

MDM Ltd

SOBR 2 Cable Route Site Investigation Surveys

Habitats Regulations Assessment Report

COMMERCIAL IN CONFIDENCE



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1. Introduction

1.1 Overview

Proposed plans or projects that have the potential to affect designated nature conservation sites are required to be considered through the Habitats Regulations Assessment (HRA) process under The Conservation of Habitats and Species Regulations 2017 and The Conservation of Offshore Habitats and Species Regulations 2017 (as amended¹) (the Habitats Regulations).

This Report to Inform Appropriate Assessment (RIAA) considers the work activities (hereafter referred to as ‘works’ or ‘work activities’) required for a marine survey and site investigation works to investigate the feasibility of constructing a new subsea telecoms cable system, SOBR2, through the stages of the HRA process. The report provides the information required by Natural Resources Wales (NRW) to fulfil its function as a ‘competent authority’ under the Habitats Regulations and determine if the proposed works are likely to have a significant effect on the Conservation Objectives of a European Site, either alone, or in-combination with other plans or projects.

1.2 Project details

McMahon Design and Management Ltd (MDM) is working to identify a cable route to support the proposed installation of a new subsea fibre optic cable system, SOBR 2, which will link Ireland to the United Kingdom, from a landfall at Portmarnock, North Dublin to a landfall at Abergele, Conwy on the north coast of Wales. Only works carried out in Welsh waters are being considered in the marine licence application to NRW (works carried out in Irish waters will be covered under the Irish regulatory system).

The site investigation works (hereafter referred to as ‘S.I. works’) will be predominately composed of a geophysical survey and a geotechnical survey (Table 1). A cable route corridor of approximately 500 m width will be surveyed (hereafter referred to as the ‘S.I. Survey Area’) for the geophysical survey and geotechnical works as shown in Figure 1.

¹ <https://www.legislation.gov.uk/ukxi/2017/1013/contents/made>

1.3 Habitats Regulations Assessments

The Habitats Regulations require that an Appropriate Assessment of the implications of any development consent must be made by the relevant competent authority, in this case NRW, if a project (or plan) is likely to have a significant effect on the Conservation Objectives of a European Site (defined below), either alone, or in-combination with other plans or projects.

HRA is generally understood to be a progressive, four stage process which determines Likely Significant Effect (LSE) and, where required, assesses potential adverse impacts on the integrity of a European Site, examines alternative solutions and provides justification of Imperative Reasons of Overriding Public Interest (IROPI) (Planning Inspectorate 2017). Further detail on the process followed and the definition of particular terms, is provided in the methodology (Section 3).

1.4 Structure and purpose of the report

This report provides information on the work activities, the HRA Screening and Appropriate Assessment process as well as the results of the Appropriate Assessment in support of a marine licence application.

The report provides information to allow NRW (as the competent authority) to determine whether there will be an adverse effect on the integrity of any European Site(s) in view of their Conservation Objectives (COs) as a result of the project.

In the context of an HRA, where the potential for likely significant effects cannot be excluded for a Site, a competent authority must make an Appropriate Assessment of the implications of the plan or project for that site, in view of the Site's conservation objectives. The competent authority may agree to the plan or project only after having ruled out adverse effects on the integrity of the European Site. Where an adverse effect on the site's integrity cannot be ruled out, and where there are no alternative solutions, the plan or project can only proceed if there are IROPI and if the necessary compensatory measures can be secured.

This RIAA has been undertaken to support the marine licence application for the geotechnical S. I. works. Due to the nature of the geophysical survey, this element of the works is considered to be exempt from requiring a marine licence, but assessment of potential effects on European Sites is included in this report for completeness.

2. The proposed works

2.1 Location and context

The proposed S.I. works area boundary in UK waters extends approximately 88.16 km out into the Irish Sea to the UK/Ireland Exclusive Economic Zone (EEZ) boundary from Abergele, north Wales with an overall area of approximately 6,541 ha. The S.I. survey area is indicated in Figure 1 and is comprised of the cable corridor and landfall locations. The cable corridor is not uniform in width but is predominately 500 m, with some sections varying between 400 – 700 m in width.

