping document is generally comprehensive although it lacks detail in terms of ornithological issues. There are some matters that we consider need further attention, through providing a detailed programme of ornithological surveys and a more comprehensive identification of protected sites and species that could be affected by the proposal. We also recommend the inclusion of plans and projects for the consideration of cumulative effects. These comments are expanded upon below.	General comment – individual issues outlined below
19/01/2019	RSPB	Designated sites, species and receptors identified in sections 6.6 & 6.6 of the scoping report are incomplete. For example, the omission of two SPAs within proximity in Welsh waters: • Carmarthen Bay / Bae Caerfyrddin SPA (designated for wintering common scoter) • Northern Cardigan Bay / Gogledd Bae Ceredigion (designated for wintering red-throated diver)	Carmarthen Bay and Northern Cardigan Bay SPAs are considered in Table 10.7 and the META HRA screening and RIAA. Any sites scoped out from further assessment is justified within Table 10.7.
28/03/2019	NRW	The EIA/ES must establish the presence of vulnerable species of bird. All species of birds need to be considered as part of the screening process for the EIA (and HRA). Possible adverse impacts may be applied to a range of birds (including bird features of SSSIs and SPAs) both breeding and non-breeding populations over a wide area of search; to include seabird features within their mean maximum foraging ranges.	All species of bird identified during the desk study have been considered as part of the screening process for this marine ornithology chapter. All seabirds listed as SPA features have been considered within their mean maximum foraging ranges for both the HRA and this chapter.
28/03/2019	NRW	The scoping area for the EIA should be denoted by mean-maximum foraging ranges from seabird SSSIs and SPAs. Thaxter *et al* (2012) initially set the standard of mean-maximum foraging ranges based on seabird tracking data. However, further tracking data has become available, in particular from the Future of the Atlantic Marine Environment (FAME) and Seabird Tracking and Research (STAR) projects.	For the purposes of this assessment the marine ornithology study area has been denoted by the mean-maximum foraging ranges set out in Thaxter *et al*,. 2012 (see section 10.6)
19/01/2019	RSPB	Seabird biotelemetry is a fast-moving field and so the scoping should not preclude the fact that more data on foraging range are likely to become available throughout the timespan of the assessment and these data should be considered in the final assessment. However, during the initial scoping phase we recommend that reference be made to the FAME/STAR data and would be happy to initiate the process by which this could be facilitated. Some seabird tracking data is available via the following link: https://rspb.maps.arcgis.com/apps/Cascade/index.html?appid=d6c3aa1ec7184a2895a01cebf451c7b3&utm_source=rspb.org.ukseabirdtracking&utm_medium=shorturl	Data and outputs from Wakefield *et al*. 2017 have been used to inform the assessment.
19/01/2019	RSPB	We recommend at least two years of bird survey effort, covering all seasons and including both breeding and non-breeding populations. In addition to bird surveys, a desk study should be completed (see above link for FAME and STAR data). We recommend sourcing bird data from the Pembrokeshire county recorder (https://birdsin.wales/counties/pembroke/).	Data was obtained from the British Trust for Ornithology (BTO), European Seabirds at Sea (ESAS), West Wales Biodiversity Information Centre (WWBIC) and Milford Haven Waterway Environmental Steering Group (MHWESG) to inform the baseline conditions with regards to marine ornithology (see Table 10.5 and Table 10.6). Due to the localised nature and scale of activities associated with the META project, this data was considered sufficient to characterise the baseline, and to allow identification and assessment any potential impacts on marine ornithology.
19/01/2019	RSPB	It will be important to identify the extent of the offshore test sites and provide a defined site boundary and appropriate buffer as a basis for undertaking baseline surveys.	Comment noted. This will be considered if ornithology surveys are undertaken
19/01/2019	RSPB	Owing to the distance of the test sites (including the application buffers) from the shore, boat-based or aerial surveys may be required, in accordance with Guidance on Survey and Monitoring in Relation to Marine Renewables Deployments in Scotland Volume 4: Birds (Scottish Natural Heritage, 2011).	Comment noted. This will be considered if pre-deployment ornithology surveys are required (see section 10.12.2 Mitigation and monitoring)
19/01/2019	RSPB	The potential impact of the scheme cannot be assessed unless surveys take account of all its ancillary components. These may include the cable landfall, access tracks, electrical connections (overhead lines or buried cables), construction compounds, sub-stations or other structures required by the scheme.	All appropriate works and ancillary equipment has been considered in this assessment (Table 10.11)
19/01/2019	RSPB	The RSPB can provide relevant terrestrial bird data for the general vicinity, including chough data, and would welcome the opportunity to offer further advice on suitable onshore and offshore ornithological survey methods.	No onshore works are associated with the META project therefore no chough data has been sought.

Date	Consultee and type of response	Issues raised	Response to issue raised and/or where considered in this chapter
01/04/2019	NRW	The proposed cumulative impact assessment (CIA) appears to be limited to direct impacts within the near vicinity and it lacks a list of potential projects and plans for consideration. The CIA must consider all relevant plans and projects – see paragraphs 0.3 and 0.4 of this scoping opinion for plans/projects to be considered and suggested information sources for identifying other relevant projects.	The CIA projects considered in this assessment are outlined in Table 10.18, and for the META project as a whole in chapter 4: Environmental Assessment Methodology.
29/07/2019	RSPB	ESAS data presented within the baseline document is relatively old (circa 2002), and there is potential for seabird populations to have changed over this period. To account for possible population changes, estimated changes to populations are to be calculated for scoped in species based on population trends since the publication of ESAS data (2002) based on data available through the Seabird Monitoring Programme (SMP).	Appendix 10.1 Ornithology baseline updated and considered within this assessment.
29/07/2019	NRW	Little grebe - a notified interest feature of the Milford Haven Waterway SSSI Site of Special Scientific Interest (SSSI) - data is perceived to be patchy and is to be reviewed/analysed to determine with more certainty numbers and distribution in relation to Warrior Way (site 6). WWBIC data is to be reviewed and results to be presented within the baseline document and reflected within the ES chapter assessments.	Appendix 10.1 Ornithology baseline updated and considered within this assessment.
09/09/2019	RSPB	The project will commit to agreeing with NRW a tidal device blade depth condition to reduce the potential impact pathway to little grebe which are shallow divers. Blade depth should be conditioned to be greater than two metres (>2m water depth).	Addressed within Chapter 2: Project Design Envelope, Chapter 10: Marine Ornithology section 10.12.2 Mitigation & Monitoring, and the META EMMP
09/09/2019	RSPB	The preferred deployment period should be to coincide with the little grebe breeding season (March to July inclusive) and deployment outside of this period would require two months of pre-deployment grebe surveys (minimum four observations).	Addressed within Chapter 2: Project Design Envelope, Chapter 10: Marine Ornithology section 10.12.2Mitigation & Monitoring, and the META EMMP
09/09/2019	RSPB	At the NRW meeting we discussed the risk of ingress and looking to design it out. Following the discussion today, we agreed that this is managed by a condition where the device design indicating how the risk of ingress is minimised is signed off by NRW prior to deployment.	Addressed within Chapter 2: Project Design Envelope, Chapter 10: Marine Ornithology section 10.12.2 Mitigation & Monitoring, and the META EMMP
09/09/2019	RSPB	There is a potential need for pre/post deployment monitoring of devices at East Pickard Bay that exceed a given size threshold. The threshold is to be agreed between NRW and the Applicant.	Addressed within Chapter 2: Project Design Envelope, Chapter 10: Marine Ornithology section 10.12.2 Mitigation & Monitoring, and the META EMMP

10.6 Methodology to inform the baseline

10.6.1 Desktop study

10.6.1.1 Information on marine birds within the marine ornithology study area and marine ornithology data search study area was collected through a detailed desktop review of existing studies and datasets. These are summarised at Table 10.5 below.

Table 10.5: Summary of key desktop reports.

Title	Source	Year	Author
Seabird Monitoring Programme	JNCC	2016	JNCC
Seabirds at Sea	Welsh Government & NRW: Lle – A Geo Portal for Wales	2017	NRW
West Wales Biodiversity Information Centre WWBIC sea and coastal bird data search	WWBIC	2009 – 2018	WWBIC
British Trust for Ornithology (BTO) Wetland Bird Survey	BTO	Low tide 2013/2014 Core counts 2012-2016	BTO
A review of the status of wetland birds in the Milford Haven Waterway and Daugleddau Estuary, 2019	Milford Haven Waterway Environmental Surveillance Group	2019	Annie Haycock
Wildfowl and wader counts on the Milford Haven Waterway 2017-18	Milford Haven Waterway Environmental Surveillance Group	2018	Annie Haycock
A review of the status of wetland birds in the Milford Haven Waterway and Daugleddau Estuary	Milford Haven Waterway Environmental Surveillance Group	2016	Annie Haycock

Identification of designated sites

10.6.1.2 All designated sites within the marine ornithology study area and marine ornithology data search study areas that have qualifying marine/coastal interest features which have the potential to be affected by the installation, operation and maintenance, and decommissioning of the META project, were identified using the three-step process described below:

- Step 1: All designated sites of international, national and local importance within the META project marine ornithology and desk search study areas were identified (using sources including Lle maps, plus a data request search from WWBIC);
- Step 2: Information was compiled on the relevant features for each of these sites; and
- Step 3: Using the above information and expert judgement, sites were included for further consideration if:
  - A designated site directly overlaps with the META project;
  - The ecology of a feature of an internationally designated site (i.e. species foraging range) directly overlaps with the META project; and
  - Sites and associated qualifying interest features are located within the potential ZoI for impacts associated with the META project.

Identification of Species Data

10.6.1.3 In order to inform the marine ornithology impact assessment, a search was carried out for relevant species information within the Marine Ornithology data search study area, using the sources listed in Table 10.6.

10.6.1.4 European Seabirds at Sea (ESAS) data provides the abundance and distribution of seabirds in Welsh waters. The datasets consist of the observations of all seabirds and derived grids, showing the density of flying and sitting species on a three km grid scale within the area covered[1].

10.6.1.5 The Wetland Bird Survey (WeBS) monitors non-breeding waterbirds in the UK. The principal aims of WeBS are to identify population sizes, determine trends in numbers and distribution, and identify important sites for waterbirds. Both high tide core count data and low tide count data was obtained. For details of the low tide sectors for which data was obtained see Appendix 10.1.

10.6.1.6 Further information regarding both data sources can be found in Table 10.6 as informed by Royal Society for the Protection of Birds (RSPB) guidance on the use of bird data in marine planning.

10.6.1.7 The species considered during the desk study were those listed as qualifying interest features of any designated sites within the marine ornithology study area or marine ornithology data search study area, as well as those that are listed under Schedule 1 of the WCA, Section 7 of the Environment Act (Wales) 2016, Red and Amber-listed Birds of Conservation Concern (Johnstone and Bladwell, 2016) or those that have occurred within the site in numbers considered of national or international importance.

Table 10.6: Further information regarding data sources used within marine ornithology assessment.

Title	Description	Dataset Owner	Relevant Season	What it shows	Confidence and Limitations
European Seabirds at Sea (ESAS)	ESAS data was amalgamated from a long-running programme of survey and research work on seabirds in the marine environment in the north-east Atlantic since 1979, and in the southwest Atlantic between 1998 and 2002 (cetacean data collected	JNCC/NRW	All – can be split into spring passage, breeding, post breeding autumn passage and wintering. Data from all seasons must be used in marine planning.	Location and seasonality of important aggregations of seabirds offshore, including spring passage, breeding, autumn passage and wintering.	Medium confidence – this data was collected over a large time period and remains one of the most comprehensive and important data sets on seabird distribution, which is a major strength. It was, however, traditionally collected on an ad-hoc basis, which means that there are significant spatial and

[1] For the detailed methodology and the approach taken, see WWT Report collating seabird distribution and abundance data in Welsh waters to support provision of strategic advice on the relative risk of deployment of tidal stream devices"

Title	Description	Dataset Owner	Relevant Season	What it shows	Confidence and Limitations
	during this period is also available from JNCC). This data set recorded a wide range of seabirds, divers and seaducks.				temporal gaps, including large areas of sea that have never been surveyed, and the dataset is also relatively old.
The Wetland Bird Survey (WeBS)	An annual scheme of counts at 2,000 coastal and wetland sites between September and March. At least 1,100 of these sites are monitored regularly (monthly) during this period and some sites are monitored year-round.	British Trust for Ornithology (BTO), RSPB and JNCC in association with the Wildfowl and Wetlands Trust.	Spring passage, autumn passage, winter	Abundance and distribution of waterbird populations, coastal and wetland locations of importance for waterbirds.	Medium to high confidence – some less visible species likely to be underrepresented and counts of gulls are optional.

Identification of Seabird Trends Since ESAS

10.6.1.8 As the ESAS programme gathered data between 1998 and 2002, there is the potential for seabird populations to have changed since this data was collected. To account for possible changes in species data in relation to the META project, estimated changes to relevant species populations have been calculated, based on population trends. UK and Welsh population trends have been extracted from the Seabird Monitoring Programme (SMP) results 'Seabird Population Trends and Causes of Change: 1986-2015) (JNCC, 2016). Colony trends have been calculated based on count data available for Skomer, Skokholm and Grassholm colonies, through the comparison of 5-year average colony counts across the ESAS period (1998-2002) to recent 5-year average colony counts (2013-2018). Updated at-sea density estimates are based on recent population trends for scoped in species.

10.6.1.9 Further details of this update are presented within Appendix 10.1.

10.6.2 Site specific surveys

10.6.2.1 No site-specific surveys have been undertaken to inform the EIA for marine ornithology.

10.6.2.2 Data was obtained from the British Trust for Ornithology (BTO), European Seabirds at Sea (ESAS), West Wales Biodiversity Information Centre (WWBIC) and Milford Haven Waterway Environmental Steering Group (MHWESG) to inform the baseline conditions with regards to marine ornithology. Due to the localised nature and scale of activities associated with the META project, this data was considered sufficient to characterise the baseline, and to allow identification and assessment any potential impacts on marine ornithology.

10.7 Baseline environment

10.7.1 Designated sites

10.7.1.1 Designated sites identified for the META project marine ornithology impact assessment are described in Table 10.7 below.

10.7.1.2 Those features shaded in grey in Table 10.7 are species whose foraging ranges from associated designated sites do not overlap with the META project area and so have been screened out due to lack of receptor-impact pathway. All other features are species whose foraging range from an associated designated site does overlap with the META project and are considered further in this assessment.

Table 10.7: Designated sites and relevant qualifying interest features for the META project marine ornithology.

Designated Site	Relevant qualifying marine bird interest features	Mean Max foraging range for relevant season (where available) based on Thaxter *et al.* (2012)	Closest Distance to META sites (km)		
			Warrior Way (site 6)	Dale Roads (site 7)	East Pickard Bay (site 8)
Skomer, Skokholm and the seas off Pembrokeshire/Sgomer, Sgogwm a Moroedd Penfro SPA	Atlantic puffin *Fratercula arctica*	105.4 km	6.5	4.5	8
	European storm petrel *Hydrobates pelagicus*	65 km			
	Lesser black-backed gull *Larus fuscus*	141 km			
	Manx shearwater *Puffinus puffinus*	330 km			
	Razorbill *Alca torda*	48.5 km			
	Common guillemot *Uria aalge*	84.2 km			
	Black-legged kittiwake *Rissa tridactyla*	60 km			
Grassholm SPA	Gannet *Morus bassanus*	229.4 km	36	22	23
Aberdaron Coast and Bardsey Island/Glannau Aberdaron ac Ynys Enlli SPA	Manx shearwater *Puffinus puffinus*	330 km	116	117	121
Irish Sea Front SPA	Manx shearwater *Puffinus puffinus*	330 km	212	211	216
Lambay Island SPA	Fulmar *Fulmarus glacialis*	400 km	211	205	210
	Cormorant *Phalacrocorax carbo*	25 km			
	Shag *Phalacrocorax aristotelis*	14.5 km			
	Lesser Black-backed Gull *Larus fuscus*	141 km			
	Herring Gull *Larus argentatus*	61.1 km			
	Kittiwake *Rissa tridactyla*	60 km			
	Guillemot *Uria aalge*	84.2 km			
	Razorbill *Alca torda*	48.5 km			
	Puffin *Fratercula arctica*	105.4 km			
Saltee Islands SPA	Fulmar *Fulmarus glacialis*	400 km	123	110	113
	Gannet *Morus bassanus*	229.4 km			
	Cormorant *Phalacrocorax carbo*	25 km			
	Shag *Phalacrocorax aristotelis*	14.5 km			
	Lesser Black-backed Gull *Larus fuscus*	141 km			
	Herring Gull *Larus argentatus*	61.1 km			
	Kittiwake *Rissa tridactyla*	60 km			
	Guillemot *Uria aalge*	84.2 km			
	Razorbill *Alca torda*	48.5 km			
	Puffin *Fratercula arctica*	105.4 km			
	Guillemot *Uria aalge*	84.2 km			
Rathlin Island SPA	Guillemot *Uria aalge*	84.2 km	405	400	404
	Razorbill *Alca torda*	48.5 km			

Designated Site	Relevant qualifying marine bird interest features	Mean Max foraging range for relevant season (where available) based on Thaxter *et al.* (2012)	Closest Distance to META sites (km)		
	Kittiwake *Rissa tridactyla*	60 km			
	Puffin *Fratercula arctica*	105.4 km			
	Herring gull *Larus argentatus*,	61.1 km			
	Lesser black-backed gull *Larus fuscus*	141 km			
	Common gull *Larus canus*	50 km			
	Fulmar *Fulmarus glacialis*,	400 km			
Carmarthen Bay/Bae Caerfyrddin SPA	Common scoter *Melanitta nigra (Winter)*	No data. Birds restricted to low disturbance suitable foraging habitat in winter (shallow <20 m sandy substrate). Unlikely to be connected.	15.5	29	26
Northern Cardigan Bay/Gogledd Bae Ceredigion pSPA	Red-throated diver *Gavia 10olychae (Winter)*	N/A Winter habitats include sheltered inshore waters, sandy bays and sandbanks offshore, as well as tidal rips and fronts. They forage where water depth is less than 30 m. Winter home ranges vary significantly but can be very large (Dierschke *et al*., 2017; LPO, 2018). They are sensitive to disturbance and avoid human activity. As such they are considered unlikely to be connected based on habitat and the existing levels of disturbance.	88	94	98
Milford Haven Waterway SSSI	The saltmarsh and mudflats within the Haven support significant numbers of over-wintering wildfowl and waders, including Curlew, Dunlin, Little Grebe, Shelduck, Teal and Wigeon.	No data	0	0.1	1.6
Broomhill Burrows SSSI	Lapwings breed within the dune slacks	No data	8.6	7.5	0.5
Castlemartin Range SSSI	Outside the breeding season, significant numbers of waders and gulls roost and feed in the sandy bays at Frainslake and Bluckspool. These often include up to several hundred lesser black-backed gulls, and smaller flocks of oystercatcher *Haematopus ostralegus*, curlew *Numenius arquata*, dunlin *Calidris alpina* and grey plover *Pluvialis squatarola*. Migratory flocks of whimbrel *N. phaeopus* and other wader species regularly occur along the coast and, in winter, large numbers of lapwing *Vanellus vanellus* and golden plover *P. apricaria* feed and roost within the Range.	No data	10.8	7.4	1.1

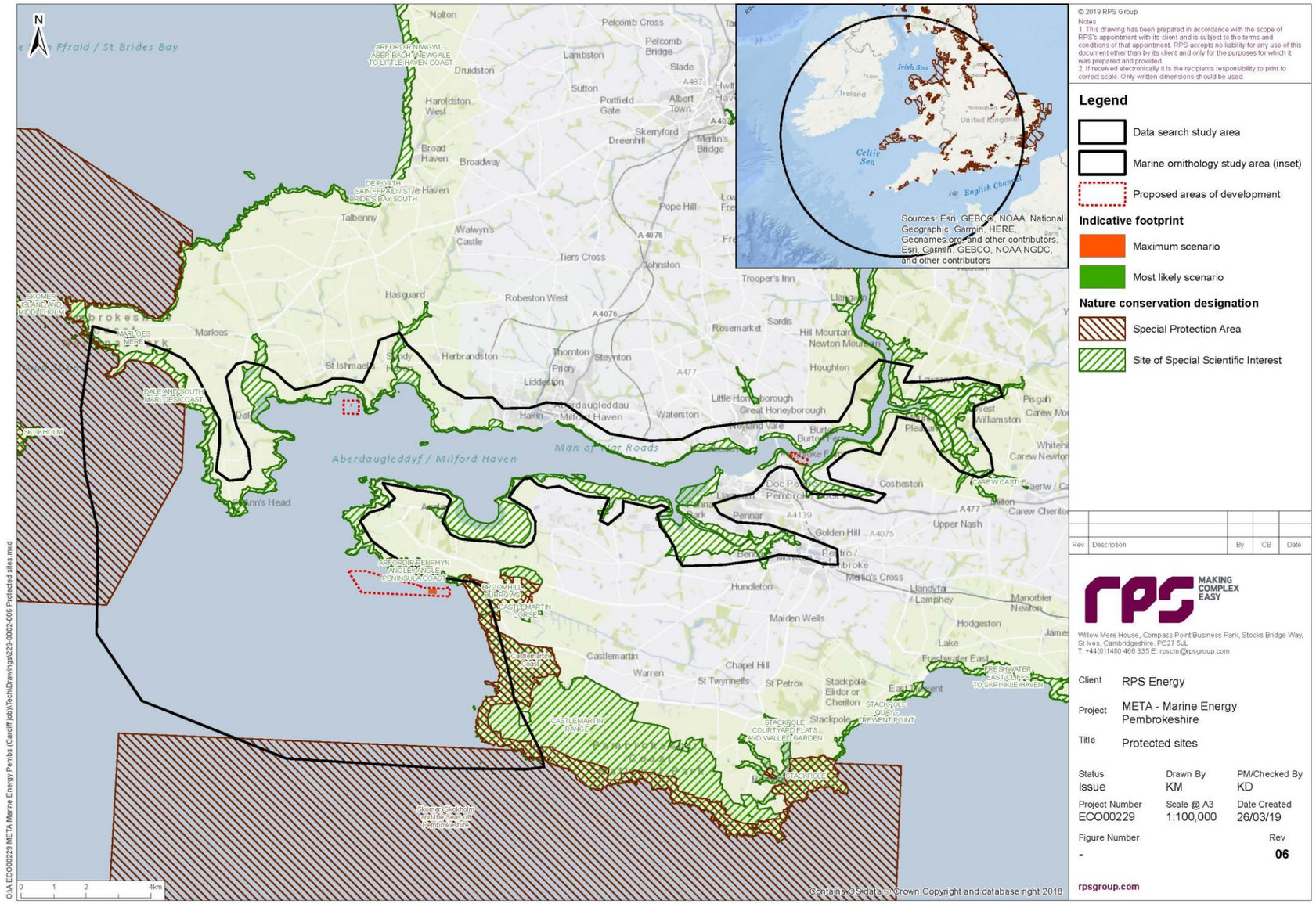

Figure 10.2 Protected sites located within marine ornithology study area and marine ornithology data search study area.

Desk Study Species Data

10.7.1.3 Species records identified within the marine ornithology desk study search area are detailed in Table 10.9, with details of updated seabird densities detailed within **Table 10.10**. A total of nine species were identified that are also listed as qualifying interest features of the SPAs as outlined in Table 10.7, either qualifying under (i) Article 4.1 of the Directive (2009/147/EC) by supporting populations of European importance listed on Annex I of the Directive; (ii) Article 4.2 of the Directive (2009/147/EC) by supporting populations of European importance of migratory species; or (iii) forming part of a seabird assemblage of international importance under Article 4.2.

10.7.1.4 Bird species identified within the ESAS data set comprised both diving and pelagic species, namely guillemot, puffin, razorbill, shag, gannet, kittiwake, fulmar and Manx shearwater. In addition, five gull species were also recorded (lesser black backed gull, great black backed gull, black headed gull, common gull and herring gull), as well as common and arctic tern.

10.7.1.5 The data received from WWBIC primarily identified coastal birds within the vicinity of the East Pickard Bay (site 8) region. The species identified within the data were diving species such as shag and cormorant, and the same gull species as the ESAS data set. Little grebe, a feature of the Milford Haven Waterway SSSI, was also identified within this data. However, the Cleddau Estuary does not now support little grebe in numbers of National Importance (see Appendix 10.1 Table 4.8) but does support an estimated 14% of the Welsh wintering population (26 birds; 5-year average peak count). Cosheston Pill is located to the east of Warrior Way (site 6) and is the closest WeBs survey sector to the proposed META site. Only eight little grebe were observed in Cosheston Pill throughout the 2000s, with no observations have been recorded since 2010 (WWBIC dataset, Appendix 10.1).

10.7.1.6 Thirteen wader species were recorded within the BTO WeBS data search including black-tailed godwit, bar-tailed godwit, turnstone, snipe, oystercatcher, ringed plover, golden plover, lapwing, redshank, greenshank, golden plover, dunlin, and curlew. The desk study data shows that wading birds use parts of the marine ornithology data search study area at both high and low tide throughout the year, with numbers peaking in winter. For the majority of species, the peak numbers recorded in the marine ornithology data search study area do not exceed the 1% threshold value of the GB wintering population(s)[2]. However, greenshank and golden plover were recorded at nationally important numbers at 39 and 5000 respectively.

10.7.1.7 Eight wildfowl/waterbird species were recorded within the BTO WeBS data search, including light-bellied brent goose, mallard, shoveler, wigeon, teal, pintail, shelduck and scaup. The desk study data shows that wildfowl use parts of the marine ornithology data search study area at both high and low tide throughout the year with numbers peaking in winter. The peak numbers recorded in the marine ornithology data search survey area for the majority of species do not exceed the 1% threshold value of the GB wintering population(s). However, teal, wigeon and light-bellied brent goose were recorded at nationally important numbers at 3818, 8703 and 90 respectively.

10.7.1.8 A similar species assemblage was identified within the MHWESG data as within the BTO WeBS data. However, a higher number of species were recorded in nationally significant numbers. Ten species were identified using the data search study area at nationally and/or internationally important numbers including spotted redshank, curlew, lapwing, little egret, common sandpiper, wigeon, whimbrel, dunlin, greenshank and brent goose.

10.7.1.9 Full accounts of each dataset can be found in Appendix 10.2.

10.7.2 Valued ecological receptors

10.7.2.1 Valued ecological receptors were identified as outlined below.

- Species that are qualifying interest features of the SPAs identified within the marine ornithology study area. Individual birds were assumed to originate from these SPA colonies if they were within the species-specific mean-maximum foraging range of the META project;
- Species that are qualifying interest features of SSSIs within 10 km of the desk study search area;
- Species occurring in nationally or internationally significant numbers (Numbers obtained from the WWBIC data); and
- Species of conservation concern (for example Red or Amber-listed status listed in Birds of Conservation Concern (BoCC) Wales).

10.7.2.2 Species have also been assigned values based upon their conservation status. The criteria are set out in Table 10.8.

10.7.2.3 The information below summarises key ecological information in relation to VERs where it is considered there is a potential for impact. Table 10.9 summarises data pertaining to all potential VERs (including those where there is considered to be no or negligible potential for an impact pathway, Table 10.12 summarises impacts and marine ornithology receptors (VERs) scoped out of further assessment for marine ornithology due to lack of receptor-impact pathway, or low or negligible risk of impact.

[2] 1% of the individuals in a population of one species or subspecies of waterbird

Table 10.8: Valued Ecological Receptors Categorisation for marine ornithology.

Value of VER	Criteria to define value
International	Qualifying species of a SPA which is within mean-maximum foraging range of the species and/or occurs in internationally important numbers (1% threshold criteria)
National	Red-listed under the BoCC Wales, SSSI listed species and/or occurring in nationally significant numbers (1% threshold criteria)
Regional/ Local	Amber-listed under the BoCC Wales and/or occurring in regionally important numbers (1% threshold criteria)

10.7.2.4 The following section outlines the marine ornithology VERs that have been identified in relation to the META project. Table 10.9 summarises relevant information to each marine ornithology VER including the value assigned to the VER based on the criteria set out in Table 10.8. Results can also be found in Figure 10.3 to Figure 10.11. For further spatial information regarding the WWBIC data see Appendix 10.3.

Atlantic Puffin VER

10.7.2.5 The Atlantic puffin breeds in Iceland, Norway, Greenland, Newfoundland, and the Faroe Islands, and as far south as Maine in the west and the west coast of Ireland and parts of the United Kingdom in the north and east. The species has declined rapidly, at least in parts of its range in recent years (2010 onwards), resulting in it being rated as vulnerable by the IUCN. The Atlantic puffin is exclusively marine, found on rocky coasts and offshore islands nesting on grassy maritime slopes, sea cliffs and rocky slopes. During the winter it is wide-ranging and is found in offshore and pelagic habitats. The population size was estimated to be increasing in the UK during 1969-2000, and populations in the North Sea are probably currently stable or increasing after a decline in the 2000s due to two very low overwinter survivals of adults (Harris and Wanless 2011, Harris *et al.,* 2013). The UK supports ~9.6% of the global population with ~508,700 pairs/ occupied burrows (Mitchell *et al*., 2004).

10.7.2.6 Adult puffins arrive back at the breeding colony in March and April and leave again in mid-August. Some remain in the North Sea over winter, others move further south to the Bay of Biscay. The Atlantic puffin is sexually mature at the age of 4–5 years. The birds are colonial nesters, excavating burrows on grassy clifftops or reusing existing holes, and on occasion may nest in crevices and among rocks and scree.

10.7.2.7 The Atlantic puffin, similar to other members of the auk family, is a relatively poor flier and has a high wing loading, meaning it is likely to have high energetic flight costs. To maintain flight, the wings need to beat very rapidly at a rate of several times each second which means the bird's flight is direct and low over the surface of the water. It can travel at 80 km (50 mi) per hour. Landing is awkward; it either crashes into a wave crest, or in calmer water, does a belly flop. In general, they have moderate flight manoeuvrability and a low flight height (Garthe and Hüppop, 2004).

10.7.2.8 The species is a pursuit-diver, catching most of its prey within 30 m of the water surface but is capable of diving to 60 m (Piatt and Nettleship, 1985; Burger and Simpson, 1986). They prey on 'forage' species, including juvenile pelagic fishes such as herring *Clupea harengus*, juvenile and adult capelin *Mallotus villosus*, and sandeel *Ammodytes* spp. (Barrett *et al*. 1987). Fish are caught by underwater pursuit, usually several at a time. When feeding chicks, birds generally forage within 10 km of their colony, but may range as far as 50 to 100 km or more (Thaxter *et al.,* 2012). They spend a lot of time on the water surface, initiating dives from it when foraging and at the start of the breeding season when they raft in close proximity to the colony before returning to burrows.

10.7.2.9 Despite the above, little is known about where Atlantic puffin spend their time away from the colony or out at sea feeding. Prey observation studies have shown that chicks are fed on small fish, primarily the lesser sandeel, followed by sprat, herring and a wide range of small juvenile gadoid fish. Recent work has begun to address where puffins go to forage. Harris *et al*. (2012) tracked birds from the Isle of May and found that during chick rearing, birds made two types of feeding trip: long absences that included an overnight stay at distant (38–66 km) feeding areas, and short daytime excursions to areas much nearer the colony (9–17 km).

10.7.2.10 Shoji *et al*. (2015) showed that puffin from Skomer spent most of their foraging dive time making shallow, V-shaped dives during daylight hours. Pratte *et al*. (2017) in Labrador, revealed that puffins there headed offshore to forage and were likely to be associated with a pelagic food web. Tracking studies on Atlantic puffins are currently being undertaken by the RSPB in Scotland and Zoological Society London (ZSL) in Ireland and recent work by ZSL in Ireland is consistent with this evidence of pelagic zone foraging with individual birds traveling up to 40 km from the colony and diving to 8-12 m deep (https://www.zsl.org/blogs/conservation/using-gps-tracking-to-conserve-puffins accessed 11/03/2019).

10.7.2.11 The META project is located approximately six km to the west of an important puffin colony which is also listed under the Skomer, Skokholm and the seas off Pembrokeshire SPA. Puffin are also Red-listed in Wales.

10.7.2.12 Puffin records were identified within the marine ornithology data search study area at densities of 14 per 3 km^2. Given puffins noted foraging preference for offshore/pelagic habitats, they are considered highly unlikely to use the areas in the vicinity of the META project for foraging, although occasional presence around East Pickard Bay (site 8) and Dale Roads (site 7) is possible.

Guillemot VER

10.7.2.13 Common guillemot has a circumpolar distribution, occurring in low-Arctic and boreal waters in the North Atlantic and North Pacific. It spends most of its time at sea, only coming to land to breed on rocky cliff shores or islands. Birds return to their British breeding colonies in March or April each year. Guillemot are found on small areas of cliffs on the south coast of England, very locally on the coasts and islands of Wales and in a handful of places in the north of England and Northern Ireland but more widely spread on cliffs in Scotland.

10.7.2.14 Britain and Ireland are home to internationally important populations of common guillemot, with 13% of the global population (708,200 pairs) – (Mitchell *et al.,* 2004). Common guillemot are listed as a feature of the Skomer, Skokholm and the seas off Pembrokeshire SPA due to the breeding colonies present. They first breed at four to nine years old. Most individuals recruit into the breeding population at ages six or seven although birds may disperse (permanently depart their natal colony) if space is limited (Lee *et al.,* 2008). The species is monogamous, but pairs may split if breeding is unsuccessful.

10.7.2.15 British breeding colonies are mainly on steep cliff faces, with most foraging during the breeding season occurring within 10 to 20 km of the colony, although foraging distances of over 100 km have been recorded (BirdLife International, 2011). Common guillemot fly with fast wing beats and have a flight speed of approximately 80 km/h (Vaughn, 1937). They often fly in small groups low over the sea surface (Mullarney *et al.,* 1999; King *et al*., 2009). They have a high wing loading meaning that this species is not very agile and take-off is difficult (Bedard, 1985; King *et al*., 2009). Flights to foraging areas tend to be relatively short and when reached, significant time between dives is spent at the surface (McCluskie *et al.,* 2012). Multiple sources report estimated fight heights between 0 and 10 m above sea level with the vast majority of flights < 5m in height (Thaxter *et al*., 2015). Guillemot have a 30% higher wing loading than razorbills and have been shown to spend twice as long in flight as a proportion of trip duration and twice as long in diving activity (Thaxter *et al*., 2010).

10.7.2.16 The main prey items of the adult common guillemot are shoaling pelagic fish, mostly sandeel, herring and sprats as well as small gadoids, and they are capable of switching prey in response to availability. Prey are caught by pursuit diving, with birds diving from the surface, typically to depths of less than 50 m, but up to 200 m (BirdLife International, 2011). Guillemot catch prey from the bottom of the water column and carry single prey items back to the colony to provision chicks (Thaxter *et al.,* 2010). This combination of pursuit diving and single prey loading imposes energetic constraints on individuals and influences habitat use and behaviour, with a preference for higher quality prey items. The bottom phase of dives by guillemots are relatively long, indicating considerable time spent searching for and pursuing prey. Loggers deployed on birds from the breeding season have shown guillemot make relatively long, deep, foraging dives in the pelagic and demersal zones (Thaxter *et al*., 2010; Linnebjerg *et al*.,2013). When feeding they spend a high proportion of time under water and have a fast rate of ascent.

10.7.2.17 Tracking and habitat suitability modelling work by Wakefield *et al*. (2017) showed that in areas with relatively simple coastlines (i.e. not island archipelagos) guillemot tend to forage further from land. This is evident in the predicted space use for the South West Wales colonies, with the highest intensity space use predicted to the South and West of Skomer and Pembrokeshire (Maps available at https://www.mba.ac.uk/projects/ oly-uk-archive-marine-species-and-habitats-data).

10.7.2.18 Tracking work data used to inform the Wakefield *et al*. (2017) study also confirmed that common guillemot space use declines with distance from colony, as would be expected for a central place forager (mean foraging distance of 10.5 km (Inter Quartile range 3.2–19.1), n=192). Guillemots are considered to be relatively plastic in their prey choice and capable of prey switching although this may not be the case at all colonies. Recent work (Riordan *et al*., 2017) on chick diet of Skomer colonies has shown that diet has remained broadly similar (mainly Clupeids) since 1973, although in recent years an increase in relatively low-quality prey (Gadids) is evident, suggesting a shift in prey availability in the region. The ability to prey shift may mean they are less at risk from the negative effects of displacement in areas of suitable foraging habitat, provided equivalent feeding opportunities are available close to the breeding colony.

10.7.2.19 Common guillemots are listed under Annex 1 of the Birds Directive and are Amber-listed in Wales. They are also listed as a qualifying species of Skomer, Skokholm and the seas off Pembrokeshire SPA, which lies approximately 6 km to the west of the META project. A review of the ESAS data set identified guillemots using the marine ornithology data search study area with peak densities of 1 per 3 km^2. This observed low density is consistent with common guillemots' habitat preferences and predicted intensity of space use from Wakefield *et al*. (2017).

Razorbill VER

10.7.2.20 Populations of razorbill are restricted to the subarctic waters of the Atlantic Ocean. They are relatively common throughout the coastal waters of Wales. They breed on small ledges or in cracks of rocky cliffs, in associated scree, and on boulder-fields. Colonies are usually in association with other seabirds. Birds only come to shore to breed and they winter in the northern Atlantic. Out-with the breeding season, they occur widely in coastal waters off western Britain and Ireland, and in the North Sea (McCluskie *et al.,* 2012).

10.7.2.21 Britain and Ireland are home to internationally important populations of breeding razorbill, with 20% of the global population (93,600 pairs) – (Mitchell *et al*., 2004). Razorbills are listed as a feature of the Skomer, Skokholm and the seas off Pembrokeshire SPA due to the breeding colonies present. Individuals breed at 3–5 years of age and as pairs grow older they will occasionally skip a year of breeding. A mating pair will court several times during breeding periods to strengthen their bond. Both members of a pair provision their chick with loads composed of a single fish or several fish, usually about 3–4 times per day (Harris and Wanless, 1986, 1989).

10.7.2.22 Razorbills have high flight costs because of their relatively high wing loading (Pennycuick, 1987; Elliott *et al*., 2013). As a result, energy expenditure is expected to increase substantially with foraging distance. Razorbill often fly in small groups low over the sea surface and are not very agile in flight and take-off is difficult (King *et al*., 2009). Estimated flight heights from multiple sources report heights between 0 and 13 m above sea level with the vast majority of flights < 5m in height (Thaxter *et al*., 2015). Flights to foraging areas tend to be relatively short with multiple stops/search phase behaviour and when food patches are identified/reached multiple dive events occur with time between dives spent at the surface (McCluskie *et al*., 2012; Shoji *et al.,* 2016).

10.7.2.23 Razorbill feed mainly on shoaling fish; mostly sandeel for birds at breeding colonies in British Isles, supplemented by herring, sprat, and rockling. Fish are caught by pursuit diving from the surface, typically to depths of 5 to 30 m, but possibly deeper than 100 m on occasions (Bird Life International, 2011). Studies of birds fitted with data loggers at the Isle of May, which is approximately 8 km from the mainland, recorded almost half of all razorbill foraging trips within 10 km of the coast (Thaxter *et al.,* 2010). The remainder of trips were to areas 30-40 km offshore. Maximum foraging ranges of up to 110 km have been recorded with a mean maximum range of 66 km (Soanes *et al*., 2016).

10.7.2.24 Foraging trips recorded from birds in the Baltic sea consisted of a number of flights interrupted by a small number of dives probably performed to explore the site for prey availability (Benvenuti *et al*., 2001). Loggers deployed on razorbills have identified they tend to make a large number of short, relatively shallow dives and spent little time in the bottom phase of the dive (Benvenuti *et al*., 2001; Thaxter *et al*., 2010; Linnebjerg *et al*., 2013). These differences in foraging behaviour are considered likely to partly reflect the fact razorbills carry and feed their chicks multiple prey items from the water column and forage both at or near the seabed and in the water column.

10.7.2.25 Recent tracking work on Skomer (Shoji *et al.,* 2016) shows that razorbills also vary their foraging patterns dependent on the stage of the breeding cycle, and shift to a more focused pattern during chick rearing, targeting a region of interest known to support prey items. Tracking data used to inform Wakefield *et al*. (2017) confirmed that razorbill space use declines with distance from colony as would be expected for a central place forager (mean foraging distance of 13.2 km (Inter Quartile range 5.1–26.2, n=299). This work also confirmed that on average, razorbill travel further than common guillemot to forage with predicted space use more dispersed through the Celtic Sea to the north and west of the colonies in Pembrokeshire.

10.7.2.26 Razorbills are listed as a feature of the Skomer, Skokholm and the seas off Pembrokeshire SPA and are listed as an Amber species of conservation concern in Wales. A review of ESAS data identified razorbill using the marine ornithology data search study area with peak densities of 1.8 per 3 km^2.

Gannet VER

10.7.2.27 The northern gannet is the largest seabird in the North Atlantic. Northern gannet (hereafter gannet) breeds in colonies on both sides of the north Atlantic with colonies as far north as Svalbard and as far west as Quebec. Great Britain is home to over half the world's breeding population of gannet, which is estimated to be approximately 290,000 pairs (Murray *et al*., 2015). Grassholm, located off the western coast of Wales, supports approximately 39,000 pairs (approximately 12% of the global population) and as such is designated as a SPA for this species.

10.7.2.28 Gannets return to their breeding colonies from early January, tending to be a month or so later in the most northern British colonies; many British breeders having spent the autumn and early winter months in waters around southern Europe and north Africa. Colony attendance is variable until April when the first eggs are laid (Cramp & Simmons, 2004). The oldest birds are the first to return to the colony, with birds not of breeding age arriving a few weeks later. In general, birds first return to a colony (not uncommonly the one in which they were hatched) when they are two or three years old. Immature birds stay on the edges of the colony and may even make a nest, but they do not breed until they are four or five years old. The adults feed their offspring for around 13 weeks, and young birds fledge between 84 and 97 days old (Nelson, 2010).

10.7.2.29 The wings of the gannet are long and narrow and are positioned towards the front of the body, allowing efficient use of air currents when flying. This relatively high wing loading results in a fast flight speed (55-65 km/hr) with relatively low manoeuvrability (Nelson, 2010). They usually fly between 3 and 105 m above sea level with most time spent between 11 and 60 m (Thaxter *et al.,* 2015).

10.7.2.30 Gannets forage for food during the day, generally by diving at high speed into the sea. Birds that are feeding young have been recorded searching for food up to 320 km (200 mi) from their nest and have recently been shown to repeatedly target specific areas associated with oceanographic fronts (Grecian *et al.,* 2018). In general, they fly less than 150 km (Nelson, 2005) although foraging range is positively correlated with colony size both across multiple colonies and within a single colony over time (Lewis *et al*., 2001).

10.7.2.31 Gannets will follow fishing boats or cetaceans to find discarded or injured fish (del Hoyo *et al.,* 2013). They dive with their bodies straight and rigid, wings tucked close to the body but angled back, they control the direction of the dive using their wings and tail and fold their wings against the body just before impact. Gannets usually push their prey deeper into the water and capture it as they return to the surface. When a dive is successful, they swallow the fish underwater before surfacing and never fly with the fish in their bill. The fish is stored in a branched bag in the throat and does not cause drag when in flight. Gannets appear to have some diet plasticity with different prey recorded from different colonies. Herring and mackerel were the two most common prey species at colonies in Shetland, the Firth of Forth and Quebec (Martin *et al.,* 1989; Garthe *et al*., 2006; Lewis *et al.,* 2003) whilst capelin dominated prey in a low Arctic colony in Newfoundland.

10.7.2.32 Projected colony-specific foraging distributions of the gannet at colonies in the UK, Ireland and France by Grecian *et al.* (2012) identified at-sea hotspots for species based on known relationships between foraging distance and colony size as well as copepod abundance. This work predicted the highest gannet densities around Grassholm and to the south and west; this was consistent with tracking data from 2006 which showed they foraged exclusively to the south and west of the colony but did not venture north of the Celtic Sea Front into the Irish Sea (Grecian *et al.,* 2012).

10.7.2.33 Gannet is of conservation concern within the UK, being Amber-listed (i.e. of moderate concern) in the UK and Wales Birds of Conservation Concern (BoCC) (Eaton *et al*., 2015; Johnstone and Bladwell, 2016). This is on the basis of the international importance of the British population, which represents over 20% of the European breeding population. Furthermore, over half of the British gannet breeding population occurs at less than ten sites.

Kittiwake VER

10.7.2.34 Black legged kittiwakes (hereafter kittiwake) are coastal breeding birds ranging in the North Pacific, North Atlantic, and Arctic oceans. They are the only gull species that are exclusively cliff-nesting. Breeding colonies can be found in the Pacific from the Kuril Islands to southeast Alaska, and in the Atlantic from the Gulf of St. Lawrence through Greenland and down to Portugal, as well as in the high Arctic islands ((BirdLife International, 2019). The UK population is an estimated 370,000 pairs (Mitchell *et al*., 2004) and this is approximately 14% or the biogeographic population. Kittiwakes have undergone a 25% decline in population estimate since ~2010 and as such are considered of conservation concern and are red listed in Wales.

10.7.2.35 Kittiwake are migratory and disperse after breeding from coastal areas to the open ocean (del Hoyo *et al*., 1996). During the winter the species is highly pelagic, usually remaining on the wing out of sight of land (del Hoyo *et al*., 1996).

10.7.2.36 Kittiwake nest on high, steep, coastal cliffs with narrow ledges in areas with easy access to freshwater (del Hoyo *et al*., 1996). They return to breeding grounds from January, where they breed from mid-May to mid-June (del Hoyo *et al*., 1996, Snow and Perrins, 1998). The species begins to disperse from the breeding colonies between July and August (Olsen and Larsson, 2003).

10.7.2.37 Kittiwake are strong capable fliers with relatively broad wings and a low wing loading. They do much foraging in flight, dipping down to take items at surface or plunging into water to take prey below surface; they also feed by seizing items at the surface while swimming. Estimated flight heights using a variety of methods summarised by Thaxter *et al.* (2015) indicate Kittiwake have a median flight height of ~16 m (80 m max) from visual surveys, and maximum heights of up to 250 m recorded using radar.

10.7.2.38 Kittiwake are pelagic surface feeders feeding in the upper couple of metres of the water column. In the breeding season they feed mainly on small (15-20 cm) pelagic shoaling fish, such as sandeel, sprat and clupeids (del Hoyo *et al*., 1996) but have been shown to have up to 40 different prey items in their diet (Soanes *et al*., 2016). At sea during the winter, they will also take planktonic invertebrates and exploit sewage outfalls and fishing vessels (del Hoyo *et al*., 1996).

10.7.2.39 Tracking and habitat suitability modelling work by Wakefield *et al.* (2017) showed that kittiwakes are more pelagic, with activity patchily distributed offshore with core hotspots including a large area of the central Irish Sea. This is evident in the predicted space use for the South West Wales colonies, with the highest intensity space use predicted to the north and west (Maps available at https://www.mba.ac.uk/projects/ oly-uk-archive-marine-species-and-habitats-data).

10.7.2.40 Maximum foraging ranges of up to 201 km have been recorded with a mean maximum range of 104 km (Soanes *et al*., 2016). Recent tracking work data used to inform the Wakefield *et al*. (2017) study confirmed that in general, Kittiwake space use declines with distance from colony, as would be expected for a central place forager (mean foraging distance of 11.9 km (Inter Quartile range 4.2–30.9), n=583).

10.7.2.41 Kittiwake are also a qualifying species of the Skomer, Skokholm and the seas off Pembrokeshire SPA and are Red-listed in Wales. Kittiwake were identified within the marine ornithology data search study area in the ESAS data set at peak densities of 1 per 3 km^2.

Shag VER

10.7.2.42 The European shag is a coastal, piscivorous seabird that obtains prey by pursuit-diving (Watanuki *et al*., 2008). The species breeds around the rocky coasts of western and southern Europe, southwest Asia and north Africa, mainly wintering in its breeding range except for the northernmost birds. It shows a strong preference for rocky coasts and islands, although they are also found over shallow, sandy sediments. They are in general an inshore species that is almost never observed out of sight of land. The UK population is an estimated 26,600 pairs (Mitchell *et al*., 2004) and this is approximately 38% of the biogeographic population. Shag have undergone an estimated 27% decline in population since 2010 and as such are considered of conservation concern and are red listed in the UK and amber listed in Wales.

10.7.2.43 Shag breed on coasts, nesting on rocky ledges. The nesting season begins in late February, but some nests are not started until May or even later. Birds first breed from years old and three eggs are laid. Chicks are altricial and naked at birth and so they rely entirely on their parents for warmth. They fledge after 48-58 days and fledging may occur at any time from early June to late August, exceptionally to mid-October.

10.7.2.44 Shags are morphologically adapted for diving, with a relatively large body mass (enabling a large oxygen store), small flight muscles (to allow for large leg muscles for underwater propulsion) and short wings (to decrease air volume in the feathers and hence buoyancy). These adaptations are however thought likely to restrict their flight performance. A similar apparent evolutionary trade-off has been investigated and described for the conspecific Kerguelen shag *Phalacrocorax verrucosus* (Watanabe *et al.,* 2011). Research from the Isle of May has shown that shags also feed on fewer sandeel on windy days, likely due to the strong effect of wind on flight in this species (Lewis *et al.,* 2015). Estimated flight heights using a variety of methods summarised by Thaxter *et al.* (2015) indicate shag spend the majority of their time in flight at heights < 5 m and no higher than 75 m.

10.7.2.45 Research by Watanuki *et al*. (2008) revealed that shags are almost exclusively benthic feeders, using two very distinct foraging habitats: sandy areas and rocky areas at depths of between 10 and 40 m. Foraging behaviour in this study differed markedly between habitats, in rocky areas birds travelled along the bottom searching for bottom-living fish, whilst in sandy habitat they spent the bottom phase of the dive probing into the sand with their bill, presumably to catch lesser sandeels. Long-term variability in the diet of this species has also been recorded (Howells *et al.,* 2018) with dramatic reductions in the frequency of lesser sandeel occurrence between 1984 and 2017 (especially during non-breeding).

10.7.2.46 Tracking and habitat suitability modelling work by Wakefield *et al.* (2017) showed that shag are primarily coastal, with activity patchily distributed offshore with core hotspots including a large area of the central Irish Sea. This is evident in the predicted space use for the South West Wales colonies, with the highest intensity space use predicted to the north and west (Maps available at https://www.mba.ac.uk/projects/17oly-uk-archive-marine-species-and-habitats-data).

10.7.2.47 Maximum foraging ranges of up to 25.4 km have been recorded with a mean maximum range of 9 km (Soanes *et al*., 2016). Recent tracking work data used to inform the Wakefield *et al.* (2017) study confirmed that in general, shag space use declines with distance from colony, as would be expected for a central place forager (median foraging distance of 3.4 km (Inter Quartile range 1.6–7.5), n=239).

10.7.2.48 Shags are Amber-listed in Wales. A review of the ESAS data set identified shag within the marine ornithology data search study area at peak densities of 0.2 per 3 km^2. Peak counts of three were identified within the WWBIC data set. No records of shag were noted in MHWESG data.

Cormorant VER

10.7.2.49 Great cormorant (henceforth cormorant) has an extremely large distribution, being found on every continent except South America and Antarctica. Colonies in North America are restricted to the north-east, although individuals do winter further south up to the tip of Florida (U.S.A.). Breeding colonies are also found in western Greenland. In Europe, cormorant can be found along most of the Atlantic coast, as well as throughout the Mediterranean and in large areas of Eastern Europe. Throughout its range the species is sedentary or locally dispersive, with northerly populations also making strong migratory movements (del Hoyo *et al*., 1992) Cormorants inhabit marine and freshwater environments. In marine areas they are generally associated with sheltered coastal areas in estuaries, coastal bays and similar habitats, and generally avoid deep water and areas far offshore (BirdLife International, 2011). The UK population is an estimated 8,900 pairs (Mitchell *et al.,* 2004) and this is approximately 2.4% of the biogeographic population. This is a 10% increase on the previous 1988 estimate.

10.7.2.50 Due to the wide geographic range of this species, timing of breeding varies occurring all year round (del Hoyo *et al*., 1992) or coinciding with the rains in the tropics (BirdLife International, 2019), and peaking between April and June in the temperate regions of the Northern Hemisphere (del Hoyo *et al*., 1992). In marine and coastal environments, it occurs in sheltered coastal areas in estuaries, saltpans, coastal lagoons and coastal bays, requiring rocky shores, cliffs and islets for nesting, but generally avoiding deep water and rarely extending far offshore (del Hoyo *et al*., 1992; BirdLife International, 2019).

10.7.2.51 The species' diet consists predominantly of fish, including sculpins, Capelin, gadids and flatfish (BirdLife International, 2019) as well as crustaceans, amphibians (del Hoyo *et al*., 1992), molluscs and nestling birds (Brown *et al*., 1982). At sea cormorant preys mostly on bottom-dwelling fish, occasionally also taking shoaling fish in deeper waters (del Hoyo *et al*., 1992). It is a generalist, having been shown to feed on at least 22 different fish species (BirdLife International, 2019).

10.7.2.52 Cormorants are morphologically adapted for diving, with a relatively large body mass (enabling a large oxygen store), small flight muscles (to allow for large leg muscles for underwater propulsion) and short wings (to decrease air volume in the feathers and hence buoyancy). These adaptations are likely to restrict their flight performance, making flight energetically costly. A similar apparent evolutionary trade-off has been investigated and described for the conspecific Kerguelen shag *Phalacrocorax verrucosus* (Watanabe *et al.,* 2011). Estimated flight heights for cormorant (Thaxter *et al.,* 2015) are similar to shag with the majority of their time in flight at heights < 5 m and no higher than 75 m.

10.7.2.53 At sea, cormorants rarely stray far from the coast, where they normally feed in shallow water. They are visual predators so require daylight and reasonably clear water for foraging. They prey mainly on benthic fish species and dive to depths up to 10 m, and exceptionally down to 35 m (BirdLife International, 2019). Several studies have shown that this species is able to forage up to 20-25 km from its wintering roosts or breeding colonies. Most foraging trips are confined to within 10 km of the colony (BirdLife International, 2019), but trips up to a 35 km radius have been recorded.

10.7.2.54 Cormorant is an Amber species in Wales and was identified within the marine ornithology data search study area with peak counts of 28 from the BTO WeBS core count data and 24 from the MHWESG data.

Brent Goose VER

10.7.2.55 The light-bellied Brent goose breeds along the high-Arctic coasts of Canada and winters almost entirely in Ireland, with small numbers in parts of Britain and France. Brent geese are winter visitors to the UK, and graze on plant material on land or in shallow waters. The UK supports an estimated 710 individuals (Musgrove *et al.,* 2011 in the winter).

10.7.2.56 This species is fully migratory, the main routes of migration being along Arctic coastlines (BirdLife International, 2019). It arrives at breeding grounds in early-June and flocks leave the breeding grounds in early-September with some arriving in wintering areas as early as mid-September. It leaves its wintering quarters again from April (BirdLife International, 2019). During the non-breeding season, the species remains gregarious, gathering in groups of only a few to several thousands of individuals, although it is rarely found in very large flocks (BirdLife International, 2019). Highest numbers (c. 30,000) are seen at Strangford Lough in Northern Ireland in October, where most congregate on arrival. Thereafter, they move to other estuarine sites. Lough Foyle in County Derry, Dublin Bay in County Dublin, Tralee Bay, Lough Gill & Akeragh Lough in County Kerry, Rogerstown Estuary in County Dublin, Wexford Harbour & Slobs in County Wexford are other well-used sites (1,000-3,500 birds).

10.7.2.57 Brent geese have a relatively small structural size and a high wing load. As such they are unable to carry enough body reserves with them to allow a non-stop migration. They stage for a considerable period in spring and autumn in Iceland, and have a hazardous trip over the Greenland Icecap in between. Recorded flight airspeeds for their conspecific dark bellied brent geese were significantly higher in spring (mean 19.0 ms^{-1}) than in autumn (mean 17.3 ms^{-1}) (Green, 2000). In general, they are considered strong, capable fliers, with low to moderate manoeuvrability and moderate risk of collision with infrastructure.

10.7.2.58 Brent geese feed on segrass (*Zostera spp.)* wherever they can, but they can only reach the plants at low tide or in shallow water (Ganter, 2000). Light-bellied Brent Geese may have relied almost entirely on *Zostera spp.* during the winter, before a wasting disease caused almost the entire depletion of *Zostera* in the 1930s. Since then, the diet in estuarine and saltmarsh areas has expanded to include algal foods such as *Enteromorpha* and *Ulva*, and saltmarsh plants such as *Festuca spp.* and *Puccinella maritima*. Feeding on grasslands has increased steadily since the 1970's, with feeding on cereal crops, both waste in autumn stubbles and spring seed, and waste potatoes also noted in some areas. Although these food types remain available in early spring, most birds return to the saltmarshes at this time to exploit fresh growth of more natural foods prior to spring migration (Robinson *et al*., 2004).

10.7.2.59 Brent geese were recorded within the marine ornithology data search study area during the winter period within the BTO Wetland Bird Survey dataset at nationally important numbers at low tide, and internationally important numbers recorded at high tide. Brent goose were also identified at internationally important numbers within the MHWESG data set.

Waders VER

10.7.2.60 Data for wading bird species at low tide and high tide were obtained from the BTO Wetland Bird Survey (WeBS) data portal and MHWESG reporting to inform the impact assessment.

10.7.2.61 A total of 16 wader species were identified as VERs either due to their Red or Amber-listed status (Johnstone and Bladwell, 2016), or because they occur at nationally or internationally important numbers. Wader species identified within the grouped 'Wader VER' are black-tailed godwit, bar-tailed godwit, turnstone, snipe, oystercatcher, golden plover, lapwing, redshank, greenshank, ringed plover, golden plover, dunlin, whimbrel, curlew, spotted redshank and common sandpiper.

10.7.2.62 The desk study data shows that wading birds use parts of the marine ornithology data search study area at both high and low tide throughout the year with numbers peaking in winter. The peak numbers recorded in the survey area for the majority of species do not exceed the 1% threshold value of the UK wintering population(s). However, six species were recorded at nationally important numbers, namely curlew, whimbrel, golden plover, greenshank, spotted redshank and common sandpiper. More details on the ecology of those species recorded in nationally important numbers is presented in the paragraphs below.

10.7.2.63 Curlew are widely distributed, breeding across Europe from the British Isles, through north-western Europe and Scandinavia into Russia, extending east into Siberia east of Lake Baikal. It winters around the coasts of north-west Europe, the Mediterranean, Africa, the Middle East, the Indian Subcontinent, South-East Asia, Japan and the Sundas. It has a large global population estimated to number c.835,000-1,310,000 individuals. The breeding population in Europe has declined in recent years, with the population most recently estimated to be decreasing by 30-49% in 31.2 years (three generations). The population in the United Kingdom has undergone a 62% decline over the period 1970-2012 (BirdLife International 2019). It is listed as near threatened by the IUCN due to noted declines in several key populations. They are currently red listed in the UK (Eaton *et al*., 2015) and red listed in Wales (Johnston *et al* 2016).

10.7.2.64 Curlew can be found around the entire UK coastline with significant aggregations found at the Dee and Severn estuaries in Wales. Most populations of this species are fully migratory (del Hoyo *et al*. 1996) and breed from April to August in solitary territorial pairs (BirdLife International 2019). After breeding adults gather on coasts (from July onwards) for the post-breeding moult before migrating south to the wintering grounds between July and November (del Hoyo *et al*. 1996). Greatest breeding numbers in the UK are found in North Wales, the Pennines and Scotland.

10.7.2.65 During the winter the species frequents muddy coasts, saltmarshes, bays and estuaries (del Hoyo *et al*. 1996). Its diet consists chiefly of annelid worms and terrestrial insects although it will also take crustaceans, molluscs, polychaete worms, spiders, berries and seeds, as well as occasionally small fish, amphibians, lizards, young birds and small rodents (del Hoyo *et al*. 1996).

10.7.2.66 Curlew in the Waterway regularly exceed the national importance threshold during autumn migration (Haycock 2016). Counts from BTO recorded peak counts of 1795 and 795 from high tide and low tide counts respectively whilst MHWESG data recorded peak counts of 1244 birds. Haycock 2016 details the distribution of Curlew at high tide in the Waterway with the highest counts noted at Pembroke River Estuary, and Carew and Cresswell noted low tide aggregations at Angle Bay and the Gann.

10.7.2.67 Whimbrel are fully migratory and travel over land on a broad front utilising few staging areas on route (in autumn no known concentrated staging occurs) (BirdLife International, 2019). They breed from May to August with autumn migration occurring from July onwards, and the return passage to the breeding grounds occurring chiefly between March and May (BirdLife International, 2019). When not breeding, the species usually forages singly or in small groups, flying in small parties or larger flocks on migration and roosting communally at night in mangrove trees or in shallow water (del Hoyo *et al*., 1996).

10.7.2.68 In the UK, whimbrel breed only in the north of Scotland and are largely a passage migrant to other areas in spring and autumn on its way from and to its wintering areas. The Shetland and Orkney breeding population has been slowly increasing. Despite this recent increase, whimbrel are red listed in the UK (Eaton *et al*., 2015) due to recent declines in both breeding and wintering counts throughout the UK, but are considered of least concern at the global level. In the UK, whimbrel are most often encountered during passage in coastal marsh and estuarine habitats. They forage on a mixture of invertebrates and plant material gleaned from the surface or upper few centimetres of substrate.

10.7.2.69 Whimbrel in the Waterway occasionally exceed the national importance threshold during autumn and spring migration (Haycock 2016). Peak counts from BTO recorded peak counts of 1 from high tide counts whilst MHWESG data recorded a peak count of 7 birds. Haycock 2016 details the saltings of the Cleddau estuary as being particularly favoured by whimbrel during passage.

10.7.2.70 Golden plover is also a fully migratory species but they only move short distances in some regions (del Hoyo *et al*., 1996). They breed from May to August (del Hoyo *et al*., 1996), adults leaving the breeding grounds before the juveniles between July and August. The return migration in the spring peaks between April and early-May (Hayman *et al*., 1986). The species feeds in small flocks during the breeding season, but on passage and in winter, feeding flocks of tens to thousands of individuals may occur (Hayman *et al*., 1986; del Hoyo *et al*., 1996). When on passage and in its winter quarters, the species frequents freshwater wetlands, moist grasslands, pastures, agricultural land (e.g. stubble, ploughed or fallow fields) and highland steppe, also foraging on tidal shores, coastal rocky outcrops, intertidal flats and saltmarshes in shallow bays and estuaries (del Hoyo *et al*., 1996, BirdLife International, 2019).

10.7.2.71 In summer in the UK, golden plovers are found in upland moorlands in the southern uplands and highlands of Scotland, the Western and Northern Isles, the Peak District, North Yorkshire, Wales and Devon. In winter they move to lowland fields, forming large flocks utilising a mixture of inland and coastal habitats. They are currently green listed in the UK (Eaton *et al*., 2015) and red listed in Wales (due to a recent breeding decline) (Johnstone and Bladwell, 2016).

10.7.2.72 Golden plover in the Waterway are irregular winter visitors but when present usually arrive in large numbers that exceed the national importance threshold (Haycock 2016). Counts from the BTO recorded peak counts of 5000 and 1500 from high tide counts and low tide counts respectively, whilst MHWESG data recorded a peak count of 2200 birds. Haycock 2016 details the Cleddau estuary as the most important site within the Waterway for this species.

10.7.2.73 Greenshank are fully migratory and generally migrate overland on a broad front, although the majority of Western European birds pass through coastal and estuarine sites (del Hoyo *et al*., 1996). Most palearctic birds are trans-Saharan migrants (del Hoyo *et al*., 1996), the main autumn passage through northern and temperate Europe occurring from the second week of July to late-October (BirdLife International, 2019). One parent (usually the female) leaves the breeding territory first from late-June to early July, with the other parent and juveniles following around 3-6 weeks later (BirdLife International, 2019). Flocks arrive in southern Africa from August to September, and depart again in March for the northward return migration (del Hoyo *et al*., 1996). The species occurs on passage singly or in small flocks, although congregations of 100 or more may very rarely occur at high tide or at roosting sites (BirdLife International, 2019). This species feeds both diurnally and nocturnally (del Hoyo *et al*., 1996).