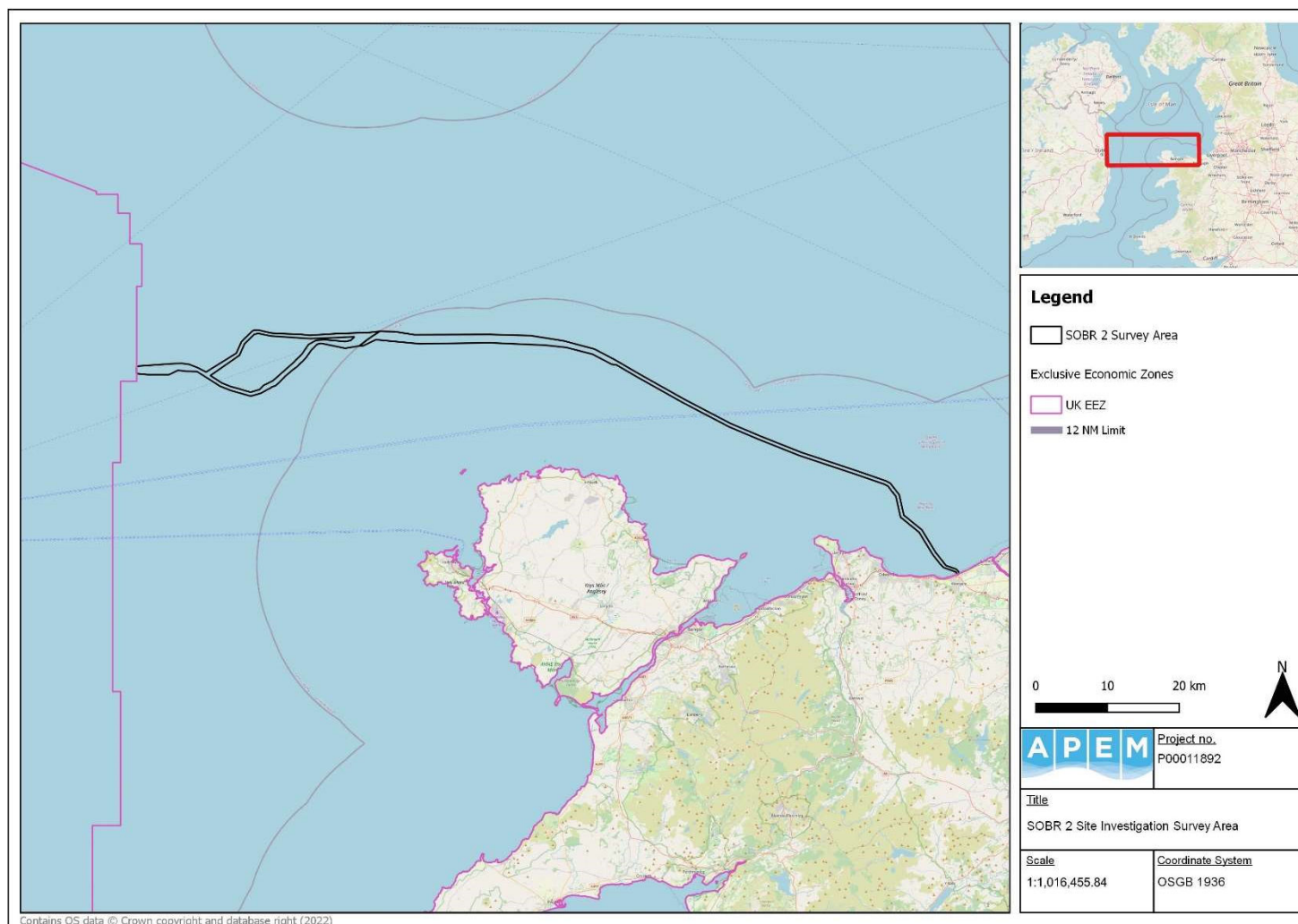


Figure 1. SOBR 2 Site Investigation Survey Area

2.2 Summary of marine works

The objective of the S.I. works is to identify a feasible and safe route for the cable system design, deployment, survivability, and subsequent maintenance. The works will also enable further understanding of site conditions including benthic characteristics, bathymetry, underlying geology, obstructions, and environmental characteristics. The geophysical survey data will be acquired prior to the geotechnical & sampling survey. The proposed programme of surveys is summarised in Table 1 below. Further information regarding survey methods can be found in the Marine Licence Application Methodology (MDM 2023) that accompanies this RIAA.

Two survey vessels are proposed for this project, namely:

- The Lady Kathleen; and
- The Roman Rebel.

The Lady Kathleen is proposed for acquisition of the geophysical data in shallow water areas within the 12 NM. The Roman Rebel is proposed to survey the deeper areas the cable routes as well as for the geotechnical survey scope. Further details of the vessels proposed to undertake the works can be found in Appendix 2: Survey vessels and equipment.

Should these vessels not be available at the planned commencement of works then comparable alternative vessels will be sourced.

Table 1. Summary of proposed survey methodology and timings.

Category	Survey	Purpose	Sampling / Area	Duration
Geophysical	Multibeam Echo Sounder (MBES)	Map seabed features and/or other cables and pipelines, obstructions, wrecks, debris etc.	Full coverage of Survey Area.	Expected to commence May 2024 and completed within four weeks.
	Side Scan Sonar (SSS)	Provide interpretation of seabed sediments and identification of any object on seabed larger than 0.5 m.		

Category	Survey	Purpose	Sampling / Area	Duration
	Sub-Bottom Profiler (SBP)	Identify character of shallow geology, locating any structural complexities or geohazards.	Minimum of five lines.	
	Magnetometer Survey	Map any metallic obstacles or hazards, including UXO		
Geotechnical	Grab samples	Representative samples of surficial seabed sediments for laboratory testing.	24-32 samples (2 per location). In-situ surficial sampling, at approximately 8 km intervals.	Expected to commence June 2024 for a duration of approximately 6 weeks
	Bar probes		Eight to 10 samples in the intertidal and 8-10 samples from Low Water to 3 m.	
	Vibrocore (VC) / Gravity Cores		10 to 14 samples (120 mm diameter) to 3 m.	
	Cone Penetration Testing (CPT)		12 to 16 samples to 3 m.	
	Slit Trenches		Four trenches on the beach, using a mini digger/JCB to excavate 0.8 – 1 m width trenches, up to 2.5 m depth.	

3. Assessment Methodology

3.1 Legislative and policy context

3.1.1 UK (domestic) legislation

This section describes the legislation as it applies now that the UK has left the European Union (EU). Guidance from Defra has been provided on the application of the relevant legislation in

the post-Brexit period in their policy paper published on 1st January 2021 available at <https://www.gov.uk/government/publications/changes-to-the-habitats-regulations-2017/changes-to-the-habitats-regulations-2017>. The Habitats Regulations provide for the protection of particular habitats, plants and animals through the creation of, and specific decision-making procedures applied to, the 'national site network' (Regulation 3 'Interpretation'). This 'national site network' consists of Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) that were designated both in that period when the UK was a member of the EU and since the UK left the EU.

Since those particular parts of the Habitats Regulations relating to the HRA process continue to refer to the designated sites collectively as 'European Sites', rather than as the 'national site network', that approach has been followed in this RIAA.

3.1.2 Policy requirements additional to domestic legislation

It is UK Government policy that all competent authorities should treat candidate SACs (cSACs) and potential SPAs (pSPAs) as being within the requirements of the Habitats Regulations. In Wales, this is identified in Appendix 4, paragraph 4.6 and 4.7 of the Developments of National Significance Guidance (The Planning Inspectorate 2019).

Accordingly, in this report the term 'European Site' is used to refer collectively to SACs, cSACs, SPAs and pSPAs.

3.1.3 International legal and policy obligations

The UK is a contracting party to the Convention on wetlands of international importance especially as waterfowl habitat, Ramsar, Iran, 1971 (the 'Ramsar Convention') which seeks to protect wetlands of international importance, especially those wetlands utilised as waterfowl habitat.