10.7.2.74 Greenshank breed in the highlands of Scotland but are primarily encountered in the UK at estuaries on passage migration, although they can also occur at inland flooded meadows, dried-up lakes, sandbars and marshes (del Hoyo *et al*., 1996). This species is chiefly carnivorous, its diet consisting of insects and their larvae (especially beetles), crustaceans, annelids, molluscs, amphibians, small fish and occasionally rodents (BirdLife International, 2019). They are currently Amber listed in the UK (Eaton *et al*., 2015).

10.7.2.75 Greenshank in the Waterway are regular winter visitors and numbers generally peak in passage periods (Haycock 2016). Counts from the BTO recorded peak counts of 20 and 21 from high tide counts and low tide counts respectively whilst MHWESG data recorded a peak count of 39 birds. Haycock 2016 details the Cleddau estuary as the most important site within the Waterway for this species.

10.7.2.76 Spotted redshank is a full migrant, breeding in the subarctic and arctic zone of Fennoscandia and Siberia. On passage to its wintering grounds, the majority of the species travels overland on a broad front, although there is also an important route down the west coast of Europe. Females begin to move south in early-June, the males following during July, and juveniles migrating from August to September. The movements of this species are characterised by long flights between staging areas (e.g. the Wadden Sea, Dutch delta region,), those birds wintering in Sahel and northern savanna zones also cross the Sahara. Arrival in Africa begins in August and peaks in October, the species being present throughout the tropics mainly between October and April and returning to arctic breeding grounds between late-April and mid-May. This species is both a diurnal and nocturnal feeder (del Hoyo *et al*., 1996). This species has an extremely large range and is evaluated as Least Concern by IUCN. They amber listed in the UK (Eaton *et al* 2015) and Wales (Johnston *et al* 2016).

10.7.2.77 During migration and on its wintering grounds, this species frequents a variety of freshwater and brackish wetlands such as sewage farms, irrigated rice fields, brackish lagoons, salt-marshes, salt-pans, sheltered muddy coastal shores (del Hoyo *et al*., 1996) and mudflats, marshes and marshy lake edges, small reservoirs, pools and flooded grasslands (BirdLife International, 2019). The species is carnivorous, its diet consisting chiefly of aquatic insects and their larvae (especially swimming beetles and hemipterans), terrestrial flying insects (such as craneflies), small crustaceans, molluscs, polychaete worms, and small fish and amphibians up to 6-7 cm long (del Hoyo *et al*., 1996).

10.7.2.78 Spotted redshank in the Waterway are irregular winter visitors usually around Hook Reach. They arrive in August and September and depart in April. This number has fallen in recent years as birds apparently prefer to winter at the new WWT site at Llanelli. (Haycock 2016). Counts from the BTO recorded no birds whilst MHWESG data recorded a peak count of 1 bird. Haycock 2016 details the area around Hook Reach as the most important site within the Waterway for this species.

10.7.2.79 Common sandpipers are fully migratory and migrate at night overland on a broad front (del Hoyo *et al.* 1996). Small numbers also remain in the northern maritime climatic zone (e.g. the British Isles, Mediterranean and Japan) throughout the year. The European population that overwinters in West Africa migrates south between mid-July and August and returns to the breeding grounds from late-March to April (del Hoyo *et al.* 1996). The species breeds from May to June in scattered single pairs 60-70 m apart in optimal breeding habitat, and migrates singly or in small flocks (del Hoyo *et al.* 1996), although it usually remains solitary in its winter range (BirdLife International 2019). It forages diurnally (del Hoyo *et al.,* 1996) and may aggregate at night (BirdLife International 2019) into roosts of over 100 individuals (del Hoyo *et al*. 1996). The species is listed as Least Concern by IUCN due to its large range and relatively stable global population trend. They are currently Amber listed in the UK (Eaton *et al*., 2015) and red listed in Wales (Johnston *et al.,* 2016).

10.7.2.80 During the breeding season this species shows a preference for pebbly, sandy or rocky margins of fast-flowing rivers (del Hoyo *et al.,* 1996), as well as small ponds, pools and, clear freshwater lake shores, sheltered sea coasts with rocky or sandy beaches, tidal creeks and estuaries (BirdLife International 2019. It often forages in patches of dry meadow. It generally avoids large coastal mudflats (del Hoyo *et al.* 1996). The diet of this species consists of adult and larval insects (such as beetles and *Diptera*), spiders, molluscs, snails, crustaceans, annelids, and occasionally frogs, toads, tadpoles and small fish, as well as plant material (including seeds) (del Hoyo *et al.* 1996).

10.7.2.81 Common sandpiper in the Waterway are a regular passage and winter visitor with peak counts usually in July with small numbers (~4) overwintering on the Cleddau (Haycock 2016). Counts from the BTO recorded no birds whilst MHWESG data recorded a peak count of 27 birds. Haycock 2016 details the Cleddau as the most important site within the Waterway for this species.

Non-diving Ducks VER

10.7.2.82 A total of six duck species (pintail, shoveler, shelduck, mallard, teal and wigeon) were identified as VERs due to their Amber-listed status in Wales (Johnstone and Bladwell, 2016). Teal and wigeon were also present at nationally important numbers. All species were recorded within the marine ornithology data search study area at both low and high tide with the exception of scaup, which was only recorded during low tide surveys with a maximum count of one. Due to the similarities of the feeding ecology of the duck species recorded they have been grouped as a single VER.

10.7.2.83 With the exception of mallard, all duck species listed in this VER are migratory in the UK context and are primarily found in the UK during the winter and passage periods (del Hoyo *et al*., 1992). The autumn migration for these species chiefly occurs between September and October (western Europe), during which they travel on a broad front (BirdLife International, 2019). In the winter, they can be found on freshwater lagoons, ponds, coastal brackish lagoons, tidal mudflats, estuaries, coastal shorelines, fresh and brackish estuarine marshes, inland seas and brackish or saline inland waters, occasionally occurring on marine waters during migration (BirdLife International, 2019).

10.7.2.84 Pintail, shoveler, shelduck, mallard, teal and wigeon are primarily dabbling ducks that feed primarily along the surface of the water or by tipping headfirst into the water. They take a variety of invertebrate and vegetative matter as part of their diet, including small aquatic invertebrates (e.g. caddisfly larvae, damselfly and dragonfly nymphs, adult beetles, bugs and flies), molluscs, planktonic crustaceans, the seeds of emergent and aquatic plants, annelids, amphibian spawn, tadpoles, spiders, fish and the vegetative parts of aquatic plants (e.g. duckweeds) (BirdLife International, 2019).

Diving Ducks VER

10.7.2.85 Due to the diving nature of scaup, red-breasted merganser and common scoter, these duck species have been listed as a separate VER instead of grouping with the remaining duck species. This is due to the different impact pathways that may affect diving species in comparison to dabbling ducks.

10.7.2.86 Scaup are fully migratory and breed in the high Arctic from late-May or early-June, often with colonies of nesting gulls or terns (del Hoyo *et al*., 1992). In the UK, they are primarily a passage migrant and winter visitor to estuaries and large inland waters. Scaup tend to winter on shallow coastal waters less than 10 m deep, as well as sheltered bays, estuaries and brackish coastal lagoons (del Hoyo *et al*., 1992; BirdLife International, 2019). The autumn migration begins after the moulting period in mid-August, with the return spring migration generally in late-February (BirdLife International, 2019).

10.7.2.87 The species is omnivorous during the winter, its diet consisting predominantly of molluscs (BirdLife International, 2019) such as mussels, cockles and clams while in coastal habitats, and *Hydrobia* snails while in brackish waters (del Hoyo *et al*., 1992, BirdLife International, 2019). Low numbers of scaup were noted during BTO WeBS low tide counts within the marine ornithology data search study area.

10.7.2.88 Red-breasted merganser are fully migratory (del Hoyo *et al*., 1992) although in temperate regions they only undertakes short distance movements to nearby coasts, or remains close to its breeding waters throughout the year (BirdLife International, 2019). It breeds from April or, in single pairs or colonies (del Hoyo *et al*., 1992), on islands or small islets. Autumn migration begins in September and the species returns from the wintering grounds as early as February. It is gregarious during the winter and on migration, flocks of up to a hundred or more occurring in suitable sites during the autumn (BirdLife International, 2019).

10.7.2.89 The majority of the species winters at sea, frequenting both inshore and offshore waters, estuaries, bays and brackish lagoons, but showing a preference for clear, shallow waters not affected by heavy wave action. Their diet consists predominantly of small, shoaling marine or freshwater fish, as well as small amounts of plant material and aquatic invertebrates (del Hoyo *et al*., 1992).

10.7.2.90 Low numbers of red-breasted merganser were noted from MHWESG data within the marine ornithology data search study area.

10.7.2.91 Common Scoter are strongly migratory, arriving on breeding grounds between late-April and May and breeding from late-May onwards in highly dispersed solitary pairs (del Hoyo *et al*., 1992, BirdLife International, 2019). After mating (from June onwards) males migrate long distances prior to their flightless moult, most travelling in small groups to inshore or offshore coastal waters whilst females and juveniles leave the breeding grounds in September. The species is highly gregarious when not breeding, with large flocks of several hundred to over 100,000 individuals occurring during winter (BirdLife International, 2019). The species breeds on Arctic dwarf heath or boggy tundra on pools, small lakes, streams (del Hoyo *et al*., 1992).

10.7.2.92 Although the species may use freshwater lakes on migration, the majority moult and overwinter at sea on shallow inshore waters less than 20 m deep (optimally 5-15 m) with abundant benthos, generally between 500 m and c.2 km from the shore (BirdLife International, 2019). Their diet consists predominantly of molluscs, especially during the winter, although it occasionally takes other aquatic invertebrates such as crustaceans (del Hoyo *et al*., 1992) (e.g. barnacles and shrimps) (Johnsgard, 1978), worms (del Hoyo *et al*., 1992), echinoderms, isopods, amphipods (Kear, 2005) and insects (e.g. midges and caddisflies [del Hoyo *et al*., 1992]) as well as small fish (del Hoyo *et al*., 1992) and fish eggs (BirdLife International, 2019).

10.7.2.93 Low numbers of common scoter were noted from MHWESG data within the marine ornithology data search study area.

Little Grebe VER

10.7.2.94 Little grebe (*Tachybaptus ruficollis*) has a global distribution, and a breeding range which extends across Europe, central/southern Asia and central/southern Africa, to as far east as Japan. European breeding occurs from Iberia, Britain and Ireland in the west and as far east as Russian borders (JNCC, 2012).

10.7.2.95 Within the UK, little grebe is thinly distributed with very sparse populations in the north of Scotland (JNCC, 2012). While little grebe nest and winter mainly on freshwater sites, outside of the breeding season some individuals are observed in sheltered coasts and estuaries free from strong wave action (Fox, 1994). The species inhabits small and shallow wetlands, typically less than 1 m deep, which are rich in vegetation with high densities of aquatic invertebrates (Fjeldsa, 2004). The little grebe breeds during the summer months in solitary pairs, with breeding times varying geographically dependent on the growth of emergent vegetation and water-levels (del Hoyo *et al*. 1992).

10.7.2.96 The little grebe typically forages on adult and larval insects, molluscs, crustaceans, adult and juvenile amphibians and small fish during the winter (Konter, 2001; Fjeldsa, 2004). In relation to foraging activities, the species typically dives to a depth of between 1-2 metres for approximately 10-25 seconds (Ingram and Salmon, 1941). Studies have observed highest feeding success during slack tides in shallowest water, with water depth rather than other factors such as turbidity the most likely link to feeding success (Fox, 1994). During this study, mean dive duration was 16.3 seconds (from 399 dives).

10.7.2.97 Listed as a wintering feature of Milford Haven Waterway SSSI, the little grebe has previously reached levels of national importance, however numbers have either declined or the threshold for national importance has been raised, and number of little grebes occurring within the Waterway no longer reach the threshold for National Importance. Low numbers of little grebe were noted from MHWESG data within the marine ornithology data search study area (26 within 2018).

10.7.2.98 Cosheston Pill (east of Warrior Way (site 6)) is the closest WeBs survey sector to the proposed META sites. Based on the WWBIC dataset, there have been no observations of little grebe since 2010 in the Cosheston Pill area.

Divers VER

10.7.2.99 During the winter red-throated divers are almost entirely marine, typically present over suitable shallow sandbanks away from shipping disturbance (del Hoyo *et al*., 1992, Snow and Perrins, 1998). The highest densities of wintering birds are associated with shallow water.

10.7.2.100 Red throated divers are strongly migratory, with inland populations moving south or to the coast after breeding. The species breeds from May onwards and can be found breeding in the uplands of Scotland in the UK. On migration, large flocks of 200-1,200 individuals may form, with similar concentrations occurring on rich marine fishing grounds during the winter (del Hoyo *et al*., 1992). The species is most commonly observed singly, in pairs or in small scattered flocks during migration and winter however (BirdLife International, 2019). Outside of the breeding season, the species frequents inshore waters along sheltered coasts, occasionally occurring inland on lakes, pools, reservoirs and rivers (del Hoyo *et al*., 1992). Their diet consists predominantly of fish as well as crustaceans, molluscs, frogs, fish spawn, aquatic insects, annelid worms and plant matter (del Hoyo *et al*., 1992, BirdLife International, 2019).

10.7.2.101 Red throated divers are vulnerable to oil spills, especially in wintering areas where large concentrations form (e.g. on rich fishing grounds) This species also has a strong reaction to disturbance from ships, resulting in an altered population distribution and habitat fragmentation. It is considered to be a species at relatively high risk of collision with offshore infrastructure due to nocturnal flight behaviour and low manoeuvrability (Garthe and Hüppop, 2004).

10.7.2.102 Great northern divers are strongly migratory, with inland breeding populations moving south or to the coast after breeding (del Hoyo *et al.,* 1992). They are primarily winter visitors to the UK, occurring singly, in pairs or in small loose flocks in marine habitats (BirdLife International, 2019). In winter, they are primarily found along the coast on exposed rocky shores, sheltered bays, channels and sheltered inlets, preferring shallow inshore waters (del Hoyo *et al.,* 1992). They may also be found inland on lakes and reservoirs during this season, although this is largely influenced by the weather (del Hoyo *et al.,* 1992). Their diet consists predominantly of fish as well as crustaceans, molluscs, aquatic insects, annelid worms, frogs, other amphibians and plant matter (e.g. *Potamogeton* spp., willow *Salix* spp. Shoots, roots, seeds, moss and algae) (del Hoyo *et al.,* 1992).

10.7.2.103 Great northern diver is on Annex 1 of the EU Birds Directive. It is also Amber listed in BoCC3 (Wales). There are an estimated 17,000 individuals overwintering in UK waters (O'Brien *et al*., 2010).

10.7.2.104 Divers were identified within the marine ornithology data search study area with peak counts of one per 3 km^2 for both red-throated and great northern diver species, with the nearest records of 1.7 km and 0 m for red-throated diver and great northern diver respectively from the META project.

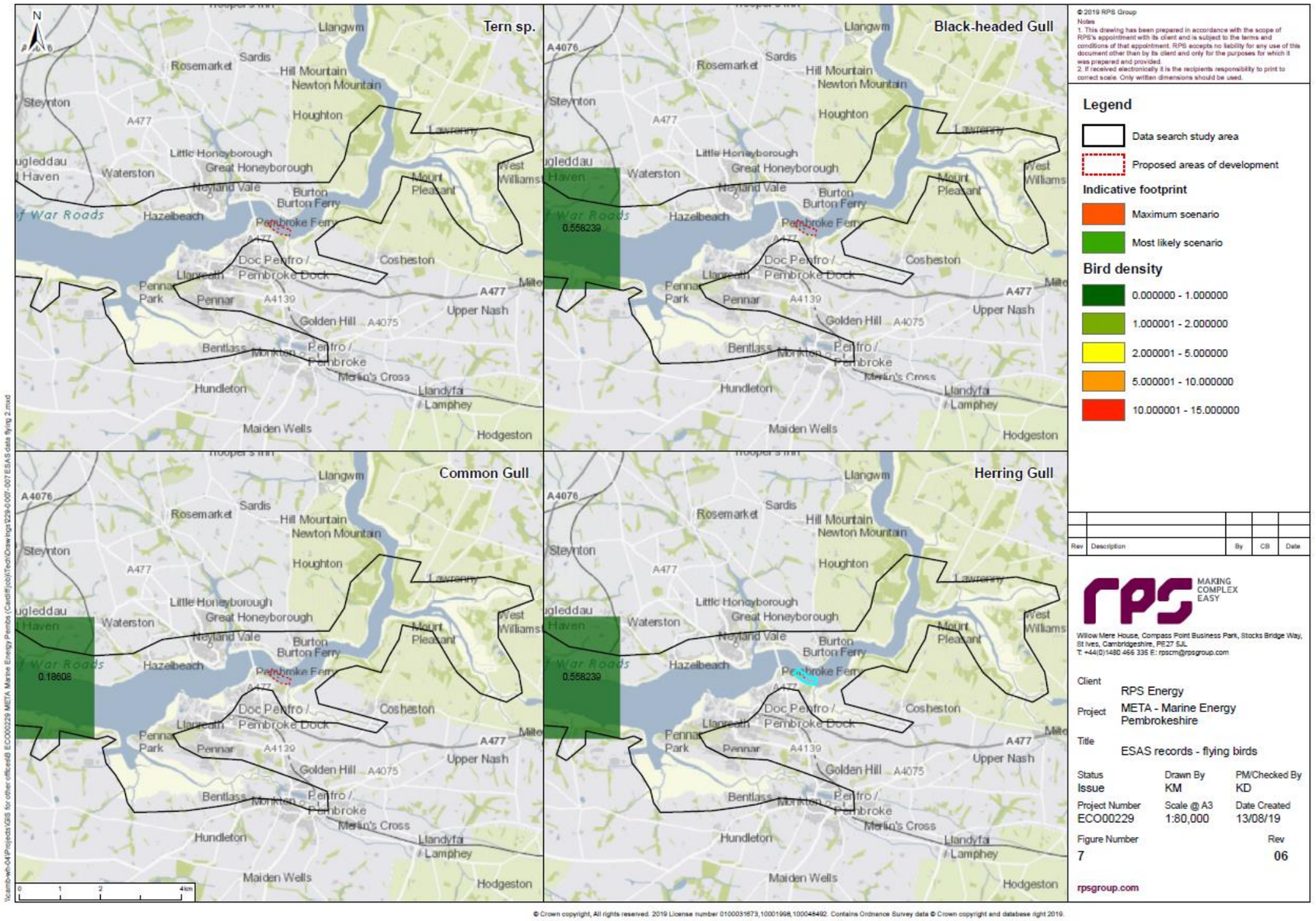

Figure 10.3: ESAS data results for black-headed gull, common gull and herring gull (flying) around Warrior Way (site 6). Density of animals per 3 km² provided within each density block.

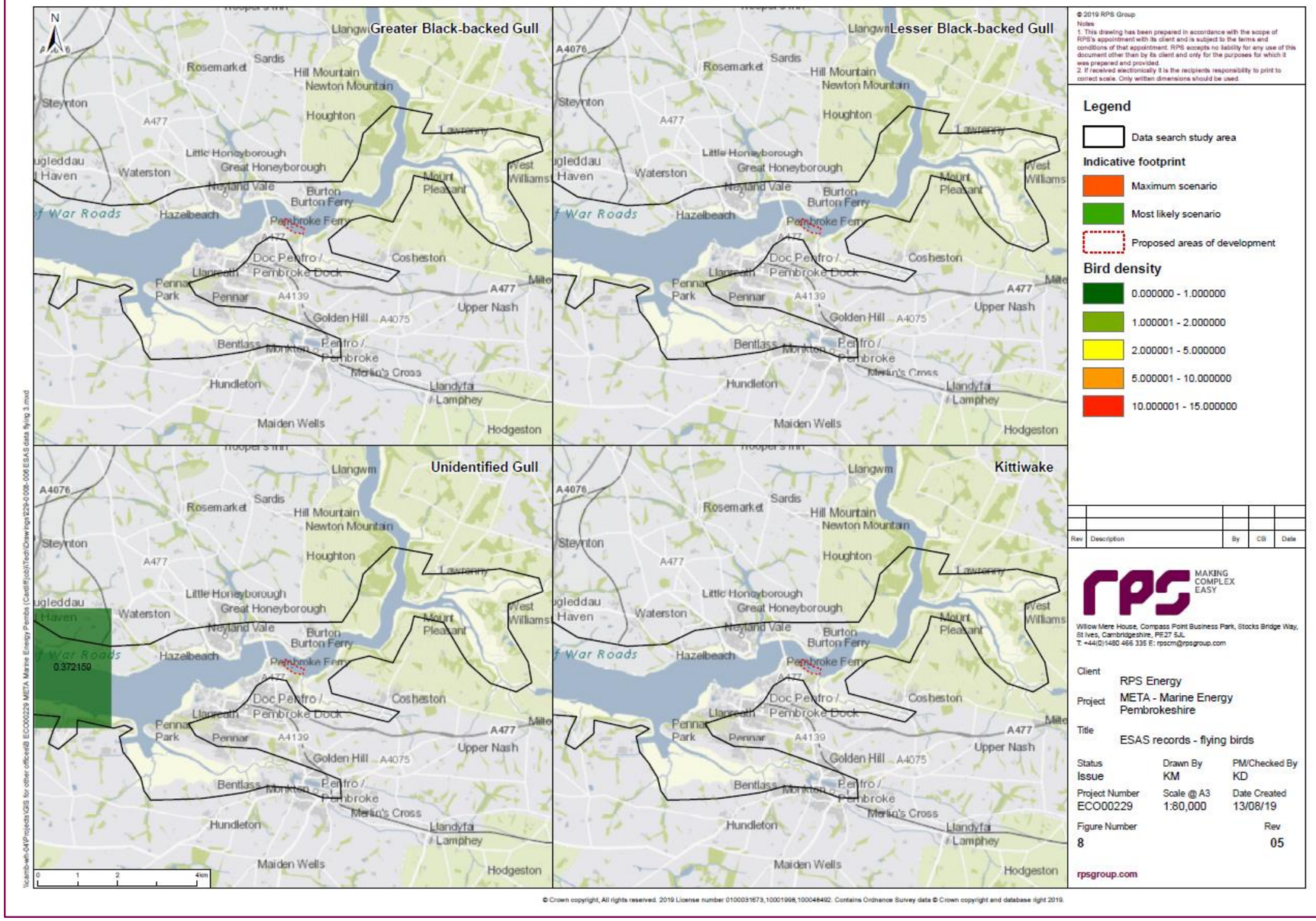

Figure 10.4: ESAS data results for unidentified gull (flying) around Warrior Way (site 6). Density of animals per 3 km² provided within each density block. .

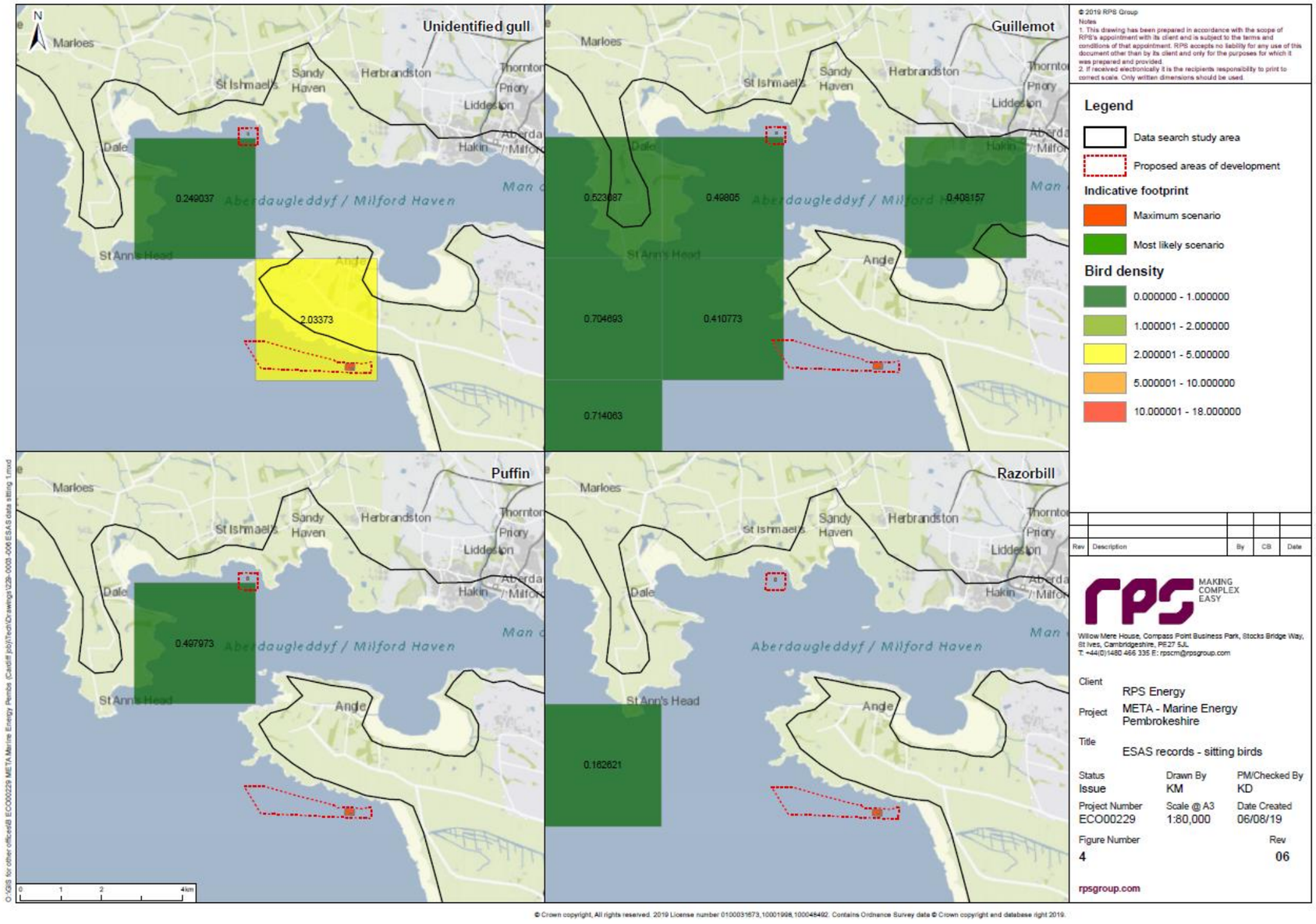

Figure 10.5: ESAS data results for unidentified gulls, guillemot, puffin and razorbill (sitting birds) around Dale Roads (site 7) and East Pick ard Bay (site 8). Density of animals per 3 km² provided within each density block.

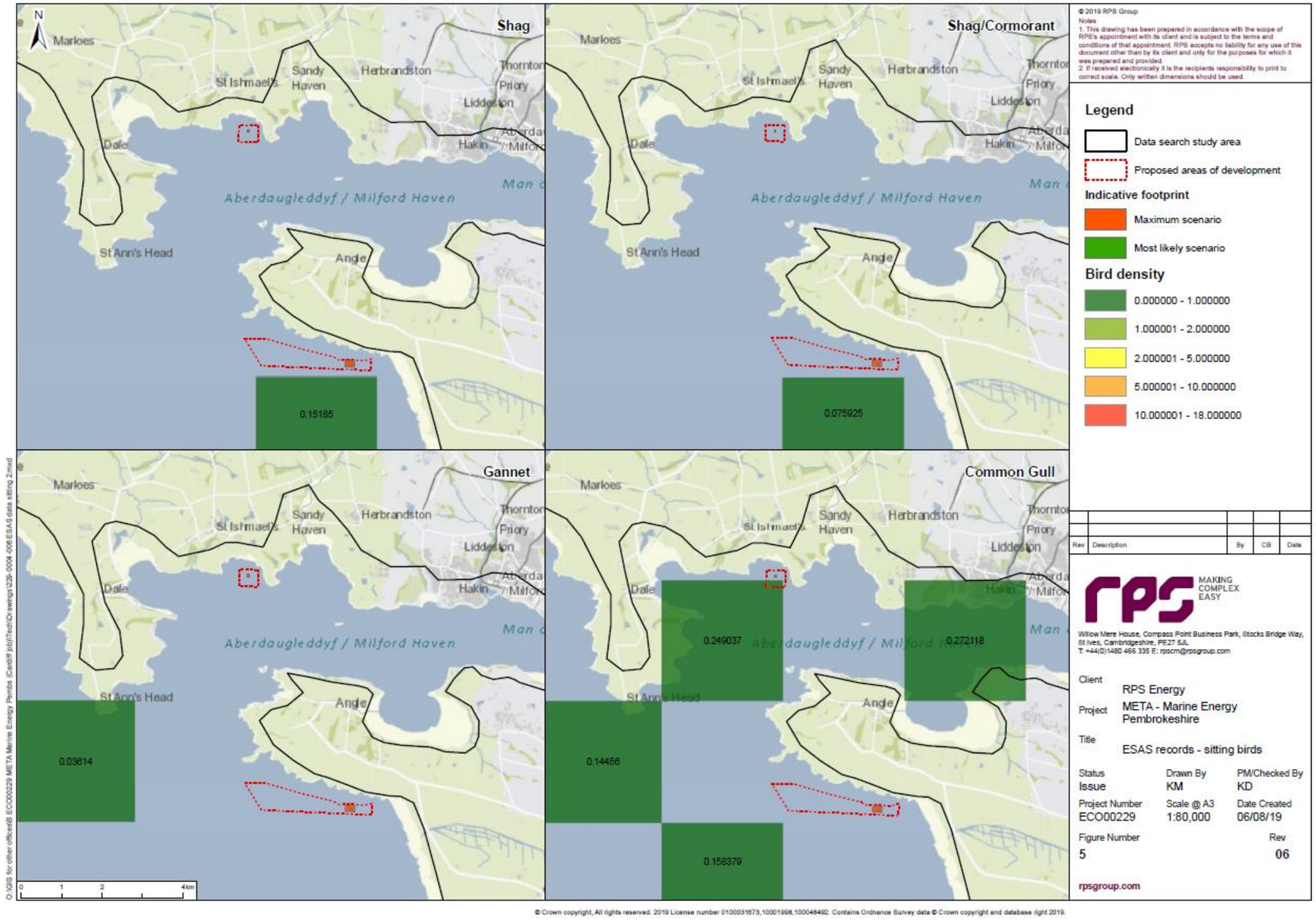

Figure 10.6: ESAS data results for shag, cormorant, gannet and common gull (sitting) around Dale Roads (site 7) and East Pickard Bay (site 8). Density of animals per 3 km² provided within each density block.

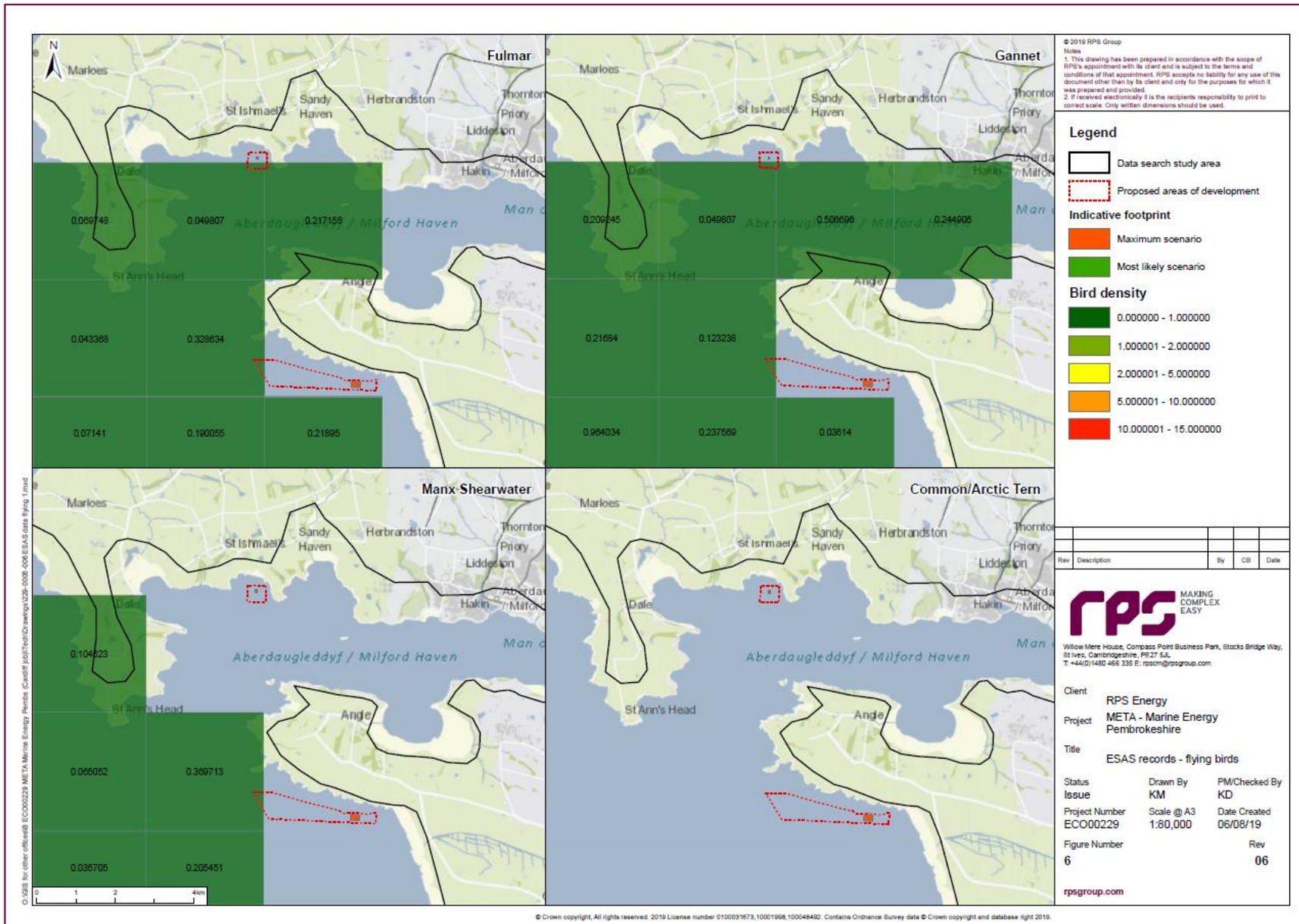

Figure 10.7: ESAS data results for fulmar, gannet, Manx shearwater and common Arctic tern (flying) around Dale Roads (site 7) and East Pic kard Bay (site 8). Density of animals per 3 km² provided within each density block.

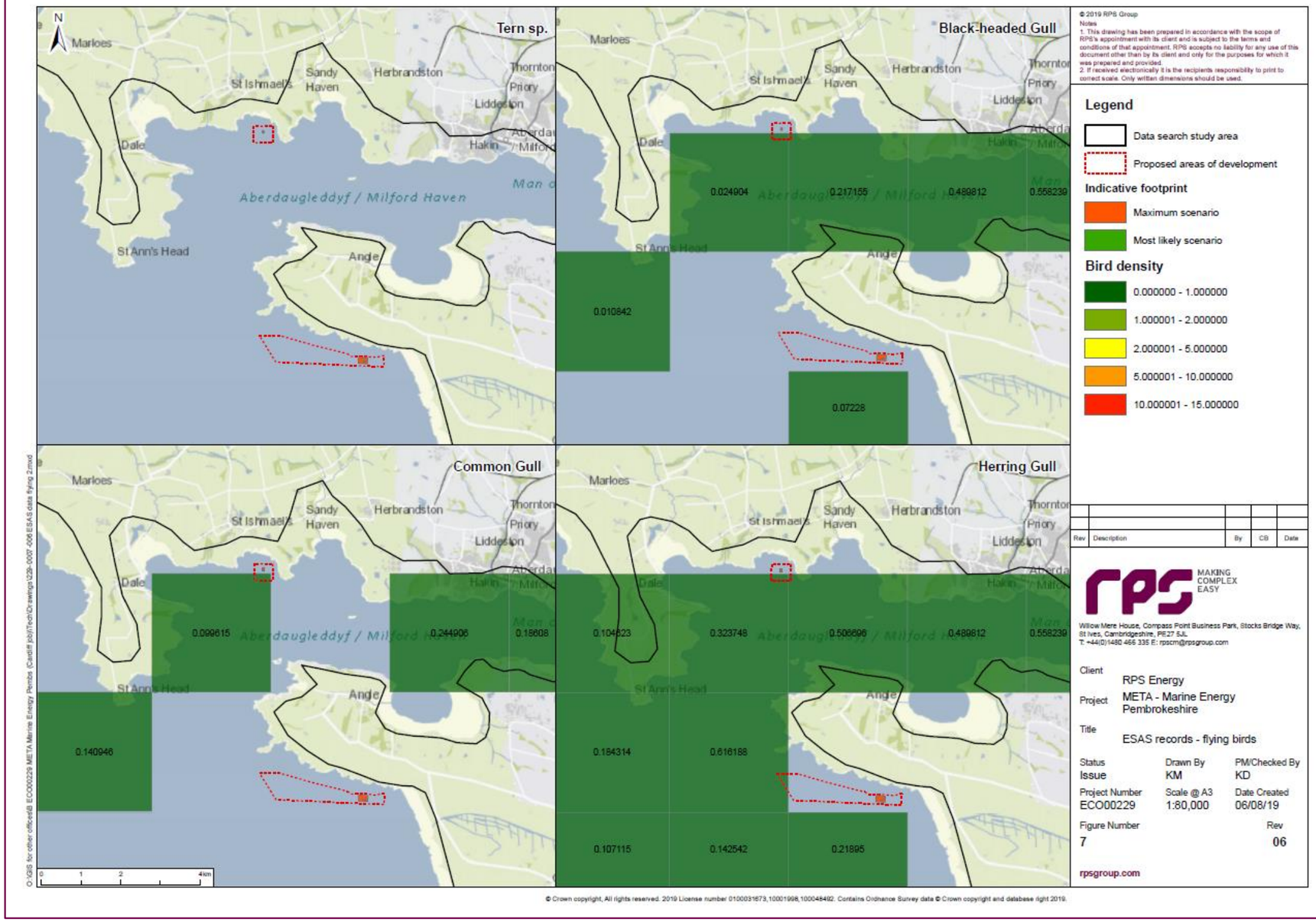

Figure 10.8: ESAS data results for tern sp., black-headed gull, common gull and herring gull (flying) around Dale Roads (site 7) and East Pickard Bay (site 8). Density of animals per 3 km² provided within each density block.

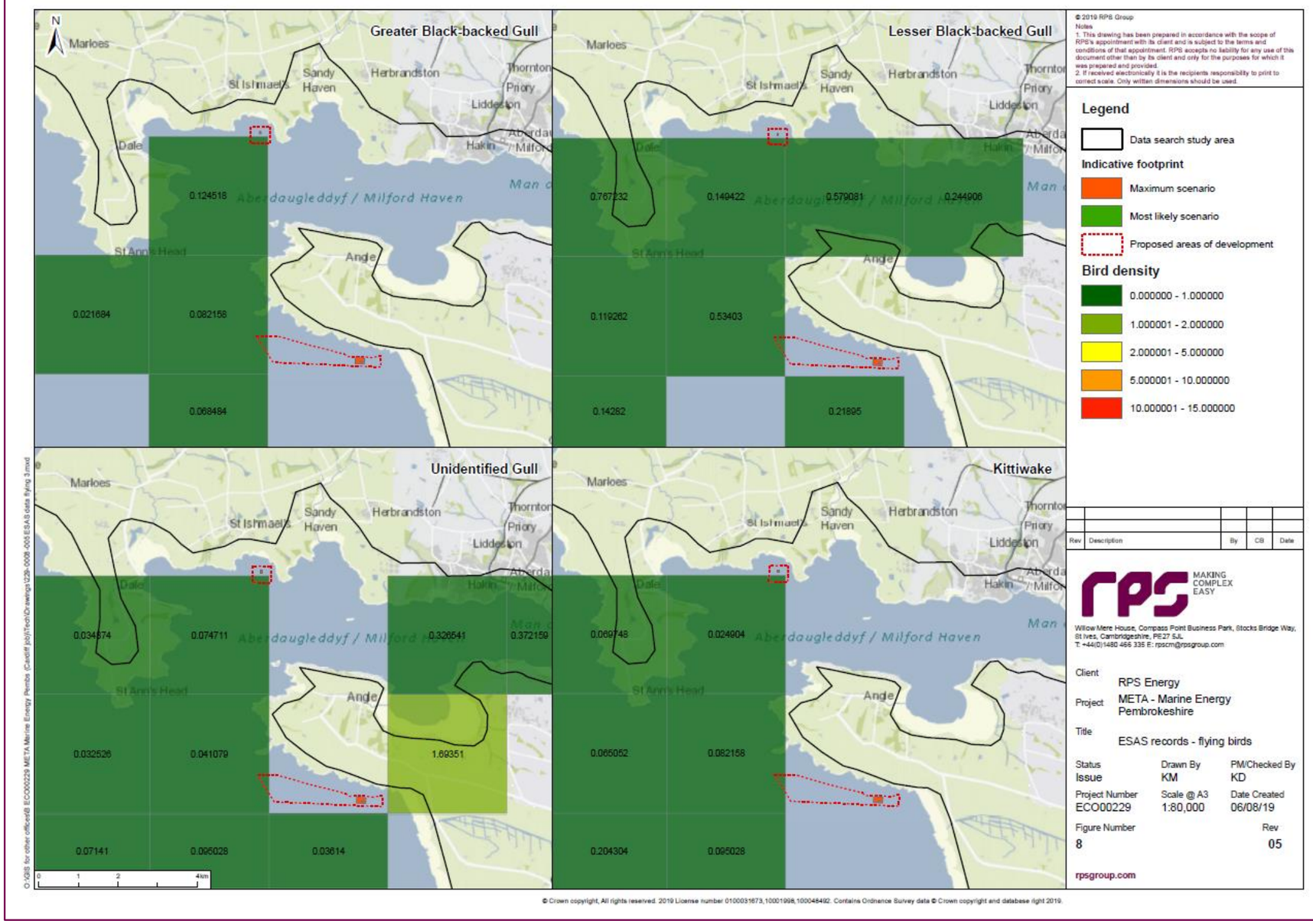

Figure 10.9: ESAS data results for great black-backed gull, lesser black-backed gull, unidentified gull and kittiwake (flying) around Dale Roads (site 7) and East Pickard Bay (site 8). Density of animals per 3 km² provided within each density block.

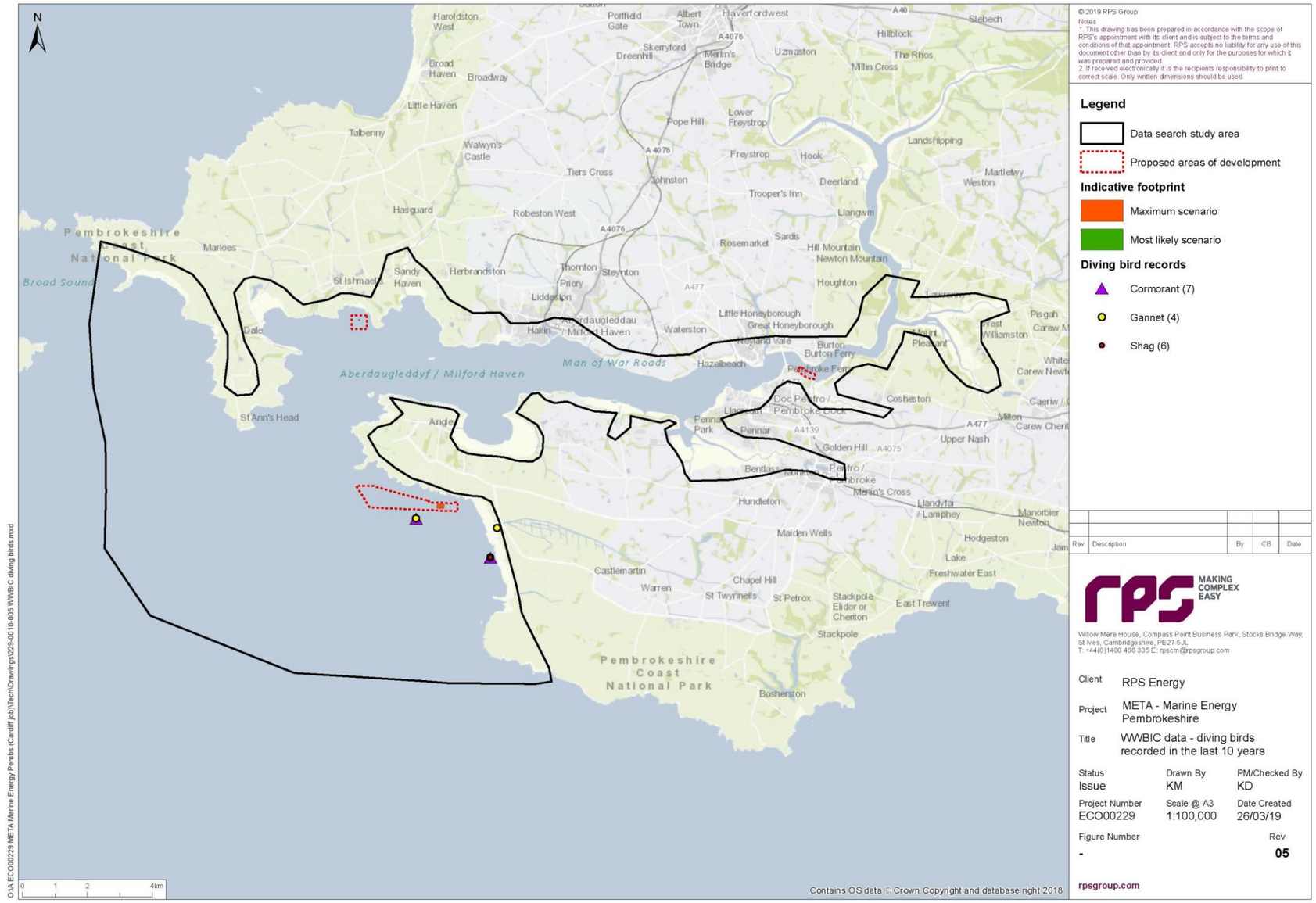

Figure 10.10: WWBIC data results – diving birds.

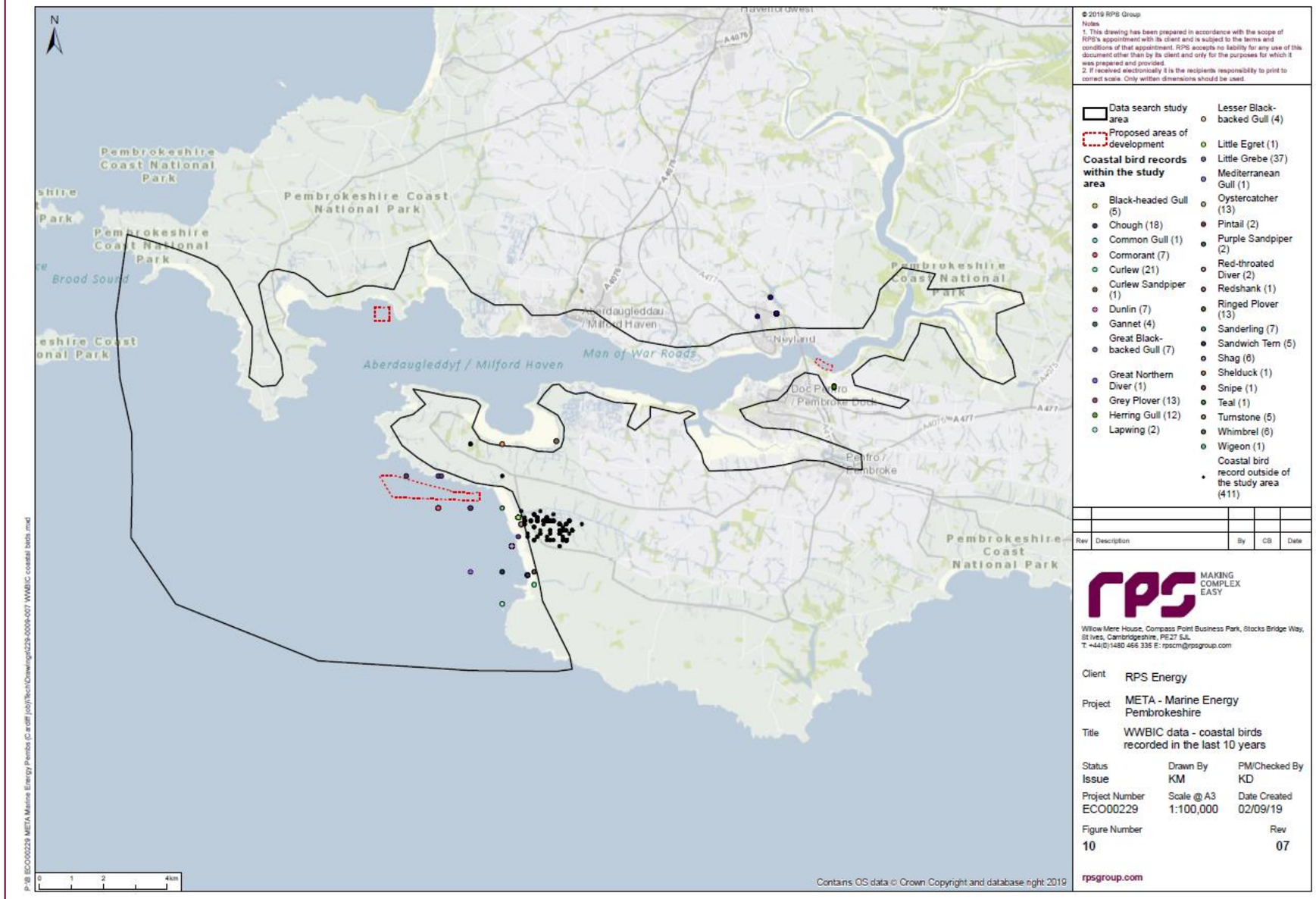

Figure 10.11: WWBIC data results – coastal birds

Table 10.9: Summary of marine ornithology species considered VERs in relation to the META project.

Species	Data source (Peak values in study area)					Closest distance to META sites (km). Density of birds (number per 3 km²) at closest distance is given in brackets for ESAS data and peak counts for BTO / WWBIC data.			Qualifying Interest Feature of a SPA (Y/N)	Species legislation/ conservation status[3]	Nationally/ internationally important numbers (number of animals)	Value (see Table 10.8 for information regarding value)
	ESAS (densities per 3 km²)	WWBIC (counts)	BTO WeBS Peak Core Count (low tide)	BTO WeBS Peak Core Count[4] (high tide)	MHWESG Report 2017-2018 (high tide)	East Pickard Bay	Dale Roads	Warrior Way				
Guillemot VER	1.2					0.0 (0.4)	0.0 (0.5)	7.3 (0.4)	Y	Amber	Not Available	International
Puffin VER	14.5					1.5 (0.5)	0.0 (0.5)	13.7 (0.5)	Y	Red	Not Available	International
Razorbill VER	1.8					2.5 (0.2)	3.8 (0.2)	11.2 (2.8)	Y	Amber	Not Available	International
Shag VER	0.2					0.3 (0.2)	5.9 (0.2)	11.2 (0.2)	N	Bern-A2; Amber	No 1100/2000	Regional
		3				1.7 (3)	8.0 (3)	10.1 (3)	N			
Cormorant VER		2				0.3 (1)	6.0 (1)	11 (2)	N	Amber	No 350/1200	Regional
			24			4.5 (2)	2.0 (2)	0.0 (2)				
				28								
					24							
Gannet VER	2					0.0 (0.1)	0.0 (0.04)	7.3 (0.2)	Y	Amber	Not Available	International
		6				0.3 (1)	6.0 (1)	10.4 (6)				
Kittiwake VER	1					0.0 (0.08)	0.0 (0.02)	13.3 (0.02)	Y	Red	Not Available	International
Little Egret VER		2				1.3 (2)	7.3 (2)	10.5 (2)	N	BirdsDir-A1	Yes 35/140	National
			27			1.8 (1)	1.5 (2)	0 (2)				
				39								
					68							
Slavonian Grebe VER					1					BirdsDir-A1; WACA-Sch1_part1; Red	No 11/55	Regional
Little Grebe VER			26	34	21	1.6 (2)	1.5 (1)	0 (2)	N		No 26/160	Regional
Herring Gull VER	8.7					0.25 (0.21)	0 (0.58)	0 (8.7)	Y	BirdsDir-A2.2 ; Red	No 7300/10200	Regional
		28				1.7 (25)	8 (25)	11 (25)				

[3] WCA Sch1: Wildlife and Countryside Act 1981 Schedule 1; BirdsDir: Birds Directive (Annexes 1, 2.1 and 2.2); Env (Wales) Act S7: Species of Principal Importance in Wales (section 7); Bern: Bern Convention (Appendices 1, 2 and 3); Red/Amber: Birds of Conservation Concern in Wales 3 (Johnstone and Bladwell, 2016) For a full account of legislation see Appendix A

[4]Data considered includes records from birds regularly using the site i.e. present in 75% of records

Species	Data source (Peak values in study area)					Closest distance to META sites (km). Density of birds (number per 3 km^2) at closest distance is given in brackets for ESAS data and peak counts for BTO / WWBIC data.			Qualifying Interest Feature of a SPA (Y/N)	Species legislation/ conservation status[3]	Nationally/ internationally important numbers (number of animals)	Value (see Table 10.8 for information regarding value)
	ESAS (densities per 3 km^2)	WWBIC (counts)	BTO WeBS Peak Core Count (low tide)	BTO WeBS Peak Core Count[4] (high tide)	MHWESG Report 2017-2018 (high tide)	East Pickard Bay	Dale Roads	Warrior Way				
			304			5.1 (33)	1.5 (33)	0 (14)				
				2647								
					1931							
Lesser Black-backed Gull VER	0.8					0 (0.5)	0 (0.14)	0.2 (7.4)				
		120				1.7 (120)	8 (120)	11 (120)				
			166			5.1 (68)	1.5 (68)	1.9 (29)	Y	BirdsDir-A2.2 ; Amber	No 1200/5500	Regional
				655								
					504							
Great Black-backed Gull VER	1.2					0 (0.08)	0 (0.3)	4.3 (1.2)				
		80				2.8 (80)	9 (80)	11 (80)				
			49			5.1 (58)	1.5 68)	1.9 (29)	N	BirdsDir-A1; Red	No 760/4200	Regional
				39								
					39							
Mediterranean Gull VER					5					BirdsDir-A1; WACA-Sch1_part1	No 18/770	Regional
Common Gull VER	0.27					0.4 (0.15)	0 (0.24)	4.3 (0.2)				
		3				1.7 (3)	8 (3)	11 (25)	Y	BirdsDir-A1; Red	No 7000/16400	Regional
					30							
Common/Arctic Tern VER	0.03					4.6 (0.03)	6.3 (0.01)	18 (0.03)	N	Common: BirdsDir-A1; Amber Arctic: Bern-A2; BirdsDir-A1; Red	No Common – International 1800 Arctic – International 20000	
Sandwich Tern VER		3				1.3 (2)	7.3 (2)	10.5 (2)	N	BirdsDir-A1; Amber	No International - 1700	
Manx Shearwater VER	0.6					0 (0.4)	2.5 (0.1)	13.5 (0.4)	Y	Amber	Not Available	Regional

Species	Data source (Peak values in study area)					Closest distance to META sites (km). Density of birds (number per 3 km^2) at closest distance is given in brackets for ESAS data and peak counts for BTO / WWBIC data.			Qualifying Interest Feature of a SPA (Y/N)	Species legislation/ conservation status[3]	Nationally/ internationally important numbers (number of animals)	Value (see Table 10.8 for information regarding value)
	ESAS (densities per 3 km^2)	WWBIC (counts)	BTO WeBS Peak Core Count (low tide)	BTO WeBS Peak Core Count[4] (high tide)	MHWESG Report 2017-2018 (high tide)	East Pickard Bay	Dale Roads	Warrior Way				
Fulmar VER	0.3					0 (0.3)	0 (0.04)	10.3 (0.2)	Y	Amber	Not Available	Regional
Divers VER												
Red Throated Diver		1				1.7 (1)	8.0 (1)	11 (1)	N	WCA Sch1 part1; Bern-A2; BirdsDir-A1; Amber	No 170	Regional
Great Northern Diver		2				2.3 (2)	8.3 (2)	12.5 (2)	N	WCA Sch1; Bern-A2; BirdsDir-A1; Amber	No 25/50	Regional
			1					0.0 (1)				
Waders VER												
Curlew		75				1.4 (55)	7.5 (55)	10.5 (55)	N	BirdsDir-A2.2; Env (Wales) Act S7; Red	Yes 1400	National
			798			1.6 (73)	1.5 (5)	0.0 (8)				
				1795								
					1244							
Whimbrel		1				0.1 (1)	5.2 (1)	10.1 (1)	N	WCA Sch1 part1; BirdsDir-A2.2; Amber	Yes 1	National
					7							
Dunlin		312				1.2 (10)	7.3 (10)	10.5 (10)	N	Bern-A2; Red	Yes 3500	National
			1922			1.6 (15)	4.0 (160)	0.0 (20)				
				4378								
					3618							
Curlew Sandpiper		2				3.0 (2)	6.5 (2)	8.5 (2)	N	Bern-A2; Amber	No	Regional
Purple Sandpiper		1				1.7 (1)	8.0 (1)	11.0 (1)	N	WCA Sch1 part1; Bern-A2; Amber	No 130	Regional
Common Sandpiper					27					Red	Yes 1/17,500	National
Grey Plover		54				1.4 (47)	7.4 (47)	10.4 (47)	N	BirdsDir-A2.2; Red	No 430	National
			8			8.9 (1)	12.2 (1)	3.0 (1)				
				72								
					14							

Species	Data source (Peak values in study area)					Closest distance to META sites (km). Density of birds (number per 3 km²) at closest distance is given in brackets for ESAS data and peak counts for BTO / WWBIC data.			Qualifying Interest Feature of a SPA (Y/N)	Species legislation/ conservation status[3]	Nationally/ internationally important numbers (number of animals)	Value (see Table 10.8 for information regarding value)
	ESAS (densities per 3 km²)	WWBIC (counts)	BTO WeBS Peak Core Count (low tide)	BTO WeBS Peak Core Count[4] (high tide)	MHWESG Report 2017-2018 (high tide)	East Pickard Bay	Dale Roads	Warrior Way				
Golden Plover			1500			14.8 (750)	16.5 (750	3.0 (750)	N			
				5000						BirdsDir-A1, Red	Yes 4000	National
					2200							
Ringed Plover		32				1.7 (32)	8.0 (32)	11.1 (32)	N			
				46						Env (Wales) Act S7; Bern-A2; Red	No 340	National
					77							
Greenshank			21			8.9 (1)	1.5 (1)	0.0 (2)	N			
				20						BirdsDir-A2.2	Yes 6	National
					39							
Redshank		1				1.5 (1)	7.5 (1)	10.5 (1)	N			
			186			1.6 (12)	1.5 (5)	0.0 (15)			No	
				650						BirdsDir-A2.2; Red	1200	National
					638							
Spotted Redshank					1					Amber	Yes 1	National
Ruff					2					Schedule 1 – Part 1; Amber	No	Regional
Lapwing		250				0.75 (>50)	6.9 (>50)	10.9 (>50)	N			
			2285			1.6 (2)	2.8 (5)	0.0 (30)				
				6585						BirdsDir-A2.2; Env (Wales) Act S7; Red	No 6200	National
					2486							
Oystercatcher		170				1.8 (53)	8.0 (53)	11.1 (53)	N			
			404			1.6 (46)	1.5 (9)	0.0 (3)				
				495						BirdsDir-A2.2; Amber	No 3200	Regional
					439							
Sanderling		8				1.3 (6)	7.3 (6)	10.5 (6)	N	Bern-A2; Amber	No 160	Regional

Species	Data source (Peak values in study area)					Closest distance to META sites (km). Density of birds (number per 3 km²) at closest distance is given in brackets for ESAS data and peak counts for BTO / WWBIC data.			Qualifying Interest Feature of a SPA (Y/N)	Species legislation/ conservation status[3]	Nationally/ internationally important numbers (number of animals)	Value (see Table 10.8 for information regarding value)
	ESAS (densities per 3 km²)	WWBIC (counts)	BTO WeBS Peak Core Count (low tide)	BTO WeBS Peak Core Count[4] (high tide)	MHWESG Report 2017-2018 (high tide)	East Pickard Bay	Dale Roads	Warrior Way				
Knot					11					Red	No 3200/4500	Regional
Jack Snipe					1					Amber	No 1000/20000	Regional
Snipe		>100				2.8 (>100)	9.0 (>100)	11.0 (>100)	N	BirdsDir-A2.1; Amber	No 10000	Regional
			51			8.5 (26)	11.8 (26)	0.5 (1)				
				100								
					248							
Turnstone		9				1.7 (9)	8.0 (9)	11.1 (9)	N	Bern-A2; Amber	No 480	Regional
			44			1.6 (1)	4.8 (1)	1.1 (29)				
				81								
				28								
Bar Tailed Godwit			49			1.6 (2)	4.5 (7)	0.0 (7)	N	Red	No 380	National
				107								
Black Tailed Godwit			72			11.6 (12)	14.0 (12)	0.0 (12)	N	Amber	No 430	Regional
				97								
				81								
Brent Goose – Light bellied VER			45			2.0 (21)	2.9 (26)	8.4 (24)	N	Amber	Yes 34 (Nationally) 75 (Internationally)	Low tide: National High tide: International
				86								
					90							
Non-diving Ducks VER												
Shelduck		1				1.7 (1)	5.3 (1)	10.0 (1)	N	Bern-A2; Amber	No 3000	Regional
			318			1.6 (1)	4.1 (13)	0.0 (16)				
				486								
					449							
Teal		26				1.8 (26)	8.0 (26)	11.1 (26)	N		Yes	National

Species	Data source (Peak values in study area)					Closest distance to META sites (km). Density of birds (number per 3 km²) at closest distance is given in brackets for ESAS data and peak counts for BTO / WWBIC data.			Qualifying Interest Feature of a SPA (Y/N)	Species legislation/ conservation status[3]	Nationally/ internationally important numbers (number of animals)	Value (see Table 10.8 for information regarding value)
	ESAS (densities per 3 km²)	WWBIC (counts)	BTO WeBS Peak Core Count (low tide)	BTO WeBS Peak Core Count[4] (high tide)	MHWESG Report 2017-2018 (high tide)	East Pickard Bay	Dale Roads	Warrior Way				
			2205			5.6 (34)	1.5 (34)	0.0 (15)			2100	
				3818						BirdsDir-A2.1; Amber		
					1812							
Mallard			88			2.0 (2)	4.0 (4)	0.0 (6)	N			
				321						Amber	No 6800	Regional
					258							
Shoveler			19			7.5 (2)	10.3 (2)	3.8 (2)	N	BirdsDir-A2.1; Amber	No 180	Regional
					19							
Wigeon		26				2.8 (26)	9.1 (26)	11.2 (26)	N			
			5213			1.6 (20)	1.6 (88)	0.0 (300)				
				4544						BirdsDir-A2.1; Amber	Yes 4400	National
					8703							
Pintail		5				3 (5)	6.5 (5)	8.5 (5)	N	WCA Sch1 part2; BirdsDir-A2.1; Amber	No 290	Regional
					9							
Diving Ducks VER												
Scaup		1				7.5 (1)	10.5 (1)	3.8 (1)	N	BirdsDir-A2.2 Amber	No 52	Regional
					1							
Common Scoter					1					Schedule 1 – Part 1; Amber	No 1000/5500	Regional/ Local
Red Breasted Merganser					1					Amber	No 84/1700	Regional/ Local

Table 10.10: Updated ESAS densities based on recent Wales population trends for key scoped in seabird VER groups

Species	Welsh population trend 1998-2002 to 2019 (% change)	Updated peak ESAS Value in study area (densities per 3 km²) applying Welsh population trend 1998-2002 to 2019 (% change). Baseline ESAS value given in brackets	Density of birds (number per 3 km²) at closest distance for ESAS data applying Welsh population trend 1998-2002 to 2019 (% change). Baseline ESAS value given in brackets		
			East Pickard Bay	Dale Roads	Warrior Way
Guillemot VER	-3.65%[1]	1.16 (1.2)	0.39 (0.4)	0.48 (0.5)	0.39 (0.4)
Puffin VER	139.5%[2]	34.73 (14.5)	1.20 (0.5)	1.20 (0.5)	1.20 (0.5)
Razorbill VER	64%[3]	2.95 (1.8)	0.33 (0.2)	0.33 (0.2)	4.59 (2.8)
Shag VER	-89.7%[4]	0.02 (0.2)	0.02 (0.2)	0.02 (0.2)	0.02 (0.2)
Cormorant VER	16 – 41%[3]*	2.32 – 2.82 (2)*	1.16 – 1.41 (1)	1.16 – 1.41 (1)	2.32 – 2.82 (2)
Gannet VER	21%[5]	2.42 (2)	0.12 (0.1)	0.05 (0.04)	0.24 (0.2)
Kittiwake VER	-44%[3]**	0.56 (1)	0.04 (0.08)	0.01 (0.02)	0.01 (0.02)

[1] Based on 5-year average of count data of Welsh colonies from SMP database (55843.6 ±4471.4).