It is UK Government policy that all competent authorities should treat Ramsar Sites in their decision-making processes as if they are SACs or SPAs and hence Ramsar Sites are considered within the requirements for HRA of the Habitats Regulations. In Wales, this is identified in Appendix 4, paragraph 4.6 and 4.7 of the Developments of National Significance Application Guidance (The Planning Inspectorate 2019). As a consequence, in this report Ramsar Sites are referred to alongside European Sites collectively as European and Ramsar Sites.

3.1.4 *Areas that are functionally linked to European and Ramsar Sites*

Animals that are interest features of European and Ramsar Sites may be mobile and not confined to the boundary of the designated site. For example, wintering waterbirds may forage or roost on agricultural land outside of the designated site. Although that agricultural land is not part of the European or Ramsar Site, it is ‘functionally linked’ because it serves a function for waterfowl that are interest features of the designated site. Account has to be taken of such functionally linked land in the HRA process since, for instance, the loss of such land to development could potentially adversely affect the survival of those wintering waterbirds and lead to a reduction in the population of birds within the designated site.

Functionally linked land has been defined as follows (Chapman & Tyldesley 2016):

‘the term ‘functional linkage’ refers to the role or ‘function’ that land or sea beyond the boundary of a European Site might fulfil in terms of ecologically supporting the populations for which the site was designated or classified. Such land is therefore ‘linked’ to the European Site in question because it provides an important role in maintaining or restoring the population of qualifying species at favourable conservation status.’

3.2 The HRA process

3.2.1 *Overview*

The requirements of the Habitats Regulations regarding the implications of plans or projects are set out within Regulation 63. The step-based approach implicit within this Regulation is referred to as a ‘Habitats Regulations Assessment’ (HRA), which is the term that has been used throughout this report.

It is a requirement of any public body, referred to as a ‘competent authority’ within the Habitats Regulations, to carry out a HRA when they are proposing to carry out a project, implement a plan or authorise another party to carry out a plan or project. Competent authorities are required to record the process undertaken, ensuring that there will be no adverse effects on the integrity of any European or Ramsar Site as a result of a plan or project whether alone or in combination with other plans or projects.

3.2.2 *Assessment stages*

The assessment of a plan or project goes through a number of stages, with guidance having been published to aid competent authorities to fulfil their responsibilities. Those stages are summarised in Table 2.

Table 2. Stages in the HRA process

Stage	Description	Legislative Context
Purpose	Determines if the purpose of the plan or project is directly connected with, or necessary, to the management of a European or Ramsar Site. If it is, then no further assessment is necessary	Regulation 63(1)(b)
Scoping	The identification of any European or Ramsar Site that might be within scope of a HRA i.e., those sites that should be taken forward to the screening stage based on a wide consideration of spatial and ecological factors. Such a site may be located within the plan or project area but may also include sites located in neighbouring authority areas.	
Screening	Assessment of whether a plan or project, either alone or in combination with other plans or projects, is likely to have a significant effect on any qualifying feature (habitats and species) and the achievement of the conservation objectives of a European or Ramsar Site. This is also known as the 'test of likely significant effect' (ToLSE).	Regulation 63(1)(a)
Appropriate Assessment	Consideration of the effects of the proposals to determine whether or not it is possible to conclude with certainty that the development will not result in any adverse effect on the integrity of European or Ramsar Site, either alone or in combination with other plans or projects and with reference to the conservation objectives of the European or Ramsar Site. This is also known as the test of 'adverse effect on integrity' (AEoI). At this stage consent may be granted for the plan or project if it is possible to conclude with certainty that the proposal will not result in any adverse effect on the integrity of any European or Ramsar Site, either alone or in combination with other plans or projects.	Regulation 63(5)
If it cannot be concluded with certainty that the proposal will not result in any adverse effect on the integrity of any European or Ramsar Site then proceed to:		
Assessment of alternative solutions	Assess whether there is an alternative solution to the plan or project i.e. one that better respect the European or Ramsar Sites. If no such alternative solution exists, the process continues to Assessment of IROPI.	Regulation 64(1)
Assessment of IROPI	Assess whether a plan or project can be justified as being needed for 'imperative reasons of overriding public interest' (IROPI).	Regulation 64(1)
Compensatory measures	Identify and secure any necessary compensatory measures to ensure that the overall coherence of the 'national site network' is protected.	Regulation 68

3.2.3 In-combination assessment

The Habitats Regulations, taken with Government policy, require the consideration of the potential effects of a project on European and Ramsar Sites both alone and in-combination with other plans or projects.