[2] Calculated from Seabird Monitoring Programme (SMP) colony data (Skomer and Skokholm all except gannet (Grassholm)). Differences calculated from 5yr average colony counts between 1998-2002 (Seabird 2000), and between 2013/14-2017/18.

[3] Seabird Monitoring Programme (SMP), (JNCC, 2016).

[4] Based on 5-year average of count data of Welsh colonies from SMP database (94 ±0.95).

[5] Gannet Census (2013-2014).

*The largest two colonies of great cormorant in Wales, at Puffin Island and Little Orme, have increased between 2010 to 2014 by 16% and 41%, respectively.

**11 colonies surveyed in 2015 held 4,353 AON, 44% fewer than was recorded at the same colonies during Seabird 2000 (6,230 AON).

*** West Wales Biodiversity Information Centre (WWBIC) Count

10.8 Future baseline scenario

10.8.1.1 In the event that the META project does not come forward, an assessment of the future baseline conditions has been carried out and is described within this section.

10.8.1.2 In the absence of the META project impacts such as overfishing and fluctuations in fish and shellfish as well as climate change are likely to impact the dynamics and baseline of marine ornithology receptors discussed in this chapter. Impacts such as climate change may impact receptors directly or indirectly, for example through changes in fish populations and prey availability.

10.8.1.3 Sea and coastal bird populations are subject to natural variation in population size and distributions, largely as a result of year to year variation in recruitment success, and these population trends will be influenced by broad-scale climatic variations, as well as anthropogenic activities such as climate change and overfishing.

10.8.1.4 Climate change is predicted to have the potential to profoundly affect trophic web structures as even apparently minor environmental changes can strongly modify the spatio-temporal availability of food resources necessary to predators. In addition, different food-web components are unlikely to respond to environmental change in the same manner, causing different degrees of spatio-temporal match–mismatch between these components, with resulting de-structuration of the food web in question (Grémillet & Boulinier, 2009). The sandeel, which makes up a significant component of many of the seabirds' diet, is less likely to be able to adapt to increasing temperatures as a result of their specific habitat requirements for coarse sandy sediment; declining recruitment in sandeel in parts of the UK has been correlated with increasing sea temperature (Heath *et al*., 2012).

10.8.1.5 The most recent information indicates that the greatest threat to fish stocks upon which seabirds prey is the combined effect of climate change and overfishing (Brander, 2007). A number of studies now strongly suggest that rapid climate change and uncontrolled removal of fish resources have drastic consequences for seabird breeding success and survival and, ultimately, for population stability (Frederiksen *et al*., 2004; Ainley & Blight, 2009).

10.8.1.6 The marine ornithology baseline characterisation described in the preceding sections represents a 'snapshot' of the marine bird assemblages of the marine ornithology data search study area, within a gradual and continuously changing environment. Any changes that may occur during the lifetime of the project (i.e. installation, operation and maintenance and decommissioning) should be considered in the context of the natural variability and anthropogenic effects, including climate change, overfishing and other environmental impacts.

10.8.2 Data limitations

10.8.2.1 Novel field surveys have not been undertaken to inform the assessment. The assessment relies on desk study data, some of which is dated (i.e. ESAS data from 1998-2002), which introduces some limitation to the baseline characterisation. To allow for consideration of current seabird populations, population trends have been applied to ESAS baseline densities within this assessment. Whilst this limitation may introduce a degree of uncertainty in the baseline characterisation and impact assessment, it is addressed through the approach that maximum adverse case scenarios have been adopted for all potential impact pathways and a precautionary approach taken to the assessment.

10.8.2.2 More recent survey data was obtained for coastal birds with dates ranging between 2009 – 2018 (see Table 10.5).

10.8.2.3 Due to the lack of spatial data associated with the BTO high tide core count and MHWESG data, it was not possible to identify the individual location of important high tide roosts within the estuary and in close proximity to the META project. However broad spatial locations of importance were identifiable from the text within the MHWESG reporting and supporting mapping. As such the assessment has been carried out based on the maximum adverse scenario i.e. VER roosting at the closest location where suitable habitat exists except where more accurate spatial information is available from MHWESG reporting. For example, at Warrior Way (site 6) potentially suitable high tide roosting habitat is associated with the point and coastal fringe habitats present approximately 150 m to the east of Warrior Way (site 6). This area is identified within the MHWESG data set as supporting significant numbers of over-wintering shelduck, redshank, curlew, teal and wigeon.

10.8.2.4 Where spatial data from BTO datasets has been available (e.g. for low tide) this has been used to determine distances to species records from the proposed development sites i.e. for Brent goose, the nearest known suitable habitat where Brent geese occur is at Angle Bay, 8.4 km away from Warrior Way (site 6), 2.9 km from Dale Roads (site 7), and 2.0 km from East Pickard Bay (site 8), hence the distances presented in Table 10.9.

10.9 Key parameters for assessment

10.9.1 Maximum and most likely design scenarios

10.9.1.1 The maximum design scenarios identified in Table 10.11 have been selected as those having the potential to result in the greatest potential effect on an identified receptor or receptor group. These scenarios have been selected from the details provided in the project description (chapter 2: Project Description). Effects of greater adverse significance are not predicted to arise should any other development scenario, based on details within the project design envelope (e.g. different infrastructure layout) to that assessed here be taken forward in the final design scheme.

10.9.1.2 The most likely design scenarios identified in Table 10.11 have been selected as those having the potential to result in the most likely effect on an identified receptor or receptor group. These scenarios have been selected from the details provided in the project description (chapter 2: Project Description).

Table 10.11: Maximum and most likely design scenarios considered for the assessment of potential impacts on marine ornithology.

Potential impact	Maximum design scenario	Most likely design scenario	Justification
All Phases			
Collision with development	**Warrior Way** • Scaled or micro tidal devices, instruments, components and subassemblies, monitoring equipment, site preparation. • Up to one device deployment occurring at any one time occupying all or part of the water column and demarked by up to four navigational marker buoys. • Rotor diameter up to 5 m. • 20 m x 10 m. • Swept area of 19.63 m^2. • Speed of moving parts up to 5 m/s. • Up to four deployments in a 12-month period. • A minimum clearance of 2 m will be maintained between turbine blade tips and the surface of the water. • Preferred deployment period will be March – July inclusive, however deployment and operation may be throughout the year (subject to survey). **Dale Roads** • Scaled or full-scale wave energy converter (WEC) devices, research and monitoring methodologies. • Up to one device deployment occurring at any one time which may occupy a significant proportion of the water column and may include surface-piercing devices, demarked by up to four navigational marker buoys. • 30 m (L) x 20 m (W). • Up to 2 m above sea surface. • Up to two devices deployed in a 12-month period. • Potential ingress of birds or fish to moving parts of wave devices will be restricted through device design • Deployment and operation of devices may be throughout the year and is not seasonally restricted. **East Pickard Bay** • Scaled or full-scale WEC device testing and component testing for floating offshore wind technology. • Up to two device deployments at any one time which may occupy a significant proportion of the water column and may include surface-piercing, at surface and sub-surface components, demarked by up to four navigational marker buoys • 147 m (L) x 230 m (W) • Up to 15 m above sea surface (A maximum scenario height of up to 15 m above sea surface will only apply in devices up to a maximum dimension scenario of 60 m length x 60 m width. Where maximum dimensions of a	**Warrior Way** • Scaled or micro tidal devices, instruments, components and subassemblies, monitoring equipment, site preparation. • Up to one device deployment occurring at any one time (which may consist of multiple components or activities for testing) occupying all or part of the water column and demarked by up to four navigational marker buoys. • Rotor diameter up to 5 m • 5 m x 5 m. • Swept area of 19.63 m^2. • Speed of moving parts up to 2 m/s. • Up to two deployments in a 12-month period. • A minimum clearance of 2 m will be maintained between turbine blade tips and the surface of the water. • Preferred deployment period will be March – July inclusive, however deployment and operation may be throughout the year (subject to survey). **Dale Roads** • Scaled or full-scale WEC devices, research and monitoring methodologies. • Up to one device deployment occurring at any one time which may occupy a significant proportion of the water column and may include surface-piercing devices, demarked by up to four navigational marker buoys. • 15 m (L) x 10 m (W) • At sea surface • Up to one device deployed in a 12-month period. • Potential ingress of birds or fish to moving parts of wave devices will be restricted through device design • Deployment and operation of devices may be throughout the year and is not seasonally restricted. **East Pickard Bay** • Scaled or full-scale WEC device testing and component testing for floating offshore wind technology. • Up to one device deployment occurring at any one time (which may occupy a significant proportion of the water column and may include surface-piercing, at surface and sub-surface components, demarked by up to four navigational marker buoys. • 80 m (L) x 17 m (W) • At sea surface • Up to one device deployment within the test site in a 12-month period	Maximum design scenario Associated with the greatest risk of collision between development and marine birds

Potential impact	Maximum design scenario	Most likely design scenario	Justification
	device are over 60 m length x 60 m width, a maximum height of 5 m above sea surface will be applied) • Up to four device deployments within the test site in a 12-month period. • Potential ingress of birds or fish to moving parts of wave devices will be restricted through device design • Deployment and operation of devices may be throughout the year and is not seasonally restricted.	• Potential ingress of birds or fish to moving parts of wave devices will be restricted through device design • Deployment and operation of devices may be throughout the year and is not seasonally restricted.	
	Warrior Way • Scaled or micro tidal devices, instruments, components and subassemblies, monitoring equipment deployed via gravity base or moored to the seabed. No tow testing. • Up to one device deployment occurring at any one time which may occupy all or part of the water column and demarked by up to four navigational marker buoys. • A minimum clearance of 2 m will be maintained between turbine blade tips and the surface of the water. • Up to 200 m^2 sea surface per device deployment. • Up to four deployments in a 12-month period Up to 104 vessel visits in a 12-month period. • Up to 104 vessel visits in a 12-month period. • Up to five vessels utilised at any one time for device operation and maintenance. • Access via Pembroke Port (vessel length up to 35 m). • Preferred deployment period will be March – July inclusive, however deployment and operation may be throughout the year (subject to survey).	**Warrior Way** • Scaled or micro tidal devices, instruments, components and subassemblies, monitoring equipment deployed via gravity base or moored to the seabed. No tow testing • Up to one device deployment occurring at any one time which may occupy all or part of the water column and demarked by up to four navigational marker buoys. • A minimum clearance of 2 m will be maintained between turbine blade tips and the surface of the water. • Up to 100 m^2 sea surface per device deployment • Up to two deployments in a 12-month period • Up to 52 vessel visits in a 12-month period. • Up to three vessels utilised at any one time for device operation and maintenance. • Access via Pembroke Port (vessel length up to 30 m). • Preferred deployment period will be March – July inclusive, however deployment and operation may be throughout the year (subject to survey).	
Disturbance/displacement	**Dale Roads** • Scaled or full-scale WEC devices, research and monitoring methodologies deployed via gravity base or moored to the seabed. No tow testing. • Up to one device deployment occurring at any one time which may occupy a significant proportion of the water column and may include surface-piercing devices, demarked by up to four navigational marker buoys. • Up to two devices deployed in a 12-month period. • Up to 104 vessel visits in a 12-month period. • Up to five vessels utilised at any one time for device operation and maintenance. • Access via Pembroke Port (vessel length up to 164 m). • Deployment and operation of devices may be throughout the year and is not seasonally restricted. • **East Pickard Bay** • Scaled or full-scale WEC device testing and component testing for floating offshore wind technology. • Up to two device deployments at any one time which may occupy a significant proportion of the water column and may include surface-piercing	**Dale Roads** • Scaled or full-scale WEC devices, research and monitoring methodologies deployed via gravity base or moored to the seabed. No tow testing. • Up to one device deployment occurring at any one time which may occupy a significant proportion of the water column and may include surface-piercing devices, demarked by up to four navigational marker buoys. • Up to one device deployed in a 12-month period. • Up to 52 vessel visits in a 12-month period. • Up to three vessels utilised at any one time for device operation and maintenance. • Access via Pembroke Port (vessel length up to 164 m). • Deployment and operation of devices may be throughout the year and is not seasonally restricted. • **East Pickard Bay** • Scaled or full-scale WEC device testing and component testing for floating offshore wind technology. • Up to one device deployment at any one time which may occupy a significant proportion of the water column and may include surface-piercing, at surface and sub-surface components, demarked by up to four navigational marker buoys.	<u>Maximum design scenario</u> Maximum vessel traffic movements (number) will be associated with the greatest potential to cause disturbance/displacement to marine birds

Potential impact	Maximum design scenario	Most likely design scenario	Justification
	(up to 15 m above sea surface), at surface and sub-surface components, demarked by up to four navigational marker buoys. • Up to two deployments per berth in a 12-month period therefore up to four moored or gravity base device deployments in a 12-month period. • Up to 150 vessel visits in a 12-month period. • Up to five vessels utilised at any one time for device operation and maintenance. • Access via local ports (Wales) (vessel length up to 200 m). • Operational testing throughout the year and not restricted to daylight hours, however maintenance activities will be restricted to daylight hours, wherever possible . • Up to 15 years total duration of consent. • Deployment and operation of devices may be throughout the year and is not seasonally restricted.	• Up to one device deployment within the test site in a 12-month period. • Up to 104 vessel visits in a 12-month period. • Up to three vessels utilised at any one time for device operation and maintenance. • Access via local ports (vessel length up to 200 m). • Operational testing throughout the year and not restricted to daylight hours, however maintenance activities will be restricted to daylight hours, wherever possible. • Up to 15 years total duration of consent. • Deployment and operation of devices may be throughout the year and is not seasonally restricted.	
Accidental Pollution	Physical presence of single devices or components at the Warrior Way and Dale Roads sites and up to two devices or components at the East Pickard Bay site. A total of up to 358 vessel movements/round trips to port, involving up to 15 vessels, associated with test deployments per year comprising: Up to 104 vessel movements/round trips to port, involving up to five vessels, associated with test deployments per year at the Warrior Way site; Up to 104 vessel movements/round trips to port, involving up to five vessels, associated with test deployments per year at the Dale Roads site; and Up to 150 vessel movements/round trips to port, involving up to five vessels, associated with test deployments per year at the East Pickard Bay site.	Physical presence of single devices or components at the Warrior Way, Dale Roads and East Pickard Bay sites. A total of up to 208 vessel movements/round trips to port, involving up to 15 vessels, associated with test deployments per year comprising: Up to 52 vessel movements/round trips to port, involving up to three vessels, associated with test deployments per year at the Warrior Way site; Up to 52 vessel movements/round trips to port, involving up to three vessels, associated with test deployments per year at the Dale Roads site; and Up to 104 vessel movements/round trips to port, involving up to three vessels, associated with test deployments per year at the East Pickard Bay site.	There is a risk of accidental pollution from vessel spills Maximum design scenario – maximum number of vessels and vessel movements has the potential to cause greatest impact on marine birds

10.9.2 Impacts scoped out of the assessment

10.9.2.1 On the basis of the baseline environment and the project description outlined in chapter 2: Project Description, a number of impacts and marine ornithology receptors are proposed to be scoped out of the assessment for marine ornithology. These impacts and marine ornithology receptors that have been scoped out are outlined in Table 10.12, together with a justification for scoping them out on a species-specific basis.

10.9.2.2 Potential lighting impacts on valued ecological receptors may occur as a result of increased artificial light at night due to the development. **Any lighting required as part of the development will be restricted to that needed on marker buoys or devices only where surface piercing, as a navigation measure.** As such the specific details of any lighting will be dependent on the design and type of device to be deployed and stakeholder feedback (Milford Haven Port Authority (MHPA), Trinity House and MCA) on specific device deployments. Given the existing status of the Waterway, any such lighting is considered unlikely to result in any additional effect or appreciable impact. However, full details of proposed lighting designs will be provided as part of device developer specific EMP's and agreed in consultation with relevant stakeholders. Where device-specific lighting proposals exceed the minimal requirements for navigation then a developer specific ornithological impact assessment may be completed and submitted to stakeholders for agreement prior to deploymment.

Table 10.12: Impacts and marine ornithology receptors scoped out of the assessment for marine ornithology.

Potential Impact Pathway	VER scoped in	VER scoped out	Justification
Collision with vessels	N/A	All	The Waterway supports a significant volume of boat traffic and the minor increase due to the proposed development is unlikely to significantly increase risk. This impact has therefore been scoped out.
Changes to fish and shellfish communities	N/A	Marine and coastal birds	Significant impacts to the fish and shellfish community are not anticipated from the META project (chapter 8) so there is no predicted change to the availability of prey species for birds. This impact has therefore been scoped out.
Collision with development	Guillemot, razorbill, puffin, shag, kittiwake, gannet, divers, diving ducks, cormorant	Fulmar, Little Grebe	Fulmar were recorded within the study area at low densities, and are considered to be a pelagic species, therefore overlap during foraging is very unlikely. Food is located by sight and taken from the top three metres of the water column as such below surface collision risk is negligible. The species spends relatively little time on the water surface making collisions with vessels and test deployments unlikely. Little Grebe were also recorded within the vicinity of the study area at very low densities, with only eight individuals observed throughout the 2000s at Cosheston Pill (located to the east of Warrior Way (site 6), Appendix 10.1). In the wider Cleddau Estuary system, 26 individuals were observed in 2018 (Haydock, 2018) but none have been recorded in the Cosheston Pill section of the estuary since 2010. Therefore, little grebe has been scoped out from further assessment. However, following consultation with RSPB, pre-deployment surveys for little grebe will be carried out if a planned deployment is outside of March-July inclusive. Further details of surveys are included in the META EMMP.
Disturbance/displacement	N/A	Fulmar	Fulmar were recorded within the study area at low densities and are considered to be a pelagic species. The species spends relatively little time on the water surface making interactions with vessels unlikely. They are also highly tolerant of disturbance.
All potential impact pathways	N/A	Little Egret	Low levels of occurrence within the marine ornithology study area. Tolerant of disturbance and no significant risk of collision. Spends no time sat on the water and as such is at low risk of impact through pollution.
	N/A	Manx shearwater	Low levels of occurrence within the marine ornithology data search study area. Manx shearwater are essentially a pelagic piscivorous species but will also eat cephalopods and small invertebrates. Their prey (largely small shoaling fish i.e. clupeids) is usually associated with the frontal systems and stratified waters. Significant spatial overlap with the META sites is therefore considered highly unlikely. As such, there is no potential pathway of interaction from disturbance by vessels, accidental pollution or collision with tidal turbines, or wave energy structures or ancillary infrastructure.
	N/A	Gull species	Gulls are highly manoeuvrable in flight and tend to fly relatively high above the water surface (Garthe and Hüppop, 2004) reducing their exposure to and risk of above surface collisions. They are surface feeders and consequently have a low risk of below surface collisions. Gulls are also used to the presence of man, both onshore and offshore and are in general highly tolerant of disturbance (McCluskie *et al.*,

Potential Impact Pathway	VER scoped in	VER scoped out	Justification
			2012). As such, there is no potential pathway of interaction from disturbance by vessels, accidental pollution or collision with tidal turbines, or wave energy structures or ancillary infrastructure.
	N/A	Tern species	Terns are highly manoeuvrable in flight and tolerant of disturbance away from breeding colonies and are shallow visual plunge feeders. As such, there is no potential pathway of interaction from accidental pollution or noise disturbance from vessels or tidal turbines, wave energy structures or ancillary infrastructure.
		Brent Goose (low tide) Brent Goose (high tide)	Geographic separation from development and lack of suitable foraging habitat in close proximity to the META project i.e. *Zostera* beds or coastal saltmarsh. MHWESG noted sites of importance/ occurrence at the Gann and Angle Bay both > 2.9 km from proposed development site. Lack of impact pathways.
		Wader species.	Geographic separation from development and lack of suitable high tide roosting & foraging habitat in close proximity (nearby coastal habitat dominated by vertical cliff faces). Lack of impact pathways.
	Red-breasted merganser	Duck species.	Geographic separation from development and lack of suitable high tide roosting and foraging habitat in close proximity (nearby coastal habitat dominated by vertical cliff faces). Lack of impact pathways.
Disturbance/displacement Dale Roads		Divers	The development sites lie in close proximity to the Waterway which supports significant vessel traffic (See Appendix 12.1: Navigational Risk Assessment). As such it can be assumed that the diver species present are tolerant of the existing level of vessel noise and the uplift in vessels through deployment, operation and retrieval i.e. up to 104 vessel movements at Dale Road in a 12-month period will represent only a small increase on this existing baseline. This allows a conclusion of no significant increase in the pathway of interaction.
		Cormorant	The development sites lie in close proximity to the Waterway which supports significant vessel traffic. As such it can be assumed that cormorant present are tolerant of the existing level of vessel noise and the uplift in vessels through deployment, operation and retrieval i.e. up to 104 vessel movements at Dale Roads in a 12-month period will represent only a small increase on this existing baseline. This allows a conclusion no significant increase in the pathway of interaction.
		Guillemot, razorbill, puffin, shag, kittiwake, fulmar & gannet	The development sites lie in close proximity to the Waterway which supports significant vessel traffic. As such it can be assumed that the species listed and present in the Waterway are tolerant of the existing level of vessel noise. The increase in vessels through deployment, operation and retrieval i.e. up to 104 vessel movements at Dale Roads in a 12-month period will represent only a small increase on this existing baseline. In-combination with the low suitability of the habitat (Wakefield *et al.,* 2017), it is therefore appropriate to conclude there would be no significant increase in disturbance/displacement In addition, recent studies in Scotland have identified an increased density of northern gannet, during summer, in the presence of a wave energy converter devices. This supports the conclusion that there will be

Potential Impact Pathway	VER scoped in	VER scoped out	Justification
			no avoidance or significant change in distribution as a result of the presence of a WEC (Leesa *et al*., 2016).
Disturbance/displacement Warrior Way	Duck & wader species	Divers	The development sites lie in close proximity to the Waterway which supports significant vessel traffic (See Appendix 12.1: Navigational Risk Assessment) with ~2-40 vessel movements per month in close proximity to the site. As such it can be assumed that any duck or wader species present are tolerant of the existing level of vessel noise and the uplift in vessels through deployment, operation and retrieval up to 104 vessel movements at Warrior Way in a 12- month period will represent only a small increase on this existing baseline. This allows a conclusion of no significant increase in interaction.
		Cormorant	The development sites lie in close proximity to the Waterway which supports significant vessel traffic (See Appendix 12.1: Navigational Risk Assessment). As such it can be assumed that cormorant present are tolerant of the existing level of vessel noise and the uplift in vessels through deployment, operation and retrieval i.e. up to 104 vessel movements at Warrior Way sites will represent only a small increase on this existing baseline. This allows a conclusion of no significant increase in interaction
		Guillemot, razorbill, puffin, shag, kittiwake, fulmar & gannet	The development sites lie in close proximity to the Waterway which supports significant vessel traffic (See Appendix 12.1: Navigational Risk Assessment) As such it can be assumed that the species listed and present in the Waterway are tolerant of the existing level of vessel noise. The increase in vessels through deployment, operation and retrieval i.e. up to 104 vessel movements at Warrior Way site over a 12-month period therefore only representing a small increase on this existing baseline. In-combination with the low suitability of the habitat (Wakefield *et al.,* 2017), it is therefore appropriate to conclude there would be no significant increase in disturbance/displacement.
Disturbance/displacement East Pickard Bay		Brent Goose (low tide) Brent Goose (high tide)	Geographic separation from development and lack of suitable foraging habitat in close proximity to the META project i.e. *Zostera* beds or coastal saltmarsh. MHWESG noted sites of importance/ occurrence at the Gann and Angle Bay both > 8.4 km from proposed development site. Lack of impact pathways.
		Brent Goose (low tide) Brent goose (high tide)	Geographic separation from development and lack of suitable foraging habitat in close proximity to the META project i.e. *Zostera* beds or coastal saltmarsh. MHWESG noted sites of importance/ occurrence at the Gann and Angle Bay both > 2 km from proposed development sites. Lack of impact pathways.
		Wader species.	Geographic separation from development and lack of suitable high tide roosting & foraging habitat in close proximity (nearby coastal habitat dominated by vertical cliff faces). Lack of impact pathways.
	Red-breasted merganser	Duck species.	Geographic separation from development and lack of suitable high tide roosting and foraging habitat in close proximity (nearby coastal habitat dominated by vertical cliff faces). Lack of impact pathways.

Potential Impact Pathway	VER scoped in	VER scoped out	Justification
		Divers	The development sites lie in close proximity to the Waterway which supports significant vessel traffic (See Appendix 12.1: Navigational Risk Assessment). As such it can be assumed that the diver species present are tolerant of the existing level of vessel noise and the uplift in vessels through deployment, operation and retrieval i.e. up to 150 movements at the East Pickard Bay site over a 12-month period will represent only a small increase on this existing baseline. This allows a conclusion no significant increase in the pathway of interaction
		Cormorant	The development sites lie in close proximity to the Waterway which supports significant vessel traffic (See Appendix 12.1: Navigational Risk Assessment). As such it can be assumed that cormorant present are tolerant of the existing level of vessel noise and the uplift in vessels through deployment, operation and retrieval i.e. up to 150 movements at the East Pickard Bay site over a 12-month period will represent only a small increase on this existing baseline. This allows a conclusion no significant increase in the pathway of interaction
		Guillemot, razorbill, puffin, shag, kittiwake, fulmar & gannet	The development sites lie in close proximity to the Waterway which supports significant vessel traffic (See Appendix 12.1: Navigational Risk Assessment). As such it can be assumed that the species listed and present in the Waterway are tolerant of the existing level of vessel noise. The increase in vessels through deployment, operation and retrieval i.e. up to 150 movements at the East Pickard Bay site over a 12-month period therefore only representing a small increase on this existing baseline. In-combination with the low suitability of the habitat (Wakefield *et al.,* 2017), it is therefore appropriate to conclude there would be no significant increase in disturbance/displacement In addition, recent studies in Scotland have identified an increased density of northern gannet, during summer, in the presence of a wave energy converter devices. This supports the conclusion that there will be no avoidance or significant change in distribution as a result of the presence of a WEC (Leesa *et al*., 2016).
Accidental Pollution	Cormorant, shag, duck species, divers, Manx shearwater, guillemot, razorbill, puffin, & gannet	Fulmar, kittiwake, gull species, terns	Species that spend significant proportions of their time sat on the sea surface or diving from the surface to pursue prey are particularly at risk of contamination due to accidental pollution. Those species that spend the majority of their time on the wing and are more opportunistic in feeding are at a much-reduced risk. On this basis fulmar, gull species kittiwake and tern species have been scoped out.
		Brent goose	Geographic separation from development and lack of suitable foraging habitat in close proximity to the META project i.e. *Zostera* beds or coastal saltmarsh. MHWESG noted sites of importance/ occurrence at the Gann and Angle Bay both > 2 km from proposed development sites. Lack of impact pathways.

10.10 Impact assessment methodology

10.10.1 Overview

10.10.1.1 The marine ornithology EIA has followed the methodology set out in chapter 4: Environmental Impact Assessment Methodology. Specific to the marine ornithology impact assessment, the following guidance documents have also been considered:

- CIEEM: Guidelines for Ecological Impact Assessment in the UK and Ireland; Terrestrial, Freshwater and Marine 2018.

10.10.2 Impact assessment criteria

10.10.2.1 The criteria for determining the significance of effects is a two-stage process that involves defining the sensitivity of the receptors and the magnitude of the impacts. This section describes the criteria applied in this chapter to assign values to the sensitivity of receptors and the magnitude of potential impacts. The terms used to define sensitivity and magnitude are based on those which are described in further detail in chapter 4: Environmental Assessment Methodology.

Sensitivity

10.10.2.2 The criteria for defining sensitivity in this chapter are outlined in Table 10.13 below. The determination of species/ VER sensitivity has been based on a combination of the conservation status of the species along with its potential for substitution. Substitution here is a subjective evaluation and summary of the species-specific population trend(s), threats and uncertainties and their capacity to buffer/ withstand environmental change and maintain current status in the relevant spatial context i.e. the Waterway and surrounding region.

Table 10.13: Definition of terms relating to the sensitivity of the receptor.

Value (sensitivity of the receptor)	Definition
Very High	International VER /National VER and very limited potential for substitution
High	International VER /National VER and limited potential for substitution
Medium	Regional/local scale VER, limited potential for substitution
Low	Regional/local scale VER with medium potential for substitution
Negligible	Local VER with high potential for substitution

10.10.2.3 Although recent CIEEM guidance does not allow for the assessment of 'unlikely' impacts, it is considered appropriate to evaluate unlikely impacts for the META project due to the wider project design envelope described for the META project (chapter 2: Project Description). The criteria for identifying likelihood of impact and the degree of confidence in the assessment of the impact is therefore based upon the following:

- Certain/near-Certain: probability estimated at 95% chance or higher;
- Probable: probability estimated above 50% but below 95%;
- Unlikely: probability estimated above 5% but less than 50%; and
- Extremely Unlikely: probability estimated at less than 5%.

Magnitude

10.10.2.4 The criteria for defining magnitude in this chapter are given in Table 10.14 below.

Table 10.14: Definition of terms relating to the magnitude of an impact.

Magnitude	Definition
Major	Loss of resource and/or quality and integrity of resource; severe damage to key characteristics, features or elements (Adverse)
Major	Large scale or major improvement or resource quality; extensive restoration or enhancement; major improvement of attribute quality (Beneficial)
Moderate	Loss of resource, but not adversely affecting integrity of resource; partial loss of/damage to key characteristics, features or elements (Adverse)
	Benefit to, or addition of, key characteristics, features or elements; improvement of attribute quality (Beneficial)
Minor	Some measurable change in attributes, quality or vulnerability, minor loss or, or alteration to, one (maybe more) key characteristics, features or elements (Adverse)
	Minor benefit to, or addition of, one (maybe more) key characteristics, features or elements; some beneficial impact on attribute or a reduced risk of negative impact occurring (Beneficial)
Negligible	Very minor loss or detrimental alteration to one or more characteristics, features or elements (Adverse)
	Very minor benefit to, or positive addition of one or more characteristics, features or elements (Beneficial)
No change	No loss or alteration or characteristics, features or elements; no observable impact in either direction

Significance

10.10.2.5 The significance of the effect upon marine ornithology is determined by correlating the magnitude of the impact and the sensitivity of the receptor. Effect is the term used to express the consequence of an impact (expressed as the 'significance of effect').

10.10.2.6 The particular method employed for this assessment is presented in Table 10.15. Where a range of significance of effect is presented in Table 10.15, the final assessment for each effect is based upon expert judgement. For the purposes of this assessment, any effects with a significance level of minor or less have been concluded to be not significant in terms of the EIA Regulations.

10.10.2.7 The magnitude of an impact does not directly translate into significance of effect. For example, a significant effect may arise as a result of a relatively modest impact on a resource of national value, or a large impact on a resource of local value. In broad terms therefore, the significance of the effect can depend on both the impact magnitude and the sensitivity of the receptor.

10.10.2.8 The assessment of significance is based on the following scale and guidance:

- Substantial: adverse or beneficial. They represent key factors in the decision-making process with regard to consenting/licensing. These effects are generally, but not exclusively, associated with sites or features of international, national or regional importance that are likely to suffer the most damaging impact and loss of resource integrity;
- Major: These beneficial or adverse effects are considered to be very important considerations and are likely to be material considerations in the decision-making process;
- Moderate: These beneficial or adverse effects may be important but are not likely to be key decision-making factors. The cumulative impacts of such factors may influence decision making if they lead to an increase in the overall adverse effect on a particular resource or receptor;
- Minor: These beneficial or adverse effects may be raised as local factors. They are unlikely to be critical in the decision-making process, but are important in enhancing the subsequent design of the project; and
- Negligible: No effects or those that are beneath levels of perception, within normal bounds of variation or within the margin of forecasting error.

10.10.2.9 Effects may also be categorised as direct or indirect, secondary, short, medium or long term, or permanent or temporary as appropriate.

Table 10.15: Matrix used for the assessment of the significance of the effect.

Sensitivity of receptor	Magnitude of impact: No change	Negligible	Minor	Moderate	Major
Negligible	Negligible	Negligible	Negligible or minor	Negligible or minor	Minor
Low	Negligible	Negligible or minor	Negligible or minor	Minor	Minor or moderate
Medium	Negligible	Negligible or minor	Minor	Moderate	Moderate or major
High	Negligible	Minor	Minor or moderate	Moderate or major	Major or substantial
Very high	Negligible	Minor	Moderate or major	Major or substantial	Substantial

10.10.3 Designated sites

10.10.3.1 Where SPAs are considered, this chapter summarises the assessments made on the interest features of internationally designated sites as described within section 10.6.10 of this chapter (with the assessment on the site itself deferred to the Report to Inform Appropriate Assessment (RIAA) for the META project).

10.10.3.2 Where SPA qualifying species are also interest features of under-lying SSSIs, only the international site has been taken forward for assessment. This is because potential effects on the integrity and conservation status of the nationally designated site are assumed to be inherent within the assessment of the internationally designated site (i.e. a separate assessment for the national site is not undertaken). However, where a nationally designated site falls outside the boundaries of an international site or supports features that are not qualifying features of the SPA and are located within the desk study search area, an assessment of the impacts on the SSSI is made in this chapter using the EIA methodology.

10.10.3.3 Although the META project is not an NSIP project the RIAA has been prepared in accordance with Advice Note Ten: Habitats Regulations Assessment Relevant to Nationally Significant Infrastructure Projects (PINS, 2016) and will be submitted to support the META Licence/Consent applications.

10.11 Measures adopted as part of the META project

10.11.1.1 As part of the project design process, a number of designed-in measures have been proposed to reduce the potential for impacts on marine ornithology (see Table 10.16). As there is a commitment to implementing these measures, they are considered inherently part of the design of the META project and have therefore been considered in the assessment presented in section 10.12 below (i.e. the determination of magnitude and therefore significance assumes implementation of these measures). These measures are considered standard industry practice for this type of development.

Table 10.16: Designed-in measures adopted as part of the META project.

Measures adopted as part of the META project	Justification
An Environmental Management Plan (EMP) will be produced and followed. The EMP will cover the installation, operation and maintenance, and decommissioning phases of the META project and will include planning for accidental spills, address all potential contaminant releases and include key emergency contact details and process to follow in the event of accidental spill.	Measures will be adopted to ensure that the potential for release of pollutants from installation, operation and maintenance, and decommissioning is minimised. In this manner, accidental release of contaminants from vessels will be strictly controlled, thus providing protection for marine life across all phases of the project development.

10.12 Assessment of significance

10.12.1 Scope of assessment

10.12.1.1 Each of the VERs identified for inclusion in the assessment are assessed in more detail below, along with the ecology of the species and potential pathways of impact from the META project. The species' conservation status and relevant legislation are also provided.

10.12.1.2 The SPAs within foraging range for which each species is a qualifying interest feature are also indicated, as well as those SSSIs within 10 km of the site where species are listed in the citation. The connectivity of SPA birds and those using the META project area is examined in more detail in the RIAA as outlined above in paragraph 10.10.3.

10.12.1.3 For the purposes of the assessment some species have been grouped into VERs based upon their feeding ecology and subsequent similarities in potential impact pathways. For example, divers, dabbling ducks and waders. In addition, the assessment of potential impacts during installation, operation and maintenance and decommissioning phases of the META project, have been assessed together as no significant differences between project stages have been identified.

10.12.1.4 For a full breakdown of the assessment of effects on the receptors identified see Table 10.17.

Collision with development

10.12.1.5 In the absence of successful avoidance, birds may collide with the development potentially resulting in reduced survival or reproductive success.

Atlantic Puffin VER

Magnitude of impact

10.12.1.6 The species is a pursuit-diver, catching most of its prey within 30 m of the water surface ‘’and 10 km of their colony (See section 10.7.2). However, likelihood of collision with marine energy device testing associated with the installation, operation and maintenance or decommissioning phases of the META project is considered unlikely due to the Project's small and localised scale, its limited spatial extent and the very small densities of puffin recorded at the closest point to the META project (0.5 animals per three km^2 (Table 10.8)). If a pre-cautionary population increase of 139.5% (based on estimated puffin population trends since ESAS for Skomer and Skokholm colony, **Table 10.10**) is applied to this density, this baseline density increases to 1.2 animals per three km^2. The potential for impact is considered to be of long-term duration, intermittent and irreversible. It is predicted that the potential impact may affect Atlantic puffin directly. The magnitude is therefore considered to be negligible (adverse).

Sensitivity

10.12.1.7 As puffin are a listed feature of Skomer, Skokholm and the seas off Pembrokeshire SPA they are considered of international importance. Puffin are a long lived, low breeding productivity species currently facing a variety of pressures due to climate change and overfishing. Populations in Wales have generally shown an increasing population trend with a 161% increase between 1969 and 1985. Through an analysis of recent population trends since the collation of ESAS data, puffin populations at the Skomer and Skokholm colony are estimated to have increased significantly. Recent counts on Skomer have also recorded over 30,000 individuals (2018 count), a large increase on the 11,497 recorded in 2012 (JNCC, 2016). This increasing population trend will likely increase the capacity of the species to adapt to environmental change. As such they are thus considered of high sensitivity.

Significance

10.12.1.8 The sensitivity of the receptor is considered to be high and the magnitude of the impact is deemed to be negligible (adverse). The effect will, therefore, be of **minor (adverse)** significance, which is not significant in EIA terms.

Guillemot VER

Magnitude of impact

10.12.1.9 Common guillemot primarily forage through pursuit diving, with birds generally diving from the surface, typically to depths of less than 50 m, but up to 200 m on occasions (BirdLife International, 2011), largely within 10 km of their colonies (See section 10.7.2).

10.12.1.10 Guillemots fly low and have a low flight manoeuvrability (King *et al*., 2009), and so are at risk of collision with above surface structures. When feeding they spend a high proportion of time under water and have a fast rate of ascent, meaning they have a high risk of below surface collision. Since they are very capable of prey switching, they may be less at risk from the negative effects of displacement, provided equivalent feeding opportunities are available close to the breeding colony. They are moderately affected by disturbance form helicopter and boat traffic (Garthe and Hüppop, 2004). Spending a relatively high proportion of time on the water surface, they will be at risk of contamination by oil-based pollutants (McCluskie *et al.,* 2012).

10.12.1.11 The potential for impact through collision is considered to be of long-term duration, intermittent and irreversible. It is predicted that the potential impact may affect guillemot directly. However, the likelihood of collision with the marine energy device testing or increasing movement of vessels associated with the installation, operation and maintenance or decommissioning phases of the META project is considered unlikely due to the Project's small scale and localised nature, it's limited spatial extent and the very small densities of guillemot recorded at the closest point to the META project (maximum 0.5 animals per three km^2 (Table 10.8)). If a precautionary population decrease of -3.65% (based on estimated population trends for guillemot populations in Wales since ESAS, **Table 10.10**) is applied to this density, this baseline density decreases to 0.48 animals per three km^2. The magnitude is therefore considered to be negligible (adverse).

Sensitivity

10.12.1.12 As guillemot are a qualifying species of Skomer, Skokholm and the seas off Pembrokeshire SPA they are considered of international importance. Guillemot are long lived, low breeding productivity species currently facing a variety of pressures due to climate change and overfishing. Based on a comparison of 5-year average of count data of Welsh colonies from SMP database (55843.6 ±4471.4) to the Seabird 2000 Wales guillemot population, there has been a -3.65% population decline (**Table 10.10**). However, in recent decades guillemot numbers have been increasing at an almost constant rate of 5% at the Skomer colony. This population increase will increase their resilience to environmental change. As such they are considered of high sensitivity.

Significance

10.12.1.13 The sensitivity of the receptor is considered to be high and the magnitude of the impact is deemed to be negligible (adverse). The effect will, therefore, be of **minor (adverse)** significance, which is not significant in EIA terms.

Razorbill VER

Magnitude of impact

10.12.1.14 With little flight manoeuvrability and low flight height (Garthe and Hüppop, 2004), razorbills will be at higher risk of above surface collisions. Their dives are relatively short and shallow, so they will be less at risk of below surface collisions. They are considered moderately susceptible to disturbance to boat traffic. They spend much time on the surface from which they dive to obtain prey (McCluskie *et al.,* 2012).

10.12.1.15 The likelihood of collision with the marine energy device testing associated with the installation, operation and maintenance or decommissioning phases of the META project is considered unlikely due to the Project's small scale and localised nature, it's limited spatial extent, and the very small densities of razorbill recorded at the closest point to the META project (2.8 animals per 3 km^2 (Table 10.8)). If a precautionary population increase of 64% (based on estimated population trends for razorbill populations in Wales since ESAS, **Table 10.10**) is applied to this density, this baseline density increases to 4.6 animals per three km^2. The potential for impact is considered to be of long-term duration, intermittent and irreversible. It is predicted that the potential impact may affect razorbill directly. The magnitude is therefore considered to be negligible (adverse).

Sensitivity

10.12.1.16 As razorbill are a qualifying species of Skomer, Skokholm and the seas off Pembrokeshire SPA, they are considered of international importance. Razorbill are a long lived, low breeding productivity species currently facing a variety of pressures due to climate change and overfishing. The trend in abundance for razorbills at Welsh colonies has generally been upward since 1986, with a new peak reached in 2015. Although around only one-quarter of Welsh razorbill colonies were surveyed in 2015 (28), numbers totalled 20,831 individuals, 64% more than was recorded in the whole country during Seabird 2000. However, productivity has a sharply declining trend in recent years and the reasons for this are unknown. This will likely compromise their capacity to adapt to change. As such they are considered of very high sensitivity.

Significance

10.12.1.17 The sensitivity of the receptor is considered to be very high and the magnitude of the impact is deemed to be negligible (adverse). The effect will, therefore, be of **minor (adverse)** significance, which is not significant in EIA terms.

Gannet VER

Magnitude of impact

10.12.1.18 Gannets are an opportunistic, generalist, predator that feed on a wide variety of prey, mostly surface schooling fish and squid, but also discards from trawlers (BirdLife International, 2011).

10.12.1.19 Most gannet flight activity is at more than 10 m above the water surface (Thaxter *et al*., 2015; Bicknell *et al.,* 2016), and so they are less susceptible to above surface collisions with devices, or associated infrastructure. However, as they plunge dive at speed they are at greater risk of below surface collisions, and subsequent pursuit of prey puts them at risk of collision or entanglement. As regular discard feeders they are not readily disturbed by shipping traffic (McCluskie *et al.,* 2012).

10.12.1.20 Due to the higher flight level initiated by gannets, the risk of collision is considered extremely unlikely. The likelihood of collision with the marine energy device testing is considered unlikely and of local spatial extent. There is predicted to be a low likelihood of birds occurring within the vicinity of the project (maximum density of gannet recorded at the closest point to the META project is six animals per 3 km^2 (Table 10.8). If a pre-cautionary population increase of 21% (based on estimated population trends for gannet populations in Wales from the 2013/2014 Gannet Census, **Table 10.10**) is applied to this density, this baseline density increases to 7.3 animals per three km^2. It is predicted that the potential impact may affect gannet directly. The potential impact is considered to be of long-term duration, intermittent and irreversible The magnitude is therefore considered to be negligible (adverse).

Sensitivity

10.12.1.21 As gannet are a qualifying species of Grassholm SPA, located approximately 22 km from the META project they are considered of international importance. Gannet are a long lived, low breeding productivity species found in a few colonies of large numbers around the Northern Atlantic. They are currently facing a variety of pressures largely due to climate change, fisheries bycatch and overfishing which may compromise their resilience to environmental change. This is buffered by a relatively large global population with an increasing population trend in Wales, with the most recent Gannet Census survey (2013-2014) reporting 36,011 apparently occupied sites (http://jncc.defra.gov.uk/page-3201#species). The population trend is also increasing globally, and the species is identified as Least Concern by IUCN (BirdLife International, 2019). As such this species is considered of high sensitivity.

Significance

10.12.1.22 The sensitivity of the receptor is considered to be high and the magnitude of the impact is deemed to be negligible (adverse). The effect will, therefore, be of **minor (adverse)** significance, which is not significant in EIA terms.

Kittiwake VER

Magnitude of impact

10.12.1.23 Kittiwake are pelagic surface feeders feeding in the upper couple of metres of the water column. Due to their low-level flights, kittiwakes are likely to be at moderate risk of surface device collisions. Sub surface collisions and entrapment are less likely as they are visual surface feeders. They are also tolerant of human disturbance, so unlikely to be affected by construction and maintenance activities (McCluskie *et al.,* 2012).

10.12.1.24 The likelihood of collision with the marine energy device testing is considered unlikely due to the Project's small scale and localised nature, it's limited spatial extent, and the very small densities of kittiwake recorded at the closest point to the META project (0.08 animals per 3 km^2 (Table 10.8)). If a precautionary population decrease of -44% (based on estimated population trends for gannet populations in Wales since ESAS, **Table 10.10**) is applied to this density, this baseline density decreases to 0.04 animals per three km^2. The potential for impact is considered to be of long-term duration, intermittent and irreversible. It is predicted that the potential impact may affect kittiwake directly. The magnitude is therefore considered to be negligible (adverse).

Sensitivity

10.12.1.25 As kittiwake are a qualifying species of Skomer, Skokholm and the seas off Pembrokeshire SPA they are considered of international importance. Kittiwake are a long lived, low breeding productivity species found across the Northern Atlantic. They are currently facing a variety of pressures largely due to climate change pollution, bycatch and overfishing which may compromise their resilience to environmental change. The population trend is also decreasing in Wales with regular low productivity also recorded in recent years (http://jncc.defra.gov.uk/page-3201#species). In 2015, surveys estimated 4,353 apparently occupied nests, 44% fewer than observed during the Seabird 2000 programme. The species is also identified as vulnerable by IUCN (BirdLife International, 2019). As such this species is considered of very high sensitivity.

Significance

10.12.1.26 The sensitivity of the receptor is considered to be very high and the magnitude of the impact is deemed to be negligible (adverse). The effect will, therefore, be of **minor (adverse)** significance, which is not significant in EIA terms.

Shag VER

Magnitude of impact

10.12.1.27 Shags are foot propelled pursuit divers that feed on a variety of benthic, pelagic and demersal fish. Foraging often involves deep dives, dive depths may also vary significantly between years at the same site depending on prey availability (BirdLife International, 2011).

10.12.1.28 Shags typically fly low and have limited manoeuvrability so could be vulnerable to above surface collision. Their deep diving technique may also put them at risk of collision with below surface structures. Contamination by floating pollutants is considered less likely due to the amount of time they spend perched on rocks and haul out points (McCluskie *et al.,* 2012).

10.12.1.29 The likelihood of collision with the marine energy device testing at the META project is considered unlikely due to the Project's small scale and localised nature, it's limited spatial extent and the very small densities of shag recorded at the closest point to the META project (three animals per 3 km^2 (Table 10.8)). If a precautionary population decrease of -89.7% (based on 5-year average of count data of Welsh colonies from SMP database (94 ±0.95) since ESAS, **Table 10.10**) is applied to this density, this baseline density decreases to 0.3 animals per three km^2. The potential for impact is considered to be of long-term duration, intermittent and irreversible. It is predicted that the potential impact may affect shag directly. The magnitude is therefore considered to be negligible (adverse).

Sensitivity

10.12.1.30 Due to their Amber status, shags are considered to be of regional value in Wales (Johnstone and Bladwell, 2016). The species is highly dependent on herring and sand eel stocks and thus is subject to climate change and overfishing impacts which may restrict its resilience to environmental change. Welsh shag populations had been relatively stable until 2012, when the 'wreck' during the winter potentially had an effect on population numbers. The species is identified as Least Concern by IUCN (BirdLife International, 2019) due to a wide range and large population. As such it is considered of medium sensitivity.

Significance

10.12.1.31 The sensitivity of the receptor is considered to be medium and the magnitude of the impact is deemed to be negligible (adverse). The effect will, therefore, be of **negligible (adverse)** significance, which is not significant in EIA terms.

Cormorant VER

Magnitude of impact

10.12.1.32 At sea, the species feeds primarily upon bottom-living fish over bare or vegetated substrates (e.g. flatfish, blennies and gadoids), but will also take schooling fish (e.g. sandeels).

10.12.1.33 Cormorants are low flying, and with limited flight manoeuvrability (Garthe and Hüppop, 2004) and could be vulnerable to collision with any above surface structures. Their foraging strategy of close quarter prey detection will have competing influences on the risk of collision with underwater structures. They may be attracted to above surface structures to use as haul-out points. Because of their flexibility in foraging strategy and habitat, they will however be less susceptible to habitat loss through any development. Their sensitivity to disturbance is considered high (Garthe and Hüppop, 2004).

10.12.1.34 The likelihood of collision with the marine energy device testing is considered unlikely due to the Project's small scale and localised nature, it's limited spatial extent, and the very small densities of cormorant recorded at the closest point to the META project (two animals per 3 km^2 (Table 10.8)). If a precautionary population increase of between 16-41% (based on estimated population trends for cormorant populations at Puffin Island and Little Orme between 2010-2014, **Table 10.10**) is applied to this density, this baseline density increases to 2.3-2.8 animals per three km^2. The potential for impact is considered to be of long-term duration, intermittent and irreversible. It is predicted that the potential impact may affect cormorant directly. The magnitude is therefore considered to be negligible (adverse).

Sensitivity

10.12.1.35 They are considered of regional importance due to their Amber-listed status in Wales (Johnstone and Bladwell, 2016). This species is plastic in its diet and able to exploit a variety of resources and is not dependent on a single stock. Great cormorant abundance in Wales has remained fairly stable since 1969-70 with no discernible trend in productivity (http://jncc.defra.gov.uk/page-3201#species). Surveys conducted between 2010-2014 suggest possible population increases of between 16-44% at the largest two colonies of great cormorant in Wales, Puffin Island and Little Orme (JNCC, 2016). As such the species is considered fairly resilient to environmental change. The species is identified as Least Concern by IUCN (BirdLife International, 2019) due to a wide range and large population. As such it is considered of low sensitivity.

Significance

10.12.1.36 The sensitivity of the receptor is considered to be low and the magnitude of the impact is deemed to be negligible (adverse). The effect will, therefore, be of **negligible (adverse)** significance, which is not significant in EIA terms.

Diving Ducks VER

Magnitude of impact

10.12.1.37 Scaup are diving ducks feeding on shellfish, crustacea and small insects. Studies have found scaup to dive to depths of around 10 m when foraging (Winfield *et al.,* 1994). As such scaup will be at potential risk of collision with the development at Warrior Way (site 6). Due to the lack of suitable foraging habitat at East Pickard Bay and Dale Roads this impact is not considered at these locations.

10.12.1.38 Red-breasted merganser diet consists predominantly of small, shoaling marine or freshwater fish, as well as small amounts of plant material and aquatic invertebrates (del Hoyo *et al*., 1992). Their winter diet shows a preference for small shoaling fish, that they catch by diving from the surface and either pursuing prey or probing the substrate with their bill (McCluskie *et al.,* 2012). They are also considered to have a moderate manoeuvrability, and a low flight height. They are considered vulnerable to inflight collisions with above surface structures, since they fly close to the water at considerable speed. As pursuit divers, they will have a moderate vulnerability to below surface collision, which may be increased by turbidity. As such they may be at risk of collision with the development at Warrior Way (site 6), East Pickard Bay (site 8) and Dale Roads (site 7).

10.12.1.39 Common scoter aggregate during the winter in shallow inshore waters less than 20 m deep (optimally 5-15 m) with abundant benthic prey, these areas are generally between 500 m and c.2 km from the shore (BirdLife International, 2019). They are benthic foraging diving species diet whose winter diet consists predominantly of molluscs (del Hoyo *et al*., 1992) as such given the occurrence of mussels *Mytilus* spp. In mid-shore habitat at Warrior Way (See Benthic Ecology Chapter 7) there may be a risk of collision with the development at Warrior Way (site 6).

10.12.1.40 However, despite the viable pathways of interaction described above the likelihood of collision with the marine energy device testing is considered unlikely due to the Project's small scale, its local spatial extent, and the very small numbers of diving ducks (peak counts of one animal for each species (Table 10.8)). The potential for impact is considered to be of long-term duration, intermittent and irreversible. It is predicted that the potential impact may affect diving duck species directly. The magnitude is therefore considered to be negligible (adverse).

Sensitivity

10.12.1.41 Scaup have Amber-listed status in Wales (Johnstone and Bladwell, 2016). Incidental capture in commercial fisheries poses a major threat to this species which shows a relatively high vulnerability to bycatch and this may compromise its ability to cope with environmental change. The species does however have an extremely large range, and a large population size and is listed as Least Concern (BirdLife International, 2019).

10.12.1.42 Red-breasted merganser are amber-listed status in Wales (Johnstone and Bladwell, 2016). This species has an extremely large range and a stable global population trend (BirdLife International, 2019) although in Europe the population size is estimated to be decreasing at a rate approaching 30% in 21.9 years (three generations) (BirdLife International, 2015). The global population size and range is very large and for these reasons combined with a stable trend the species is evaluated as Least Concern by IUCN.

10.12.1.43 Red-breasted merganser are however subject to persecution and may be shot by anglers and fish-farmers who perceive it as a competitor and accuse it of depleting their fish stocks (del Hoyo *et al*., 1992). The level of impact from direct persecution is currently unknown. The species is also hunted in North America and Denmark whilst eggs are possibly still harvested in Iceland. It may also be threatened by accidental entanglement and drowning in fishing nets (BirdLife International, 2019). Alterations to its breeding habitats by dam construction and deforestation, and habitat degradation from water pollution could represent threats (del Hoyo *et al*., 1992).

10.12.1.44 Common scoter are at particular risk of impact through oil spill and chronic oil pollution as large and highly vulnerable concentrations of the population occur. Development can also cause low-level impacts through human disturbance and the degradation of food resources (BirdLife International, 2019). The 1996 Sea Empress oil spill in Carmarthen Bay resulted in a rapid and drastic reduction in common scoter numbers in the area, complete recovery occurred after three winters with no observable long-term effects (Banks *et al*., 2008).

10.12.1.45 The commercial exploitation of benthic shellfish poses an additional threat, through competition for food resources (BirdLife International, 2019). Interaction with wind farms could pose a potential threat to the species. While Stewart *et al*. (2007) showed that duck densities were more adversely affected by wind farms than other groups of species, Dürr (2013) found the opposite, stating that collision rates between ducks and wind turbines are low compared to other species groups.

10.12.1.46 In light of the above diving ducks are considered of medium sensitivity.

Significance

10.12.1.47 The sensitivity of the receptor is considered to be medium and the magnitude of the impact is deemed to be negligible (adverse). The effect will, therefore, be of **negligible (adverse)** significance, which is not significant in EIA terms.

Divers VER

Magnitude of impact

10.12.1.48 Garthe and Hüppop (2004) gave their highest vulnerability scores to red-and black-throated divers, based in part on their conservation status as an Annex 1 species, but also other key ecological factors. Their assessment of flight manoeuvrability was low, which is not as important for low surface structures as it is for wind turbines, the focus of their analysis. There remains, however, a collision threat with any above surface infrastructure of wave or tidal stream devices, magnified by the low flight altitude, nocturnal flight and poor flight manoeuvrability of divers. Beneath the surface, they are likely to have a lower collision risk than plunge divers, since they will have a controlled and highly targeted foraging dive. However, the subsequent active pursuit of prey potentially increases collision risk (McCluskie *et al.,* 2012).

10.12.1.49 Red-throated divers are also susceptible to disturbance by shipping traffic (Schwemmer *et al*., 2011), and construction, maintenance and repair vessels are particularly likely to cause displacement.

10.12.1.50 While there is a scarcity of direct data on great northern divers in the wintering period, it is known that they hunt visually, diving from the surface (McCluskie *et al.,* 2012). As such, they are likely to detect any object before the dive has commenced and therefore be at low risk of sub-surface collision, although there is a risk of entanglement during pursuit. Although not included in either Garthe and Hüppop's (2004) or King *et al.* (2009) sensitivity indices, it can be assumed that their flight behaviour will be similar to the two congeneric species, and so they could be at risk of above surface collisions, although this is considered unlikely given the recognised high avoidance rates for these species applied to onshore wind farm collision risk assessments (Furness, 2015). They will be vulnerable to disturbance.

10.12.1.51 The likelihood of collision with the marine energy device testing is considered unlikely due to the Project's small scale, localised nature, its limited spatial extent and the very small densities of divers recorded at the closest point to the META project (two great northern diver per 3 km^2, one red-throated diver per 3 km^2 (Table 10.8)). The potential for impact is considered to be of long-term duration, intermittent and irreversible. It is predicted that the potential impact may affect divers directly. The magnitude is therefore considered to be negligible (adverse).

Sensitivity

10.12.1.52 Divers are considered of regional importance due to their Amber-listed status in Wales (Johnstone and Bladwell, 2016). Divers have been identified as susceptible to climate change, overfishing and disturbance impacts (BirdLife International, 2019) and as such their resilience to environmental change may be compromised. However, they have an extremely large range and large population and hence are assessed as Least Concern (BirdLife International, 2019). As such they are therefore considered of medium sensitivity.

Significance

10.12.1.53 The sensitivity of the receptor is considered to be medium and the magnitude of the impact is deemed to be negligible (adverse). The effect will, therefore, be of **negligible (adverse)** significance, which is not significant in EIA terms.

Disturbance and displacement

10.12.1.54 In the event of increased disturbance, birds may be displaced from breeding, foraging or resting habitat resulting in reduced survival or reproductive success.

Non-diving Ducks VER

Magnitude of impact

10.12.1.55 The majority of duck species recorded within the search area are known as dabbling ducks due to their feeding ecology; primarily along the surface of the water or by tipping headfirst into the water to graze on aquatic plants, vegetation, larvae and insects. These species can be sensitive to visual disturbance at distances up to 500m (i.e.) from the source (Cutts *et al*., 2013). A study and review of wildfowl sensitivity to construction by Cutts *et al*., (2009) also details disturbance associated with construction activities; it concludes that wildfowl generally become habituated to steady noise from construction between 55 dB and 85 dB Generally only activities over 85 dB elicited a behavioural response, although it was observed that any birds displaced by the activity (foraging and loafing) would generally move a small distance (200m) away before resuming their normal behaviour.

10.12.1.56 Due to the lack of suitable habitat in proximity to the Dale Roads (site 7) and East Pickard Bay (site 8) META sites, no viable pathway of interaction exists at these sites and they have been scoped out from the assessment. However, given the presence of suitable habitat (intertidal mud and saltmarsh - see Chapter 7 benthic) at Warrior Way (site 6) and the presence of duck species in this area (shelduck, teal and wigeon), a viable pathway of interaction and disturbance impact is possible at Warrior Way (site 6) through either visual stimuli or noise disturbance. These impact pathways are assessed together below.

10.12.1.57 The likelihood of disturbance or displacement due to the increasing movement of vessels associated with the installation, operation and maintenance or decommissioning phases of the META project at Warrior Way (site 6) is considered unlikely as although the development is located in close proximity to desk study occurrence records (e.g. notable numbers of wigeon present at Cosheston Pill) the steep-side cliffs at Warrior Way (site 6) effectively screen the intertidal habitats at Cosheston Pill from the development. The potential for impact is considered to be of long-term duration, intermittent and reversible. It is predicted that the potential impact may affect ducks directly. The magnitude is therefore considered to be negligible (adverse).

Sensitivity

10.12.1.58 Due to the Amber status of the duck species identified within the site they are considered to be of regional value. This species group generally have a large geographic range and global population size (BirdLife International 2019), they are however impacted by hunting and disturbance and these factors may affect the capacity for these species cope with environmental change. As such they are considered to be of medium sensitivity.

Significance

10.12.1.59 The sensitivity of the receptor is considered to be medium and the magnitude of the impact is deemed to be negligible (adverse). The effect will, therefore, be of **negligible (adverse)** significance, which is not significant in EIA terms.

Diving Ducks VER

Magnitude of impact

10.12.1.60 Scaup are diving ducks feeding on shellfish, crustacea and small insects. Studies have found scaup to dive to depths of around 10 m when foraging (Winfield *et al.,* 1994). The species winters on shallow coastal waters in sheltered bays, estuaries and brackish coastal lagoons (del Hoyo *et al*., 1992). Based on habitat preferences, viable pathways of interaction between the project and scaup are only considered present for Warrior Way. This is consistent with desk study records from the marine ornithology study area with records noted in closest proximity to Warrior Way (3.8 km distance).

10.12.1.61 Red-breasted merganser diet consists predominantly of small, shoaling marine or freshwater fish, as well as small amounts of plant material and aquatic invertebrates (del Hoyo *et al*., 1992). They are pursuit diving species that usually dive in relatively shallow water, <10m, (Holm & Burger, 2002) and as such may be at risk of disturbance if present at Warrior Way (site 6). Experience from offshore wind farms has however shown that vessel traffic temporarily displaces mergansers but that operating turbines do not cause major disturbance and so it is probable that they will not be greatly susceptible to disturbance impacts (McCluskie *et al.,* 2012).

10.12.1.62 Common scoter aggregate during the winter in shallow inshore waters less than 20 m deep (optimally 5-15 m) with abundant benthic prey, these areas are generally between 500 m and c.2 km from the shore (BirdLife International, 2019). They are benthic foraging diving species diet whose winter diet consists predominantly of molluscs (del Hoyo *et al*., 1992) as such given the occurrence of mussels *Mytilus* spp in mid-shore habitat at Warrior Way (See Benthic Ecology Chapter 7) there may be a risk of disturbance if present at Warrior Way (site 6).

10.12.1.63 Diving ducks may be sensitive to disturbance at Warrior Way (site 6) due to availability of suitable habitat at this site. Due to the lack of suitable habitat for scaup and common scoter at East Pickard Bay (site 8) and Dale Roads (site 7) this impact is not considered for these META sites. However, suitable habitats for red-breasted merganser may be present at East Pickard Bay (site 8) and Dale Roads (site 7) and as such impacts through disturbance are also considered for these sites on this receptor only.

10.12.1.64 The likelihood of disturbance/displacement with vessel movement at Warrior Way (site 6) during the installation, operation and maintenance or decommissioning phases of the META project is considered probable due to the Project's proximity to suitable habitat. However due to the Project's small scale, its limited spatial extent and the very small numbers of diving ducks recorded at the closest point to the META project (one animal Table 10.8), the potential for impact is considered to be of long-term duration, intermittent and irreversible. It is predicted that the potential impact may affect diving ducks directly. The magnitude is therefore considered to be negligible (adverse).

Sensitivity

10.12.1.65 Scaup have Amber-listed status in Wales (Johnstone and Bladwell, 2016). Incidental capture in commercial fisheries poses a major threat to this species which shows a relatively high vulnerability to bycatch and interaction with fisheries is thought common, direct persecution is also known but is considered unlikely to be currently affecting populations (BirdLife International, 2019). Scaup have been assessed as Least Concern based on their large geographic range and population size (BirdLife International, 2019).

10.12.1.66 Red-breasted merganser are amber-listed status in Wales (Johnstone and Bladwell, 2016). This species has an extremely large range and a stable global population trend (BirdLife International, 2019) although in Europe the population size is estimated to be decreasing at a rate approaching 30% in 21.9 years (three generations) (BirdLife International, 2015). The global population size and range is very large and for these reasons combined with a stable trend the species is evaluated as Least Concern by IUCN.

10.12.1.67 Red-breasted merganser are however subject to persecution and may be shot by anglers and fish-farmers who perceive it as a competitor and accuse it of depleting their fish stocks (del Hoyo *et al*., 1992). The level of impact from direct persecution is currently unknown. The species is also hunted in North America and Denmark whilst eggs are possibly still, harvested in Iceland. It may also be threatened by accidental entanglement and drowning in fishing nets (BirdLife International, 2019). Alterations to its breeding habitats by dam construction and deforestation, and habitat degradation from water pollution could represent threats (del Hoyo *et al*., 1992).

10.12.1.68 Common scoter are at particular risk of impact through oil spill and chronic oil pollution as large and highly vulnerable concentrations of the population occur. Development can also cause low-level impacts through human disturbance and the degradation of food resources (BirdLife International, 2019). The 1996 Sea Empress oil spill in Carmarthen Bay resulted in a rapid and drastic reduction in Common Scoter numbers in the area, complete recovery occurred after three winters with no observable long-term effects (Banks *et al*., 2008).