The identification of plans and projects to include in the in-combination assessment will be based on:

- approved plans;
- approved, but as yet unconstructed projects; and
- projects for which an application has been made, are currently under consideration and will be consented before the proposed development begin.

3.3 Guidance on the HRA process

In preparing this report, consideration has been given to the relevant guidance issued by a number of Governmental, statutory and industry bodies.

Guidance from Government bodies includes:

- Ministry of Housing, Communities and Local Government online Guidance on the use of Habitats Regulations Assessment <https://www.gov.uk/guidance/appropriate-assessment>
- Defra, NE, Welsh Government and NRW guidance on Habitat Regulations Assessments <https://www.gov.uk/guidance/habitats-regulations-assessments-protecting-a-european-site>

Guidance from the Statutory Bodies includes:

- NRW online guidance on HRA in the marine licensing process <https://naturalresources.wales/permits-and-permissions/marine-licensing/marine-licence-habitats-regulations-assessment/?lang=en>
- NRW's position on the use of Marine Mammal Management Units for screening and assessment in Habitats Regulations Assessments for Special Areas of Conservation with marine mammal features <https://cdn.cyfoethnaturiol.cymru/media/695250/ps006-mmmus-in-hra-position-statement-may22.pdf>

4. Identification of European and Ramsar Sites and features potentially affected by the proposed works

4.1 European and Ramsar Site Identification process

For the screening process, European and Ramsar Sites in the vicinity of the proposed works activities which could potentially be influenced by the proposed works were identified. The different interest features within these sites were then considered individually.

It only requires one site interest feature to be considered to be potentially impacted by the work activities for the European and/or Ramsar Site to be screened into the HRA, along with each of its associated interest features.

This screening used the conceptual ‘source-pathway-receptor’ model. The model was used to identify potential environmental effects resulting from the works activities. This process provides an easy-to-follow assessment route between impact sources and potentially sensitive receptors ensuring a transparent impact assessment. The parameters of the model are defined as follows:

- source – the origin of a potential effect (noting that one source may have several pathways and receptors);
- pathway – the means by which the effect of the activity could impact a receptor; and
- receptor – the element of the receiving environment that is impacted.

Where there is no pathway, or the pathway is so long that the effect from the source has dissipated to a negligible level before reaching the receptor, there is justification for the screening out of that particular receptor.

Where the receptor (site interest feature) only occurs in the area on a seasonal basis and/or that receptor is not present in the period in which particular activities of the proposed works are a source of a potential effect, there is justification for the screening out of that particular receptor.

4.1.3 Potential European and Ramsar Site (receptors)

The proposed S.I. works area extends from Abergele, north Wales, out to 88.16 km northwest into the Irish Sea. The site investigation area is approximately 16 km off the north coast of Anglesey.

The following criteria for European site selection was applied for screening, using a precautionary approach (reasons for the distances considered are indicated below):

- Inclusion of any site within a potential Zone of Influence (Zoi) of 2 km of the investigation area (i.e. including sites with only habitat features, only mobile features, or a combination of the two). This is considered to be highly precautionary for sites with just habitat features;
- Inclusion of any site up to 50 km from the investigation area that contains mobile receptors (not including birds) that have the potential to occur within the investigation area – this applies to marine mammals and migratory fish species;

- For marine mammals, protected sites can be incorporated at greater distances for this receptor, based on NRW guidance (NRW 2022). Where NRW guidance is not applicable or available, the ZoI is set at 50 km, which should be regarded as precautionary.
- Inclusion of sites within a 10 km ZoI from the investigation area for coastal birds and within a 20 km ZoI for sites with geese as a qualifying feature given typical commuting ranges between roosting and foraging grounds (Mitchell 2012, SNH 2016); and
- ZoI based on mean max foraging ranges for seabirds (Woodward *et al.* 2019).

For benthic habitat features, a 2 km ZoI will be applied. The potential impacts of the expected survey activities include abrasion/penetration of substrate, smothering/siltation rate change and pollution, which pose a potential risk to benthic habitat features (Merck & Wasserthal 2009; Farr *et al.* 2021). Given the nature of the activities, potential effects will be restricted to the immediate survey area with the exception of an accidental spill event, which may extend beyond the immediate survey area. However, the 2 km ZoI is considered highly precautionary for habitat features.

For some species of marine mammal, such as harbour seals, grey seals and bottlenose dolphins, telemetry data (seal species) and photo-identification data (seal species and bottlenose dolphins), can assist in identifying connectivity to protected areas. These data are often used in the process of designating protected areas. For example, harbour seals show high site fidelity, and although some telemetry tagged individuals have travelled beyond 100 km (Thompson *et al.*, 1998; Wilson *et al.*, 2015), the majority of sea trips are less than 50 km from their preferred haul-out site (Carter *et al.*, 2022). Grey seals along the Welsh coast also show connectivity between haul-out sites up to 230 km apart; however, photo-identification studies show that on average, grey seals typically remain within 50 km of their preferred haul-out site (Langley *et al.*, 2020). Taking a precautionary approach, and following NRW guidance on grey seals (NRW 2022), three SACs in Welsh waters are scoped into the assessment:

- Pen Llyn a'r Sarnau/ Llyn Peninsula and the Sarnau SAC;
- Bae Ceredigion / Cardigan Bay SAC; and,
- Sir Benfro Forol / Pembrokeshire Marine SAC
- Gorrlewin Cymru Forol / West Wales Marine SAC

In addition, following the 50 km ZoI approach, Lambay Island SAC in Irish waters is also scoped in. The latter SAC also includes harbour seals as a qualifying feature; therefore, this species is also screened in for this site. Harbour seals are not a qualifying feature of any Welsh SAC, therefore NRW do not provide any guidance on this species in relation to screening for HRA.

For bottlenose dolphins, boat-based surveys can provide information on where animals occur, and with the addition of photo-identification, these data can show that individuals using protected areas also use areas further afield (Cheney *et al.* 2013; Robinson *et al.* 2012). The Pen Llyn a'r Sarnau/ Llyn Peninsula and the Sarnau SAC is within the Zol of the S. I. works, and therefore has been screened into the assessment. Furthermore, following NRW guidance (NRW, 2022), Cardigan Bay SAC is also included in the assessment, despite being further than 50 km from for S. I. works, due to known connectivity of individuals from this site and the wider area, including the Pen Llyn a'r Sarnau/ Llyn Peninsula and the Sarnau SAC (Feingold and Evans, 2013).

For other more elusive and challenging species to study at the individual-level, such as harbour porpoise, protected areas are often identified as areas with higher densities of the species as compared to other regions. For harbour porpoise, which is the most abundant cetacean species in UK and Irish waters, connectivity to the site is likely, but it is important to remember the rationale for designating the protected site; it is an area of higher density and is therefore considered to be more important to the species when compared to neighbouring areas. Consequently, a key Conservation Objective in these cases is to ensure that the potential usage of the site by harbour porpoise is maintained (JNCC 2019a; 2019b). Following NRW guidance (NRW, 2022), and incorporating the precautionary 50 km Zol, two SACs in Welsh waters, North Anglesey Marine SAC, and West Wales Marine SAC, have been screened into the assessment. In addition, the Rockabill to Dalkey Island SAC in Irish waters has also been screened in.

There is no guidance or literature to support a specific distance for the consideration of sites with mobile fish features. Consequently, a distance of 50 km has been used for mobile marine fish species (including anadromous species) as a precautionary approach. Migratory fish could potentially pass through the Zol if transiting to sites near the S. I. area, however, there would likely also be many routes for migration available outside the Zol. For migratory fish features of sites further than 50 km from the S. I. area it is considered that individuals will likely not need to transit through the S. I. area during migration, and if they did, it would only be a small proportion of the population of migratory fish from the SAC. In addition, they would also be able to avoid an area during S. I. works, if required.