10.12.1.69 The commercial exploitation of benthic shellfish poses an additional threat, through competition for food resources (BirdLife International, 2019). Interaction with wind farms could pose a potential threat to the species. While Stewart *et al*., (2007) showed that duck densities were more adversely affected by wind farms than other groups of species, Dürr (2013) found the opposite, stating that collision rates between ducks and wind turbines are low compared to other species groups

10.12.1.70 In light of the above diving ducks are considered are of medium sensitivity.

Significance

10.12.1.71 The sensitivity of the receptor is considered to be medium and the magnitude of the impact is deemed to be negligible (adverse). The effect will, therefore, be of negligible significance, which is not significant in EIA terms.

Waders VER

Magnitude of impact

10.12.1.72 Due to the proximity of the META project Warrior Way site (site 6) to intertidal habitats there is a viable potential pathway of interaction with wading birds (Waders VER) though disturbance pathways. It is likely that the increased disturbance associated with deployment and retrieval will temporarily impact those wading bird species present and displace some birds from the area. It has been demonstrated through academic research that increased disturbance can impact wintering waders through a reduced intake rate of feeding and flushing (a bird or flock of birds that has been frightened from cover), resulting in energetic costs and stress (Liley *et al*., 2010). Due to the lack of suitable habitat at East Pickard Bay (site 8) and Dale Roads (site 7) this impact pathway is not considered viable at these META sites.

10.12.1.73 At the Warrior Way site (site 6), the potential for disturbance at high tide is considered to be minor. This is due to the higher physiological stress that birds are likely to be under during the winter at high tide roosts and the restricted extents of alternative suitable habitat. Conversely at low tide the potential for disturbance is considered much lower (negligible) as suitable alternative habitat will likely be greater in extent. It is however likely that as the Warrior Way site (site 6) is located outside the mouth of Cosheston Pill it is quite likely that suitable habitat is substantially screened by the local topography.

10.12.1.74 The Cosheston Pill BTO/ MHWESG count site is located to the east of Warrior Way (site 6) and supports significant numbers of over-wintering redshank and curlew. Average mid-winter counts for these species for the years since 2010, taken from Haycock (2016), were as follows respectively, 23.35 (redshank) and 13.23 (curlew).

10.12.1.75 The likelihood of disturbance or displacement due to the increasing movement of vessels associated with the installation, operation and maintenance or decommissioning phases of the META project is considered possible due to the Project's proximity to suitable habitat, and of local spatial extent. The potential for impact is considered to be of long-term duration, intermittent and reversible. It is predicted that the potential impact may affect waders directly. Due to the small number of birds potentially affected in a trivial extent of the estuary and the intermittent nature of potential disturbance stimuli the magnitude is therefore considered to be negligible (adverse).

Sensitivity

10.12.1.76 Given a number of waders recorded within proximity to the Warrior Way (site 6) site were present in nationally important numbers, the birds at this site are considered of national importance and therefore of high sensitivity.

Significance

10.12.1.77 The sensitivity of the receptor is considered to be high and the magnitude of the impact is deemed to be negligible (adverse). The effect will, therefore, be of minor (adverse) significance, which is not significant in EIA terms

Accidental Pollution

10.12.1.78 In the event of accidental pollution, birds may be directly impacted through interaction with pollutants. Such interaction can cause reduced survival or reproductive success through hypothermia, hyperthermia, or direct ingestion and resultant damage to internal organs.

Atlantic Puffin VER

Magnitude of impact

10.12.1.79 The species is a pursuit-diver often sitting and repeatedly diving from the surface. It also forms large rafts around colonies at some times of the year (See section 10.7.2). As such, there is a potential pathway of interaction with any accidental pollution in the marine environment. However, as the development will result in a negligible increase above baseline of vessel movements and the devices will use EU/Internationally approved marine environment suitable anti-foulants or lubricants, no significant increase in marine pollution events is envisaged. This coupled with the lack of puffin records at the development site locations and the very small densities of puffin recorded at the closest point to the META project (0.5 animals per three km^2 (Table 10.7)). If a precautionary population increase of 139.5% (based on estimated puffin population trends since ESAS for Skomer and Skokholm colony, **Table 10.10**) is applied to this density, this baseline density increases to 1.2 animals per three km^2.The potential for impact is considered to be of long-term duration, intermittent and irreversible. It is predicted that the potential impact may affect Atlantic puffin directly.

10.12.1.80 A Marine Pollution Contingency Plan (MPCP) will be developed and agreed with stakeholders prior to development. This will be implemented during all phases of the development and will further reduce the potential for occurrence of this impact.

10.12.1.81 In light of the above the magnitude is therefore considered to be negligible (adverse).

Sensitivity

10.12.1.82 As puffin are a listed feature of Skomer, Skokholm and the seas off Pembrokeshire SPA they are considered of international importance. Puffin are long lived low breeding productivity species currently facing a variety of pressures due to climate change and overfishing. Populations in Wales have generally shown an increasing population trend with a 161% increase between 1969 and 1985. Through an analysis of recent population trends since the collation of ESAS data, puffin populations at the Skomer and Skokholm colony are estimated to have increased significantly. Recent counts on Skomer have also recorded over 30,000 individuals (2018 count), a large increase on the 11,497 recorded in 2012 (JNCC, 2016, http://jncc.defra.gov.uk/page-3201#species). This increasing population trend will likely increase the capacity of the species to adapt to environmental change. As such they are considered of high sensitivity.

Significance

10.12.1.83 The sensitivity of the receptor is considered to be high and the magnitude of the impact is deemed to be negligible (adverse). The effect will, therefore, be of minor (adverse) significance, which is not significant in EIA terms.

Guillemot VER

Magnitude of impact

10.12.1.84 Common guillemot primarily forage through pursuit diving, with birds generally diving from the surface, typically to depths of less than 50 m, but up to 200 m on occasions (BirdLife International, 2011) largely within 10 km of their colonies (see section 10.7.2). When feeding they spend a high proportion of time under water and make multiple dives. This means they spend a relatively high proportion of time on the water surface and as such will be at risk of contamination by oil-based pollutants (McCluskie *et al.* ,2012).

10.12.1.85 The potential for impact through accidental pollution is considered to be of long-term duration, intermittent and irreversible. It is predicted that the potential impact may affect guillemot directly. However, the likelihood of impact is considered extremely unlikely as the development will result in a negligible increase above baseline of vessel movements and the devices will use EU/Internationally approved marine environment suitable anti-foulants or lubricants. Also, the lack of guillemot records from the META project sites and the very small densities of guillemot recorded at the closest point to the META project makes interaction unlikely (maximum 0.5 animals per three km^2 (Table 10.7)). If a precautionary population decrease of -3.65% (based on estimated population trends for guillemot populations in Wales since ESAS, **Table 10.10**) is applied to this density, this baseline density deceases to 1.2 animals per three km^2.

10.12.1.86 A MPCP will be developed and agreed with stakeholders prior to development. This will be implemented during all phases of the development and will further reduce the potential for occurrence of this impact. The magnitude is therefore considered to be negligible (adverse).

Sensitivity

10.12.1.87 As guillemot are a qualifying species of Skomer, Skokholm and the seas off Pembrokeshire SPA they are considered of international importance. Guillemot are long lived, low breeding productivity species currently facing a variety of pressures due to climate change and overfishing. Based on a comparison of 5-year average of count data of Welsh colonies from SMP database (55843.6 ±4471.4) to the Seabird 2000 Wales guillemot population, there has been a -3.65% population decline (**Table 10.10**). However, in recent decades guillemot numbers have been increasing at an almost constant rate of 5% at the Skomer colony (http://jncc.defra.gov.uk/page-3201#species). This population increase will increase their resilience to environmental change. As such they are considered of high sensitivity.

Significance

10.12.1.88 The sensitivity of the receptor is considered to be high and the magnitude of the impact is deemed to be negligible (adverse). The effect will, therefore, be of minor (adverse) significance, which is not significant in EIA terms.

Razorbill VER

Magnitude of impact

10.12.1.89 Razorbills primarily forage through pursuit diving, their dives are relatively short and shallow. They spend much of their time on the surface, from which they dive to obtain prey, and as such are vulnerable to contamination by oil-based pollutants (McCluskie *et al.,* 2012).

10.12.1.90 The potential for impact through accidental pollution is considered to be of long-term duration, intermittent and irreversible. It is predicted that the potential impact may affect razorbill directly. However, the likelihood of impact is considered extremely unlikely as the development will result in a negligible increase above baseline of vessel movements and the devices will use EU/Internationally approved marine environment suitable anti-foulants or lubricants. Also, the lack of guillemot records from the META project sites and the very small densities of razorbiill recorded at the closest point to the META project makes interaction unlikely (maximum 0.2 animals per three km^2 (Table 10.7)). If a precautionary population increase of 64% (based on estimated population trends for razorbill populations in Wales since ESAS, **Table 10.10**) is applied to this density, this baseline density increases to 0.3 animals per three km^2.

10.12.1.91 A MPCP will be developed and agreed with stakeholders prior to development. This will be implemented during all phases of the development and will further reduce the potential for occurrence of this impact. The magnitude is therefore considered to be negligible (adverse).

Sensitivity

10.12.1.92 As razorbill are a qualifying species of Skomer, Skokholm and the seas off Pembrokeshire SPA, they are considered of international importance. Razorbill are a long lived, low breeding productivity species currently facing a variety of pressures due to climate change and overfishing. The trend in abundance for razorbills at Welsh colonies has generally been upward since 1986, with a new peak reached in 2015. Although around only one-quarter of Welsh razorbill colonies were surveyed in 2015 (28), numbers totalled 20,831 individuals, 64% more than was recorded in the whole country during Seabird 2000. However, productivity has a sharply declining trend in recent years and the reasons for this are unknown. This will likely compromise their capacity to adapt to change. As such they are considered of very high sensitivity.

Significance

10.12.1.93 The sensitivity of the receptor is considered to be very high and the magnitude of the impact is deemed to be negligible (adverse). The effect will, therefore, be of **minor (adverse)** significance, which is not significant in EIA terms.

Gannet VER

Magnitude of impact

10.12.1.94 Gannets are an opportunistic, generalist, predator that feed on a wide variety of prey, mostly surface schooling fish and squid, but also discards from trawlers (BirdLife International, 2011). They tend to forage diurnally, but spend some nocturnal periods at sea, presumably loafing on the water and also spend time loafing in close proximity to the colony (McSorley *et al*., 2003; Mcluskie *et al.,* 2012). As such there is a viable potential pathway of interaction with accidental pollution.

10.12.1.95 However, as gannet spend little time on the water away from the colony and given the geographic separation of the development sites from the Grassholm colony coupled with the low likelihood of birds occurring within the vicinity of the project (maximum density of gannet recorded at the closest point to the META project is six animals per 3 km^2 (Table 10.7)), an impact is considered extremely unlikely. If a precautionary population increase of 21% (based on estimated population trends for gannet populations in Wales from the 2013/2014 Gannet Census, **Table 10.10**) is applied to this density, this baseline density increases to 7.3 animals per three km^2. The potential for impact is considered to be of long-term duration, intermittent and irreversible with local spatial extent. It is predicted that the potential impact may affect gannet directly.

10.12.1.96 A MPCP will be developed and agreed with stakeholders prior to development. This will be implemented during all phases of the development and will further reduce the potential for occurrence of this impact. The magnitude is therefore considered to be negligible (adverse).

Sensitivity

10.12.1.97 As gannet are a qualifying species of Grassholm SPA, (22 km from the META project) they are considered of international importance. Gannet are long lived, low breeding productivity species found in a few colonies of large numbers around the Northern Atlantic. They are currently facing a variety of pressures largely due to climate change, fisheries bycatch and overfishing which may compromise their resilience to environmental change. This is buffered by a relatively large global population with an increasing population trend in Wales, with the most recent Gannet Census survey (2013-2014) reporting 36,011 apparently occupied sites (http://jncc.defra.gov.uk/page-3201#species).The population trend is also increasing globally, and the species is identified as Least Concern by IUCN (BirdLife International, 2019). As such this species is considered of high sensitivity.

Significance

10.12.1.98 The sensitivity of the receptor is considered to be high and the magnitude of the impact is deemed to be negligible (adverse). The effect will, therefore, be of minor (adverse) significance, which is not significant in EIA terms

Shag VER

Magnitude of impact

10.12.1.99 Shags are foot propelled pursuit divers that feed on a variety of benthic, pelagic and demersal fish. Foraging often involves deep dives, dive depths may also vary significantly between years at the same site depending on prey availability (BirdLife International, 2011). Contamination by floating pollutants is considered less likely due to the amount of time they spend perched on rocks and haul out points (McCluskie *et al.,* 2012). However, they will be attracted to above surface structures in order to use them as haul-out points and as such may be more likely to interact with any accidental pollution from marine structures.

10.12.1.100 The likelihood of interaction with accidental pollution associated with the installation, operation and maintenance or decommissioning phases of the META project is considered unlikely as a negligible increase above baseline of vessel movements is predicted and the devices deployed will use EU/Internationally approved marine environment suitable anti-foulants or lubricants. This coupled with the very small densities of shag recorded at the closest point to the META project (three animals per 3 km^2 (Table 10.7)) allow this conclusion. If a precautionary population decrease of -89.7% (based on 5-year average of count data of Welsh colonies from SMP database (94 ±0.95) since ESAS, **Table 10.10**) is applied to this density, this baseline density decreases to 0.3 animals per three km^2. The potential for impact is considered to be of long-term duration, intermittent and irreversible. It is predicted that the potential impact may affect shag directly.

10.12.1.101 A MPCP will be developed and agreed with stakeholders prior to development. This will be implemented during all phases of the development and will further reduce the potential for occurrence of this impact. The magnitude is therefore considered to be negligible (adverse).

Sensitivity

10.12.1.102 Due to their Amber status, shags are considered to be of regional value in Wales (Johnstone and Bladwell, 2016). The species is highly dependent on herring and sand eel stocks and thus is subject to climate change and overfishing impacts which may restrict its resilience to environmental change. The population trend in Wales was relatively stable until 2012 but has now fallen to its lowest point since 1993 (http://jncc.defra.gov.uk/page-3201#species). The species is however identified as Least Concern by IUCN (BirdLife International, 2019) due to a wide range and large population. As such it is considered of medium sensitivity.

Significance

10.12.1.103 The sensitivity of the receptor is considered to be medium and the magnitude of the impact is deemed to be negligible (adverse). The effect will, therefore, be of negligible (adverse) significance, which is not significant in EIA terms.

Cormorant VER

Magnitude of impact

10.12.1.104 At sea, the species feeds primarily upon bottom-living fish over bare or vegetated substrates (e.g. flatfish, blennies and gadoids), but will also take schooling fish (e.g. sandeels). They are attracted to above surface structures to use as haul-out points but spend a significant proportion of their time out of the water, making impact through pollution unlikely (Mcluskie *et al.,* 2012). However, a viable potential pathway of interaction exists.

10.12.1.105 The likelihood of impact through accidental pollution with the marine energy device testing is considered extremely unlikely as the project will result in a negligible increase above baseline of vessel movements and the devices deployed will use EU/Internationally approved marine environment suitable anti-foulants or lubricants, coupled with very small densities of cormorant recorded at the closest point to the META project (two animals per 3 km^2 (Table 10.7)). If a precautionary population increase of between 16-41% (based on estimated population trends for cormorant populations at Puffin Island and Little Orme between 2010-2014, **Table 10.10**) is applied to this density, this baseline density increases to 2.3-2.8 animals per three km^2. The potential for impact is considered to be of long-term duration, intermittent and irreversible. It is predicted that the potential impact may affect cormorant directly.

10.12.1.106 A MPCP will be developed and agreed with stakeholders prior to development. This will be implemented during all phases of the development and will further reduce the potential for occurrence of this impact. The magnitude is therefore considered to be negligible (adverse).

Sensitivity

10.12.1.107 They are considered of regional importance due to their Amber-listed status in Wales (Johnstone and Bladwell, 2016). This species is plastic in its diet and able to exploit a variety of resources and is not dependent on a single stock. Great cormorant abundance in Wales has remained fairly stable since 1969-70 with no discernible trend in productivity (http://jncc.defra.gov.uk/page-3201#species). Surveys conducted between 2010-2014 suggest possible population increases of between 16-44% at the largest two colonies of great cormorant in Wales, Puffin Island and Little Orme (JNCC, 2016). As such the species is considered fairly resilient to environmental change. The species is identified as Least Concern by IUCN (BirdLife International, 2019) due to a wide range and large population. As such it is considered of low sensitivity.

Significance

10.12.1.108 The sensitivity of the receptor is considered to be low and the magnitude of the impact is deemed to be negligible (adverse). The effect will, therefore, be of negligible (adverse) significance, which is not significant in EIA terms.

Non-diving Ducks VER

Magnitude of impact

10.12.1.109 The majority of duck species recorded within the search area are known as dabbling ducks due to their feeding ecology; primarily along the surface of the water or by tipping headfirst into the water to graze on aquatic plants, vegetation, larvae and insects. They spend the majority of their time on the water surface and as such will be susceptible to contamination by floating pollutants (Mcluskie *et al.,* 2012).

10.12.1.110 However, due to the lack of foraging suitable habitat in proximity to the Dale Roads (site 7) and East Pickard Bay (site 8) META sites for no viable pathway of interaction exists at these sites are and they have been scoped out from the assessment. However, given the presence of suitable habitat (intertidal mud and saltmarsh - see Chapter 7: Benthic) at Warrior Way (site 6) and the recorded presence of duck species in this area, a viable pathway of interaction exists, and impact is possible.

10.12.1.111 The likelihood of interaction with accidental pollution due to the installation, operation and maintenance or decommissioning phases of the META project at Warrior Way are considered possible due to the proximity of the development to suitable habitat and the presence of duck species of importance in this area (shelduck, teal and wigeon). However, as the project will result in a negligible increase above baseline of vessel movements (Appendix 12.1: Navigational Risk Assessment) and the devices deployed will use EU/Internationally approved marine environment suitable anti-foulants or lubricants any impact is considered unlikely. The potential for impact is considered to be of long-term duration, intermittent and irreversible with a local spatial extent. It is predicted that the potential impact may affect ducks directly.

10.12.1.112 A MPCP will be developed and agreed with stakeholders prior to development. This will be implemented during all phases of the development and will further reduce the potential for occurrence of this impact. The magnitude is therefore considered to be minor (adverse).

Sensitivity

10.12.1.113 Due to the Amber status of the duck species identified within the site they are considered to be of regional value. This species group generally have a large geographic range and global population size (BirdLife International, 2019), they are however impacted by hunting and disturbance and these factors may affect the capacity for these species cope with environmental change. As such they are considered to be of medium sensitivity.

Significance

10.12.1.114 The sensitivity of the receptor is considered to be medium and the magnitude of the impact is deemed to be minor (adverse). The effect will, therefore, be of minor (adverse) significance, which is not significant in EIA terms.

Diving Ducks VER

Magnitude of impact

10.12.1.115 Diving ducks such as scaup, red-breasted merganser, and common scoter spend the majority of their time on the water surface and as such will be susceptible to contamination by floating pollutants (Mcluskie *et al.,* 2012).

10.12.1.116 The likelihood of impact through accidental pollution associated with the META project is however considered unlikely due to a predicted negligible increase above baseline of vessel movements (Appendix 12.1: Navigational Risk Assessment) and the devices deployed will use EU/Internationally approved marine environment suitable anti-foulants or lubricants. Coupled with the very small numbers of diving ducks recorded in the marine ornithology study area (peak count of one animal (Table 10.7)). The potential for impact is considered to be of long-term duration, intermittent and irreversible. It is predicted that the potential impact may affect diving ducks directly.

10.12.1.117 A MPCP will be developed and agreed with stakeholders prior to development. This will be implemented during all phases of the development and will further reduce the potential for occurrence of this impact.

10.12.1.118 In light of the above the magnitude is therefore considered to be negligible (adverse).

Sensitivity

10.12.1.119 Scaup have Amber-listed status in Wales (Johnstone and Bladwell, 2016). Incidental capture in commercial fisheries poses a major threat to this species which shows a relatively high vulnerability to bycatch and this may compromise its ability to cope with environmental change. The species does however have an extremely large range, and a large population size and is listed as Least Concern (BirdLife International, 2019).

10.12.1.120 Red-breasted merganser are amber-listed status in Wales (Johnstone and Bladwell, 2016). This species has an extremely large range and a stable global population trend (BirdLife International, 2019) although in Europe the population size is estimated to be decreasing at a rate approaching 30% in 21.9 years (three generations) (BirdLife International, 2015). The global population size and range is very large and for these reasons combined with a stable trend the species is evaluated as Least Concern by IUCN.

10.12.1.121 Red-breasted merganser are however subject to persecution and may be shot by anglers and fish-farmers who perceive it as a competitor and accuse it of depleting their fish stocks (del Hoyo *et al*., 1992). The level of impact from direct persecution is currently unknown. The species is also hunted in North America and Denmark whilst eggs are possibly still, harvested in Iceland. It may also be threatened by accidental entanglement and drowning in fishing nets (BirdLife International, 2019). Alterations to its breeding habitats by dam construction and deforestation, and habitat degradation from water pollution could represent threats (del Hoyo *et al*., 1992).

10.12.1.122 Common scoter are at particular risk of impact through oil spill and chronic oil pollution as large and highly vulnerable concentrations of the population occur. Development can also cause low-level impacts through human disturbance and the degradation of food resources (BirdLife International, 2019). The 1996 Sea Empress oil spill in Carmarthen Bay resulted in a rapid and drastic reduction in common scoter numbers in the area, complete recovery occurred after three winters with no observable long-term effects (Banks *et al*., 2008).

10.12.1.123 The commercial exploitation of benthic shellfish poses an additional threat, through competition for food resources (BirdLife International, 2019). Interaction with wind farms could pose a potential threat to the species. While Stewart *et al*. (2007) showed that duck densities were more adversely affected by wind farms than other groups of species, Dürr (2013) found the opposite, stating that collision rates between ducks and wind turbines are low compared to other species groups

10.12.1.124 In light of the above diving ducks are considered are of medium sensitivity.

Significance

10.12.1.125 The sensitivity of the receptor is considered to be medium and the magnitude of the impact is deemed to be negligible (adverse). The effect will, therefore, be negligible (adverse) significance, which is not significant in EIA terms.

Divers VER

Magnitude of impact

10.12.1.126 Red-throated and great northern divers spend a high proportion of time on the water surface and as such are vulnerable to any contamination or pollution (Mcluskie *et al.,* 2012).

10.12.1.127 The likelihood of interaction with accidental pollution associated with the META project is considered unlikely given the predicted negligible increase above baseline of vessel movements (Appendix 12.1: Navigational Risk Assessment) and the fact that devices deployed will use EU/Internationally approved marine environment suitable anti-foulants or lubricants. This is supported by the very small densities of divers recorded (two great northern divers per 3 km^2, one red-throated diver per 3 km^2 (Table 10.7)). The potential for impact is considered to be of long-term duration, intermittent and irreversible. It is predicted that the potential impact may affect divers directly.

10.12.1.128 A MPCP will be developed and agreed with stakeholders prior to development. This will be implemented during all phases of the development and will further reduce the potential for occurrence of this impact.

10.12.1.129 In light of the above the magnitude is therefore considered to be negligible (adverse).

Sensitivity

10.12.1.130 Divers are considered of regional importance due to their Amber-listed status in Wales (Johnstone and Bladwell, 2016). Both species have been identified as susceptible to climate change, overfishing and disturbance impacts (BirdLife International, 2019) and their resilience to environmental change may be compromised. However, both diver species have an extremely large range and large population and hence are assessed as Least Concern (BirdLife International, 2019). As such they are therefore considered of medium sensitivity.

Significance

10.12.1.131 The sensitivity of the receptor is considered to be medium and the magnitude of the impact is deemed to be negligible (adverse). The effect will, therefore, be of negligible (adverse) significance, which is not significant in EIA terms.

Table 10.17: Summary table of impacts with regards to marine ornithological features

VER	Impact	Project phase impact likely to occur	Magnitude of Impact	Sensitivity of VER	Significance				Additional Measures	Residual effect	Proposed Monitoring
					Warrior Way	Dale Roads	East Pickard Bay	Overall			
Puffin	Collision with development	Operation and maintenance / installation & decommissioning	Negligible	High	Minor	Minor	Minor	Minor	Not required	Minor	No META project specific survey or monitoring has been identified following this assessment. However, following engagement with RSPB regarding the East Pickard Bay (site 8) test parameters it is proposed that where proposed devices for deployment at East Pickard Bay (site 8) are expected to approach the maximum dimensions scenario (i.e. 147 m x 230 m, or a size to be agreed with NRW), developers may be required to undertake ornithological surveys prior to deployment – see the META EMMP for further detail. Species, frequency and duration to be agreed in liaison with NRW Marine Advisory team on a case by case basis Furthermore, MEW will seek to work with industry, developers and regulators to agree and implement strategic monitoring should strategic priorities be identified as a research priority
	Accidental pollution	Operation and maintenance / installation & decommissioning	Negligible	High	Minor	Minor	Minor	Minor	EMMP best practice pollution prevention adopted	Negligible	
Guillemot	Collision with development	Operation and maintenance / installation & decommissioning	Negligible	High	Minor	Minor	Minor	Minor	Not required	Minor	
	Accidental pollution	Operation and maintenance / installation & decommissioning	Negligible	High	Minor	Minor	Minor	Minor	EMMP best practice pollution prevention adopted	Negligible	
Razorbill	Collision with development	Operation and maintenance / installation & decommissioning	Negligible	Very High	Minor	Minor	Minor	Minor	Not required	Minor	
	Accidental pollution	Operation and maintenance / installation & decommissioning	Negligible	Very High	Minor	Minor	Minor	Minor	EMMP best practice pollution prevention adopted	Negligible	
Gannet	Collision with development	Operation and maintenance / installation & decommissioning	Negligible	High	Minor	Minor	Minor	Minor	Not required	Minor	
	Accidental pollution	Operation and maintenance / installation & decommissioning	Negligible	High	Minor	Minor	Minor	Minor	EMMP best practice pollution prevention adopted	Negligible	
Kittiwake	Collision with development	Operation and maintenance / installation & decommissioning	Negligible	Very High	Minor	Minor	Minor	Minor	Not required	Minor	
Shag	Collision with development	Operation and maintenance / installation & decommissioning	Negligible	Medium	Negligible	Negligible	Negligible	Negligible	Not required	Negligible	
	Accidental pollution	Operation and maintenance / installation & decommissioning	Negligible	Medium	Negligible	Negligible	Negligible	Negligible	EMMP best practice pollution prevention adopted	Negligible	

VER	Impact	Project phase impact likely to occur	Magnitude of Impact	Sensitivity of VER	Significance				Additional Measures	Residual effect	Proposed Monitoring
					Warrior Way	Dale Roads	East Pickard Bay	Overall			
Cormorant	Collision with development	Operation and maintenance / installation & decommissioning	Negligible	Low	Negligible	Negligible	Negligible	Negligible	Not required	Negligible	
	Accidental pollution	Operation and maintenance / installation & decommissioning	Negligible	Low	Negligible	Negligible	Negligible	Negligible	EMMP best practice pollution prevention adopted	Negligible	
Divers	Collision with development	Operation and maintenance / installation & decommissioning	Negligible	Medium	Negligible	Negligible	Negligible	Negligible	Not required	Negligible	
	Accidental pollution	Operation and maintenance / installation & decommissioning	Negligible	Medium	Negligible	Negligible	Negligible	Negligible	EMMP best practice pollution prevention adopted	Negligible	
Diving ducks	Collision with development	Operation and maintenance / installation & decommissioning	Negligible	Medium	Negligible	Negligible	Negligible	Negligible	Not required	Negligible	
	Accidental pollution	Operation and maintenance / installation & decommissioning	Negligible	Medium	Negligible	Negligible	Negligible	Negligible	EMMP best practice pollution prevention adopted	Negligible	
Waders	Disturbance/displacement	Operation and maintenance / installation & decommissioning	Negligible	High	Minor	N/A	N/A	Minor (Warrior Way only)	Not required	Negligible/Minor (warrior way only)	
Non-diving Ducks	Disturbance/displacement	Operation and maintenance / installation & decommissioning	Negligible	Medium	Negligible	N/A	N/A	Negligible	Not required	Negligible	
	Accidental pollution	Operation and maintenance / installation & decommissioning	Minor	Medium	Minor	N/A	N/A	Minor (warrior way only)	EMMP best practice pollution prevention adopted	Negligible	

10.12.2 Mitigation and monitoring

10.12.2.1 As referenced within the CIEEM (2018) Guidelines for EcIA, adaptive mitigation and monitoring strategies (i.e. adaptive management) can be adopted to resolve uncertainties on impacts from developments on the marine environments. Adaptive management with appropriate monitoring and reactive management is considered appropriate in relation to this assessment.

10.12.2.2 Adaptive management is a decision process that promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. Careful monitoring of these outcomes both advances scientific understanding and helps adjust policies or operations as part of an iterative learning process. These adaptive solutions have also been referred to as 'deploy and monitor' techniques or as 'iterative implementation' processes (as used over recent years for the implementation of strategic marine plans in the UK).

Mitigation

10.12.2.3 For operational tidal devices at Warrior Way (site 6) there will be a minimum clearance of 2 m between blade tip and the surface of the water. This will mitigate any collision risk with diving birds such as little grebe.

10.12.2.4 Wave devices to be deployed at Dale Roads (site 7) and East Pickard Bay (site 8) will demonstrate in their design that the potential for bird or fish ingress to moving parts will be minimised through device design.

10.12.2.5 Due to the high/very high sensitivity of some VERs, mitigation measures have been identified in relation to the impact of exposure to pollutants and disturbance.

- All vessels associated with Project operations will comply with International Maritime Organisation (IMO) Maritime and Coastguard Agency (MCA) codes for prevention of oil pollution;
- All vessels associated with the META project operations will carry onboard oil and chemical spill mop up kits;
- Where possible vessels with a proven track record for operating in similar conditions will be employed; andVessel activities associated with installation, operation, routine maintenance and decommissioning will occur in suitable weather conditions to reduce risk of accidental spill/pollution.

Survey and Monitoring

10.12.2.6 Consultation with NRW and RSPB identified a potential interaction with the species little grebe at Warrior Way (site 6). Whilst existing evidence suggests that there is a very low likelihood of interaction due to minimal occurrence of little grebe in proximity to Warrior Way (site 6) in recent years, where test deployments at Warrior Way (site 6) are expected to occur outside the months of March to July (inclusive), prior to deployment of test devices user may be required to conduct two months of pre-deployment little grebe surveys (minimum of four observations) to corroborate this evidence. Furthermore, MEW will seek to work with industry, developers and regulators to agree and implement strategic monitoring should strategic priorities be identified as a research priority.

10.12.2.7 Consultation with NRW and RSPB also identified a potential concern over interaction of wave energy devices at East Pickard Bay (site 8) and marine birds. It has therefore been agreed that where proposed devices for deployment at East Pickard Bay (site 8) are expected to approach the maximum dimensions scenario (i.e. 147 m x 230 m, or a size to be agreed with NRW), developers may be required to undertake ornithological surveys prior to deployment – see the META EMMP for further detail. Details of survey and to be undertaken will be agreed with NRW on a case-by-case basis.

10.12.2.8 Consultation with NRW concluded that information provided in the revised baseline ornithology report is sufficient to provide a characterisation of the ornithological receptors in the META Project area and no pre-application baseline monitoring is required.

10.12.2.9 Further details of survey and monitoring requirements are detailed in the META EMMP.

10.13 Cumulative impact assessment methodology

10.13.1 Screening of other projects and plans into the Cumulative Impact Assessment

10.13.1.1 The Cumulative Impact Assessment (CIA) takes into account the impact associated with the META project together with other projects and plans. The projects and plans selected as relevant to the CIA presented within this chapter are based upon the results of a screening exercise. Each project has been considered on a case by case basis for scoping in or out of this chapter's assessment based upon data confidence, effect-receptor pathways and the spatial/temporal scales involved.

10.13.1.2 In undertaking the CIA for the META project, it is important to bear in mind that other projects and plans under consideration will have differing potential for proceeding to an operational stage and hence a differing potential to ultimately contribute to a cumulative impact alongside the META project. For example, relevant projects and plans that are already under installation are likely to contribute to cumulative impact with the META project (providing effect or spatial pathways exist), whereas projects and plans not yet approved or not yet submitted are less certain to contribute to such an impact, as some may not achieve approval or may not ultimately be built due to other factors.

10.13.1.3 Table 10.18 presents the projects that have been considered for inclusion in the META project CIA. Due to the only impact pathways found to have an above negligible significance to marine ornithology VERs being collision, disturbance and displacement and accidental pollution these impact pathways are those considered further. In addition, only those receptors where effects have been predicted at minor significance or above have been considered further in the CIA.

Table 10.18: List of other projects and plans considered within the CIA.

Phase	Developer - Reference	Distance from Warrior Way (site 6) (km)	Distance from Dale Roads (site 7) (km)	Distance from East Pickard Bay (site 8) (km)	Spatial/temporal overlap with the META project	Details	Date of Installation/ operation	Further Assessment required?	Taken further for assessment
Plans									
Draft National Welsh Marine Plan (dWNMP) (Welsh Government, 2017)	NRW	0.00	0.0	0.0	Spatial overlap and temporal overlap.	The WNMP is being prepared by the Welsh Government in accordance with the Marine and Coastal Access Act 2009 (MCAA). The purpose of marine planning under the MCAA is to help achieve sustainable development in the marine area. Welsh Ministers are the Marine Planning Authority under the MCAA, responsible for creating marine plans for both the inshore region (0 - 12 nautical miles) and offshore region (beyond 12 nautical miles) of Wales. Plans for both regions will be presented in a single document, the WNMP. The dWNMP applies to the Welsh marine area which consists of around 32,000 km^2 of sea, as well as 2,120 km of coastline.	The WNMP will be implemented over a 20-year period, with 3 yearly reviews.	Yes – Benthic Subtidal and Intertidal habitats, Coastal and supralittoral habitats, Marine Mammals, Diadromous fish, Pelagic seabirds (breeding and wintering); and Wildfowl and waders (breeding and wintering).)	As there is the potential for both temporal and spatial overlap of the META project with the dWNMP, it cannot be excluded from further consideration in the CIA. The dWNMP does not need to be considered further for Coastal Processes, Underwater Noise, commercial Fisheries, Shipping and Navigation, Marine Archaeology, Seascape and Landscape, Socio-economic and Tourism and Other Users as the plan does not cover these interests or they have been screened out on the basis that an assessment would be deferred to the project level, or an assessment was not possible at the policy level (Defence, Dredging and disposal, Energy – Oil and Gas, Fisheries, Subsea Cabling, Surface Water and Wastewater Treatment and Disposal, and Tourism and Recreation).
Dredging sites									
Installation/ operation and maintenance	Neyland Yacht Haven ltd. - DML1743	1.1	12.3	10.5	No spatial overlap with consented areas. Potential for temporal overlap.	Dredge and disposal from Neyland Marina - annual volume 5500 m^3.	13/12/2017-12/12/2020	Yes	Given the distances to META phase 2 sites and the potential for temporal overlap, these projects can not be excluded from further consideration in the CIA.
Installation/ operation and maintenance	Milford Haven Port Authority - DML1646	1.3	1.5	2.5	No spatial overlap with consented areas Temporal overlap with all sites.	Maintenance dredging throughout the Milford Haven. Annual volume 362500 m^3.	09/03/2017-08/03/2022	Yes	
Dredge disposal sites									
Installation/ operation and maintenance	Neyland dredge disposal site - LU190	0.5	12.4	10.5	No spatial overlap with any of the consented areas. Temporal overlap	Location: South of Neyland within the central channel of the Milford Haven, 0.22 nm diameter x 5 m depth. Status: Open	Not applicable	Yes	Given the distances to META phase 2 sites and the potential for temporal overlap, this project cannot be excluded from further consideration in the CIA.
Installation/ operation and maintenance	Milford Haven Two dredge disposal site - LU169	26.7	20	15	No spatial overlap with any of the consented areas. No temporal overlap.	Location: To the south of Milford Haven dredge disposal grounds, unknown diameter x 50 m depth. Status: Open	Not applicable	No	Dredge disposal site is located at its closest 15 km from the META project, it is therefore highly unlikely to have any impact overlap.
Installation/ operation and maintenance	Milford Haven Three dredge disposal site - LU169	48.9	36	34.7	No spatial overlap with any of the consented areas. No temporal overlap.	Location: To the west of Milford Haven dredge disposal grounds, 1 nm diameter x unknown depth. Status: Open	Not applicable	No	Dredge disposal site is located at its closest 34.7 km from the META project, it is therefore highly unlikely to have any impact overlap.

Phase	Developer - Reference	Distance from Warrior Way (site 6) (km)	Distance from Dale Roads (site 7) (km)	Distance from East Pickard Bay (site 8) (km)	Spatial/temporal overlap with the META project	Details	Date of Installation/ operation	Further Assessment required?	Taken further for assessment
Research									
Installation	Greenlink Interconnector Ltd. - RML1827	10.4	6	0	Spatial overlap with East Pickard Bay (site 8). Temporal overlap with East Pickard Bay.	Ground investigations	07-2018 - no end date given	Yes	Research operations are likely to have vessels present, with equipment for undertaking ground truthing surveys therefore this project cannot be excluded from further consideration in the CIA.
Installation	Swansea University - DEML1861	~4-5	~8-9	~6-7	Location is assumed to be by the Pembroke Power station. No spatial overlap with any of the consented areas. Temporal overlap.	Pembroke Power bubble barrier experiment Investigation into the effectiveness of bubble curtains in sediment management	Band 2 licence issued 12/12/2018 - three-year study	Yes	Given the distances to META phase 2 sites and the potential for temporal overlap, these projects cannot be excluded from further consideration in the CIA.
Installation	Swansea University - DEML1845	12.7	5.4	0	Spatial overlap with East Pickard Bay (site 8). Temporal overlap with East Pickard Bay.	Deposition and subsequent removal of marker buoys with environmental monitoring and mid-water settlement plates.	30/08/2018-29/08/2019	Yes	Vessels and equipment will be required for the placement of marker buoys. It is highly likely to have temporal or spatial overlap with META phase 2 activities, therefore this project cannot be excluded from further consideration in the CIA.
Infrastructure									
Installation/ operation and maintenance	Neyland Yacht Haven Ltd - CML1658	1.1	12.3	10.5	No spatial overlap with consented areas Temporal overlap with Warrior Way (site 6)	Pile replacement in Neyland Marina.	21/11/2016-20/11/2019	Yes	Pile replacement is currently ongoing until 2019, which does not overlap with the installation and operational phases of the META project. Operational phases of this project may overlap with operation and installation phases of META therefore this project cannot be excluded from further consideration in the CIA.
Installation/ operation and maintenance	Mixed use developments - Local Planning Authority Reference: 14/0158/PA	7.3	5.3	5.6	No spatial overlap with any consented areas. Temporal overlap remains unknown due to insufficient information on start and end dates.	Undetermined planning application. Demolition of several existing buildings and the mixed-use redevelopment of Milford Waterfront comprising up to 26,266 m^2 of commercial, hotel, leisure, retail and fishery related floorspace. Up to 190 residential properties, up to 70 additional marina berths, replacement boat yards, landscaping, public realm enhancements, access and ancillary works. A decision on this application is yet to be made by the local planning authority.	EIA screening decision was returned on the 30/04/2018 - no further information has been provided	Yes	Given the distance from the project and likely impact pathways, there is potential for cumulative impacts.
Installation/ operation and maintenance / decommissioning	Greenlink Interconnector Ltd. - Government reference: qA1296053	10.4	6	0	Spatial overlap with East Pickard Bay (site 8). Temporal overlap will occur throughout the duration of the META project	The Project is a 500MW subsea electricity interconnector linking the power markets in Ireland and Great Britain and is planned for commissioning in 2023. As an EU Project of Common Interest, it is one of Europe's most important energy infrastructure projects. The interconnector is planned to make Landfall at Fresh Water West beach to the south of the mouth of the Waterway.	07/2018 - ongoing	Yes	Given potential for temporal and spatial overlap with META phase 2 sites this project cannot be excluded from further consideration in the CIA.

Phase	Developer - Reference	Distance from Warrior Way (site 6) (km)	Distance from Dale Roads (site 7) (km)	Distance from East Pickard Bay (site 8) (km)	Spatial/temporal overlap with the META project	Details	Date of Installation/ operation	Further Assessment required?	Taken further for assessment
Installation/ operation and maintenance / decommissioning	Valereo - Welsh Government reference: qA1312073	-	-	-	No overlap with the META project as project is assumed to have no marine components.	Development of a cogeneration facility to supplement electrical power and steam demands of the refinery all within the refinery boundaries on land	07/12/2017 - Nationally significant project (ongoing)	No	Project is assumed to have no marine elements to the project, therefore there will be no impact overlap.
Installation/ operation and maintenance / decommissioning	Bombora Wave Energy	11.6	5.0	0	Spatial overlap with East Pickard Bay in intertidal area. Potential for temporal overlap	Bombora on- and off-shore infrastructure and deployment of Bombora mWave device at East Pickard Bay. This is to include device deployment (mWave device), installation of temporary communications cable between mWave device and temporary onshore control station to be located above East Pickard Bay, and installation and operation of temporary control station onshore. Laying of marine cable to shore and through intertidal area at East Pickard Bay to involve up to 3 days cable laying below MHWS using cable lay vessel and up to four vessels, including guard boat. Cable to be laid on seabed and kept in place in sandy sediment by using six, three tonne rock bags covering an area of 4.5 m^2 per rock bag. Where the marine cable traverses potential reefy habitat, it will follow natural rock channel. In the intertidal area, the cable will be laid through a natural gully, or up the vertical gully side and attached to the semi-vertical rock face with rock bolts using hand held tools. JCB will pull the cable through the intertidal area from a location above MHWS.	Q1 2020 - 2022	Yes	Bombora works are likely to cumulatively impact with the META project as spatial overlap is present
Ministry of Defence sites									
Installation/ operation and maintenance / decommissioning	Ministry of Defence	8.1	5.5	0.0	Temporal overlap	The Castlemartin Range is located immediately south of the entrance to the Waterway and extends for up to 12 NM from the coast between Little Furznip (at the southern extent of Freshwater West) and St Govan's Head (Milford Haven Port Authority 2019). The southern boundary of the East Pickard Bay (Site 8) site is located adjacent to the northern boundary of the Castlemartin Military Practice Area D113A. The range at Castlemartin supports the training of military personnel (Army) in the firing of a range of munitions at land-based targets. The seaward danger area provides a safety zone for overfire and shrapnel which may result from the striking of targets (RPS, 2010). The Castlemartin Range is used every day of the week and on some weekends (RPS, 2010).	N/A	Yes	There is a high level of uncertainty as to timing of MOD activities at the MOD site, however on-going activity is likely therefore there is the potential for cumulative impacts with the META project.
Aquaculture projects									
Installation/ operation and maintenance	Tehthys Oysters	8.9	2.6	5.1	Temporal overlap	The oyster farm is located on the eastern side of Angle Bay, whereby oysters are grown in baskets on metal supports. The farm will be serviced from the shore by foot.	Oct 2017 – Oct 2020 (possible renewal of licence)	Yes	There is potential for temporal overlap with the META project and as such will be included for assessment.

Phase	Developer - Reference	Distance from Warrior Way (site 6) (km)	Distance from Dale Roads (site 7) (km)	Distance from East Pickard Bay (site 8) (km)	Spatial/temporal overlap with the META project	Details	Date of Installation/ operation	Further Assessment required?	Taken further for assessment
Installation/ operation and maintenance	Pembrokeshire Scallops	15.3	3.9	1.8	Temporal overlap	The scallop farm is located within Castlebeach Bay, whereby a system of weighted ropes will be deployed for growing scallops and mix species of native algae. The farm will be serviced by vessels and divers.	Jan 2019 – Q4 2020 (possible renewal of licence)	Yes	There is potential for temporal overlap with Dale Roads (site 7) and as such will be taken forward for assessment.
Pembroke Dock Marine Projects									
Installation/ operation and maintenance	Milford Haven Port Authority - SC1810: Pembroke Dock Infrastructure	2	11.3	8.8	No spatial overlap with consented sites. Potential for temporal overlap.	Pembroke Dock redevelopment Scoping Report submitted. The intention of the Project is to create a flexible and efficient port-related office, industrial, warehousing and distribution, and ancillary operations infrastructure. This will involve the redevelopment of its existing space to incorporate increased deep-water access, internal and external heavy fabrication areas, construction of MEECE and Education/Skills Facility and the construction of a heavy lift facility.	Q3 2019 – Q3 2023	Yes	Port activity as a result of Pembroke Dock Port operations could cause an increase in underwater noise emissions, increased potential for suspended sediments, and impacts on shipping and navigation. There is therefore the potential for cumulative effects with activities associated the META project.
Installation/ operation and maintenance / decommissioning	Marine Energy Wales - DEML1875	1.7	11.7	9.4	No spatial overlap with any of the consented areas. Potential for temporal overlap	Marine Energy Test Area - Phase 1 Band 2 application submitted. The Project aims to create pre-consented test areas within the Pembroke Dock area. The test areas will have licensable activities to suit testing of initial stage marine renewable devices. These include testing of non-operating components and subassemblies. No full-scale testing is to be support within the test areas.	21/04/2019-21/04/2029	Yes	Vessel use and some testing activities have the potential for temporal overlap with the META project, therefore this project cannot be excluded from further consideration in the CIA.
Installation/ operation and maintenance / decommissioning	Wave Hub Ltd. - SC1082	31.4	31.1	25.8	No spatial overlap with any consented areas. Potential for temporal overlap as the projects are linked.	Pembrokeshire Demonstration zone Scoping Report submitted The Project entails the development of 90 km2 of seabed with water depths of approximately 50 metres and a wave resource of approximately 19 kW/m; to support the demonstration of wave arrays with a generating capacity of up to 30MW for each project. Consent for this Project could be achieved in 2022, infrastructure could be built by 2024 and the first technology could be installed in 2025.	Jul-18	Yes	There is the potential for temporal overlap with this project therefore this project cannot be excluded from further consideration in the CIA.

10.14 Cumulative impacts assessment

10.14.1.1 A description of the significance of cumulative effects upon marine ornithology receptors arising from each identified impact is given below.

10.14.1.2 The CIA consider impacts that have the potential for a temporal or spatial overlap with the META project. This is based on the assessment of magnitude of effects of the META project are all negligible-minor and therefore highly unlikely to elevate local or regional scale cumulative impacts to a level of significance.

10.14.1.3 The dWNMP undertook an HRA of the proposed plans included within the dWNMP. The screening exercise for the HRA screened out policies relating to Defence, Dredging and Disposal, Energy – Oil and Gas, Fisheries, Subsea Cabling, Surface Water and Wastewater Treatment and Disposal, and Tourism and Recreation from further consideration in the HRA on the basis that an assessment would be deferred to project level or an assessment was not possible at the policy level. Aggregates, Aquaculture, Energy – Low Carbon (marine renewable energy), and Ports and Shipping were screened in for further assessment. All sites within 50 km (marine buffer area), were considered to be potentially exposed to the effects of the dWNMP.

10.14.1.4 It was concluded within the dWNMP HRA Appropriate Assessment (AA) for screened in policies, that it would be necessary to rely on implementation of general cross-cutting protective policies within the WNMP to safeguard European sites during future assessment of specific schemes/projects. However, it was considered that there would be no adverse effect on site integrity due to the implementation of the policies due to measures that are in place i.e. – the policies are sufficiently caveated and flexible to ensure that adverse effects on site integrity are entirely avoidable at the project-level; the general cross-cutting protective policies within the WMNP will provide safeguards for European sites; evidence from existing schemes suggest that project-level mitigation and avoidance measures are achievable and effective; all projects would require project-level HRA; and Strategic Resource Areas (SRAs) can be modified to reflect best available evidence. For policy on Tidal Lagoons, it was considered that the nature of tidal lagoons means that adverse effects on European sites, particularly habitats, fish and birds, cannot be clearly avoided at the project level, regardless of policy control. However, the AA concludes that there is an over-riding reason of public interest (IROPI) for a Tidal Lagoon policy.

Cumulative disturbance and displacement

Magnitude of Impact

10.14.1.5 Disturbance and displacement may occur as a result of cumulative effects arising from projects that spatially or temporally overlap with the META project, as listed in Table 10.18. There is the potential for cumulative disturbance and displacement within the marine ornithology study area as a result of installation and operation and maintenance activities associated with the META project together with activities associated with META Phase 1, the Pembroke Dock Marine project, dredging and disposal activities in the Waterway, the Greenlink Interconnector project, Pembroke Power Bubble experiment (University College of Swansea - DEML1861), Neyland Yacht Haven Ltd CML1658, the proposed Bombora Wave Energy project, Mixed use developments - Local Planning Authority Reference: 14/0158/PA and Tethys Oysters.

10.14.1.6 The significance of effect of disturbance and displacement on waders and non-diving ducks at high tide was considered to be minor at Warrior Way (site 6) due to increased vessel movements and the proximity of the Warrior Way site to the Cosheston Pill WeBS count sector which has been shown to host important numbers of waders and dabbling ducks.

10.14.1.7 The META Phase 1 project has recently submitted a Marine Licence application to NRW-MLT accompanied by an environmental appraisal (RPS, 2018a) which confirms that META Phase 1 activities will be temporary in nature and spatially restricted to the habitats within Pembroke Dock. Therefore, there will be no cumulative increase in vessel traffic and thus increased disturbance at Warrior Way (site 6) as a result of the META Phase 1 project and the META phase 2 project due to spatial overlap. Temporal overlap of the projects will occur and as such discrete spatial impacts could result in-combination effects. However, it is clear from the desk study data and in particular the MHWESG (Haycock *et al* 2016) data, that the docks do not support any important numbers of coastal or marine bird species and as such no cumulative effect through increased disturbance is likely.

10.14.1.8 The Pembroke Dock Infrastructure project has submitted a Scoping Report (RPS, 2018b) which outlines that the creation of a new slipway, the infilling of the Graving Dock and capital dredging works. Although an EIA for the project was not available at the time of writing this Environmental Statement, it is understood that all works will be confined to the Pembroke Dock area. Therefore, there will be no cumulative increase in vessel traffic and thus disturbance at Warrior Way (site 6) as a result of this project and the META project due to spatial overlap. Temporal overlap of the META and Pembroke Dock Infrastructure project is likely and as such discrete spatial impacts at other points in the waterway could result in in-combination effects. However, it is clear from the desk study data and in particular the MHWESG (Haycock *et al.,* 2016) data that the Pembroke docks proposed development site does not support important numbers of coastal or marine bird species and as such no cumulative effect through increased disturbance is likely through temporal overlap.

10.14.1.9 The Greenlink Interconnector project has also submitted a Scoping Report for the UK marine route (Intertek, 2016) which outlines that disturbance may occur as a result of cable burial and maintenance activities. Although a detailed assessment was not available at the time of writing this Environmental Statement, the Scoping Report concludes that it is likely that any impacts to species and habitats will be localised and short-term, and once installed, the substratum will be reinstated over the cable. It is our understanding that the development will connect into the Pembroke substation and make landfall at East Pickard bay. As such the project will not overlap spatially with the META project. The Greenlink project is planned for commissioning in 2023 as such temporal overlap with META is likely and as such discrete spatial impacts could result in in-combination effects. However, it is clear from the desk study data and in particular the MHWESG (Haycock *et al* 2016) data that the intertidal and coastal habitats potentially affected by Greenlink (East Pickard bay) do not support important numbers of coastal or marine bird species and as such no cumulative effect through increased disturbance is likely through temporal overlap with the Greenlink Interconnector project.

10.14.1.10 Dredging and associated disposal activities within the Waterway may result in disturbance in the vicinity of these activities. However, these activities are ongoing within the Waterway and it is considered likely that the birds at Warrior Way (site 6) have been accustomed to any dredging activities required in the vicinity of the site. It is also likely given the location of the site upstream of the major ports in the Waterway that any dredging activity in this area is highly limited in extent as such cumulative effects through spatial overlap are considered unlikely

10.14.1.11 Temporal overlap of META with ongoing dredging and associated disposal activities within the Waterway are very likely and as such discrete spatial impacts within the marine ornithology study area could result in in-combination affects. As such cumulative effects through temporal overlap are considered possible.

10.14.1.12 The Pembroke Power Bubble experiment (University College of Swansea - DEML1861), Neyland Yacht Haven Ltd CML1658, Mixed use developments - Local Planning Authority Reference: 14/0158/PA, proposed Bombora project, and Tehthys Oysters are all additional developments that are although not spatially overlapping with the Warrior Way site (site 6) they are considered likely to temporally overlap with the META project and potentially require additional vessel movements or result in additional disturbance activities that could affect waders or dabbling ducks. No detailed additional information on the ecological effects of these projects was available at the time of assessment and as such this assessment has been limited as result of this. However, as all of these proposed sites are located to the west of the Warrior Way site (site 6) it is considered unlikely that vessel traffic associated with these developments will result in a cumulative increase in vessel traffic and thus disturbance at Warrior Way (site 6) through spatial overlap. Temporal overlap and affects through in-combination affects are however possible.

10.14.1.13 The dWMNP concludes no adverse effect on site integrity of any European site due to the plans included within the dWNMP.

10.14.1.14 The impact is therefore predicted to be of local spatial extent, long-term duration, intermittent and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be negligible.

Sensitivity

10.14.1.15 The ornithological VERs with the potential to be affected by cumulative disturbance/ displacement are the same as previously described in paragraph 10.12.1.52 *et seq*. and paragraph 10.12.1.71 *et seq*. for the META project alone.

10.14.1.16 The Waders VER is deemed to be of national value due to the numbers recorded. The sensitivity of the receptor is considered to be high due to the population trend, range and population size of the constituent species providing resilience to environmental change.

10.14.1.17 The non-diving ducks VER is deemed to be of national importance due to the numbers recorded and of medium sensitivity due to the population trend, range and population size of the constituent species providing resilience to environmental change.

Significance of effect

10.14.1.18 Overall, the sensitivity of the Waders VER is considered to be high and the magnitude of the impact is deemed to be negligible. Based on the matrix of sensitivity and magnitude this would result in an impact of minor (adverse) or negligible (adverse) significance (not significant in EIA terms). Despite the inherent uncertainty over the extent and scope of potential in-combination affects outlined above, in light of the limited magnitude of effects of META (all negligible) these are considered highly unlikely to elevate local or regional scale cumulative impacts to a level of significance.

10.14.1.19 Overall, the sensitivity of the non-diving ducks VER is considered to be low and the magnitude of the impact is deemed to be negligible. Based on the matrix of sensitivity and magnitude this would result in an impact of minor (adverse) or negligible (adverse) significance (not significant in EIA terms). Despite the inherent uncertainty over the extent and scope of potential in-combination affects outlined above in light of the limited magnitude of effects of META (all negligible) these are considered highly unlikely to elevate local or regional scale cumulative impacts to a level of significance.

Cumulative accidental pollution

Magnitude of Impact

10.14.1.20 Accidental pollution may occur as a result of cumulative effects arising from projects that spatially or temporally overlap with the META project, as listed in Table 10.18. Installation/decommissioning activities associated with the META project together with construction activities associated with the Pembroke Dock Marine project, dredging and disposal activities in the Waterway and the Greenlink Interconnector project have the potential for cumulative accidental pollution within the marine ornithology study area.

10.14.1.21 The significance of effect of accidental pollution on puffin, guillemot, razorbill, gannet and non-diving ducks was considered to be minor.

10.14.1.22 The META Phase 1 project has recently submitted a Marine Licence application to NRW-MLT accompanied by an environmental appraisal (RPS, 2018a) which confirms that META Phase 1 activities will be temporary in nature and spatially restricted to the habitats within Pembroke Dock. Therefore, there will be no cumulative increase in the potential for accidental pollution at the META sites as a result of this project and the META project due to spatial overlap. Temporal overlap of the projects will occur and as such discrete spatial accidental pollution impacts could result in in-combination effects. However, it is clear from the desk study data and in particular the MHWESG (Haycock *et al* 2016) data, that the docks do not support any important numbers of coastal or marine bird species and as such no cumulative effect through accidental pollution is likely.

10.14.1.23 The Pembroke Dock Infrastructure project has submitted a Scoping Report (RPS, 2018b) which outlines that the creation of a new slipway, the infilling of the Graving Dock and capital dredging works. Although an EIA for the project was not available at the time of writing this Environmental Statement, it is understood that all works will be confined to the Pembroke Dock area. Therefore, there will be no cumulative increase in the potential for accidental pollution at the META sites as a result of this project and the META project due to spatial overlap. Temporal overlap of the projects will occur and as such discrete spatial accidental pollution impacts could result in in-combination effects. However, it is clear from the desk study data and in particular the MHWESG (Haycock *et al* 2016) data that the docks do not support any important numbers of coastal or marine bird species and as such no cumulative effect through accidental pollution is likely.

10.14.1.24 The Greenlink Interconnector project has also submitted a Scoping Report for the UK marine route (Intertek, 2016) which outlines that accidental pollution may occur as a result of cable burial, construction and maintenance activities. Although a detailed assessment was not available at the time of writing this Environmental Statement, the Scoping Report concludes that it is likely that any impacts to species and habitats will be localised and short-term, and once installed, the substratum will be reinstated over the cable.

10.14.1.25 Finally, dredging and associated disposal activities within the Waterway may result in accidental pollution in the vicinity of these activities. However, these activities are sporadic rather than constant and will likely follow current standard marine pollution prevention and control strategies. As such it is considered unlikely that any dredging activities required in the vicinity of the META sites will significantly increase this risk of accidental pollution. As such the cumulative effect from these activities on the risk of accidental pollution is considered negligible.

10.14.1.26 The Pembroke Power Bubble experiment (University College of Swansea - DEML1861), Neyland Yacht Haven Ltd CML1658, Mixed use developments - Local Planning Authority Reference: 14/0158/PA, the proposed Bombora project, and Tethys Oysters are all additional developments that do not spatially overlap with the META project but do likely temporally overlap. No detailed additional information on the ecological effects of these projects was available at the time of assessment and as such this assessment has been limited as result of this. It is possible that these developments could result in accidental pollution impacts to coastal and marine areas in the Waterway through inappropriate water management or spillages. However, appropriate water management and pollution prevention and control measures would likely be implemented at these sites as part of standard construction practice and as such any impact is considered unlikely.

10.14.1.27 The dWMNP concludes no adverse effect on site integrity of any European site due to the plans included within the dWNMP.

10.14.1.28 The impact is therefore predicted to be of local spatial extent, long-term duration, intermittent and irreversible. It is predicted that the impact will affect the receptor directly. The cumulative effect from these activities on the risk of accidental pollution is considered of negligible magnitude.

Sensitivity

10.14.1.29 The ornithological VERs with the potential to be affected by cumulative accidental pollution are the same as previously described in paragraphs 10.12.1.77 *et seq*. to 10.12.1.113 for the META project alone.

10.14.1.30 The puffin VER is deemed to be of international value due to the numbers recorded. The sensitivity of the receptor is considered to be high due to the positive population trend, large range and recent increase in population size providing resilience to environmental change.

10.14.1.31 The guillemot VER is deemed to be of international importance due to the numbers recorded and of high sensitivity due to the positive population trend, large range and recent increase in population size providing resilience to environmental change.

10.14.1.32 The razorbill is deemed to be of international importance due to the numbers recorded and of very high sensitivity due to the negative population trend in recent years, compromising the species resilience to environmental change

10.14.1.33 The gannet VER is deemed to be of international importance due to the numbers recorded and of high sensitivity due to the positive population trend, large range and recent increase in population size providing resilience to environmental change.

10.14.1.34 The non-diving ducks VER is deemed to be of regional importance due to the numbers recorded and of medium sensitivity due to a large geographic range and global population size providing resilience to environmental change.

Significance of effect

10.14.1.35 Overall, the sensitivity of puffin, guillemot, razorbill, gannet and non-diving ducks VER's is considered to be high or medium (non-diving ducks) and the magnitude of the impact is deemed to be negligible. The effect will, therefore, be of minor (adverse) significance, which is not significant in EIA terms.

Cumulative Collision

10.14.1.36 Collision may occur as a result of cumulative effects arising from projects that spatially or temporally overlap with the META project, as listed in Table 10.17. However, no projects have been identified that have the potential to increase collision risk and as such no potential for cumulative effects exists within the marine ornithology study area. This cumulative effect pathway is thus considered no further.

10.15 Transboundary effects

10.15.1.1 A screening of transboundary impacts has been carried out and has identified that there was no potential for significant transboundary effects with regard to marine ornithology from the META project upon the interests of other EEA States.

10.16 Inter-related effects

10.16.1.1 Inter-relationships are considered to be the impacts and associated effects of different aspects of the proposal on the same receptor. These are considered to be:

- Project lifetime effects: Assessment of the scope for effects that occur throughout more than one phase of the project (installation, operation and maintenance, and decommissioning), to interact to potentially create a more significant effect on a receptor than if just assessed in isolation in these three key project stages; and
- Receptor led effects: Assessment of the scope for all effects to interact, spatially and temporally, to create inter-related effects on a receptor. As an example, all effects on benthic subtidal and intertidal ecology, such as habitat loss/disturbance and sediment plumes may interact to produce a different, or greater effect on this receptor than when the effects are considered in isolation. Receptor-led effects might be short term, temporary or transient effects, or incorporate longer term effects.

10.16.1.2 A description of the likely inter-related effects arising from the META project on marine ornithology is provided in here.

10.16.2 Project lifetime effects

10.16.2.1 The greatest potential for project lifetime effects to occur with respect to marine ornithology is associated with temporary disturbance/ displacement across the installation, operation and maintenance and decommissioning phases of the META project.

10.16.2.2 When temporary habitat loss/disturbance is considered additively across all phases, the total duration of displacement is longer than when considered across an individual phase (i.e. just installation). The project lifetime of META is estimated at up to 15 years and therefore there is the potential for repeat disturbance/ displacement. This disturbance will however be highly localised to the vicinity of the activity (i.e. limited to the immediate footprints) during each phase and are also likely to be substantially less than the extents predicted for the maximum design scenario when the most likely scenario is considered. Therefore, across the project lifetime, the effects on receptors are not anticipated to interact in such a way as to result in combined effects of greater significance than the assessments presented for each individual phase.

10.16.3 Receptor-led effects

10.16.3.1 Based upon expert knowledge, it is considered that there is limited potential for inter-related impacts across the lifetime of the META project on marine ornithological receptors.

10.17 Conclusion and summary

10.17.1.1 Installation, decommissioning, operation and maintenance activities associated with the META project have the potential to result in a range of potential impacts on marine ornithology. These include the disturbance/ displacement of coastal birds, accidental pollution impacts to marine and coastal birds, and increase collision risk to marine birds. Table 10.17: Summary table of impacts with regards to marine ornithological features provides a summary of the potential impacts, mitigation measures and residual effects during the installation phase with respect to marine ornithology. These impacts are predicted to result in effects on coastal and marine birds, of negligible or minor adverse significance (which is not significant in EIA terms).

10.17.1.2 ESAS seabird density data, along with other data sets, has informed the assessment within this chapter. To account for possible changes in species data in relation to the META project, estimated changes to relevant species populations have been calculated, based on population trends, and discussed in relation to each impact pathway.

10.17.1.3 At a Welsh national level, guillemot, kittiwake and shag populations have experienced a declining trend since the collation of data during the ESAS programme (2002). This has varied from 3.65% declines for guillemot populations, to 44% and 89% for kittiwake and shag populations. At a national level, several species experienced population trend increases, including razorbill, gannet and cormorant populations (64%, 21% and up to 41% respectively). Despite these various increases and decreases, these have resulted in only minor alterations in seabird densities in relation to the META project, and no impacts of significance in relation to EIA regulations have been found.

10.17.1.4 Cumulative impacts upon marine ornithology from the META project have been considered together with the impacts predicted to arise from the META Phase 1 project as well as from the construction and operation of other planned nearby projects (e.g. Pembroke Dock Infrastructure and Greenlink Interconnector) and licenced dredging and disposal activities in the Waterway. Overall, the cumulative impacts on marine ornithological interest and designated features of nature conservation sites will be of minor adverse significance (not significant in EIA terms).

10.17.1.5 A screening of transboundary impacts has been carried out which has identified that there is no potential for significant transboundary effects with regard to marine ornithology from the META project upon the interests of other EEA States.

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