For SPAs with birds as qualifying features, an area of interest of 10 km has been adopted for coastal and intertidal bird species, extended to 20 km for geese and swans given typical commuting ranges between roosting and foraging grounds (Mitchell 2012; SNH 2016). For breeding seabird species, published mean-maximum foraging ranges have been used to establish potential connectivity between the S. I. Survey Area and designated sites (Woodward *et al.* 2019). For those sites with features where there could be connectivity, they have been considered in the screening stage. There is no guidance or literature to support a

specific distance for the consideration of sites with seabird features, however, using professional judgement sites up to 230 km from the S. I. Survey Area have been included in the screening stage to include all sites for seabirds with a lower mean-maximum foraging range (e.g. lesser black-backed gull or kittiwake) which may have connectivity to the area. In addition, more distant SPAs which have the potential to be functionally linked (see Section 3.1.4), may be connected to the S. I. Survey Area should they host seabirds with extremely large foraging ranges, such as Manx shearwater, Leach's storm petrel, European storm petrel, fulmar and gannet which have mean maximum foraging ranges between 315.2 and 1,346.8 km. However, no sites over 230 km from the S. I. Survey Area have been considered in this report as it is not anticipated that birds from these colonies will reach the S. I. Survey Area in sufficient numbers to warrant inclusion within the assessment. These locations, over 230 km from the S. I. Survey Area, also have no straight-line route to the site without crossing over land and as seabirds generally avoid overland flights this means that foraging distances that would need to be travelled to fly to the S. I. Survey Areas are in effect, much greater than they would be if measured in a straight line.

The European and Ramsar Sites that fall within the screening criteria described above are listed below and are displayed in Figure 2, Figure 3 and Figure 4. These protected sites are designated for a variety of habitats and / or bird, fish and marine mammal species as listed in Table 3. The majority of sites are within UK waters however, two SACs in Irish waters also met the screening criteria for marine mammals: Rocakabill to Dalkey Island SAC and Lambay SAC. These sites have been included in this assessment for completeness, however, they will also be assessed as part of the licensing process for the survey in Irish waters.

SACs

- Gogledd Mon Forol / North Anglesey Marine SAC (UK0030398)
- Pen Llyn a'r Sarnau/ Llyn Peninsula and the Sarnau SAC (UK0013117)
- Gorllewin Cymru Forol / West Wales Marine SAC (UK0030397)
- Bae Ceredigion / Cardigan Bay SAC (UK0012712)
- Sir Benfro Forol / Pembrokeshire Marine SAC (UK0013116)
- Rockabill to Dalkey Island SAC (003000)
- Lambay Island SAC (000204)

SPAs

- Bae Lerpwl / Liverpool Bay SPA (UK9020294)
- Morwenoliaid Ynys Môn / Anglesey Terns SPA (UK9013061)
- Aber Dyfrdwy / Dee Estuary SPA (UK9013011)
- Ynys Seiriol / Puffin Island SPA (UK9020285)

- Traeth Lafan/Lavan Sands, Conway Bay SPA (UK9013031)
- Mersey Narrows and North Wirral Foreshore SPA (UK9020287)
- Ribble and Alt Estuaries SPA (UK9005103)
- Morecambe Bay and Duddon Estuary SPA (UK9020326)
- Solway Firth SPA (UK9005012)
- Strangford Lough SPA (UK9020111)
- Belfast Lough Open Water SPA (UK9020290)
- Outer Ards SPA (UK9020271)
- Larne Lough SPA (UK9020042)
- Carlingford Lough SPA (UK9020161)
- Sgomer, Sgogwm a Moroedd Penfro / Skomer Skokholm and the Seas off Pembrokeshire SPA (UK9014051)
- Irish Sea Front SPA (UK9020328)
- Mersey Estuary SPA (UK9005131)
- Gogledd Bae Ceredigion / Northern Cardigan Bay SPA (UK9020327)

Ramsar Sites

- The Dee estuary Ramsar (Site no. 298)
- Duddon Estuary Ramsar (Site no. 938)
- Mersey Estuary Ramsar (Site no. 785)
- Mersey Narrows and North Wirral Foreshore Ramsar (Site no. 2202)
- Morecambe Bay Ramsar (Site no. 863)
- Ribble and Alt Estuaries Ramsar (Site no. 325)
- Upper Solway Flats and Marshes Ramsar (Site no. 341)

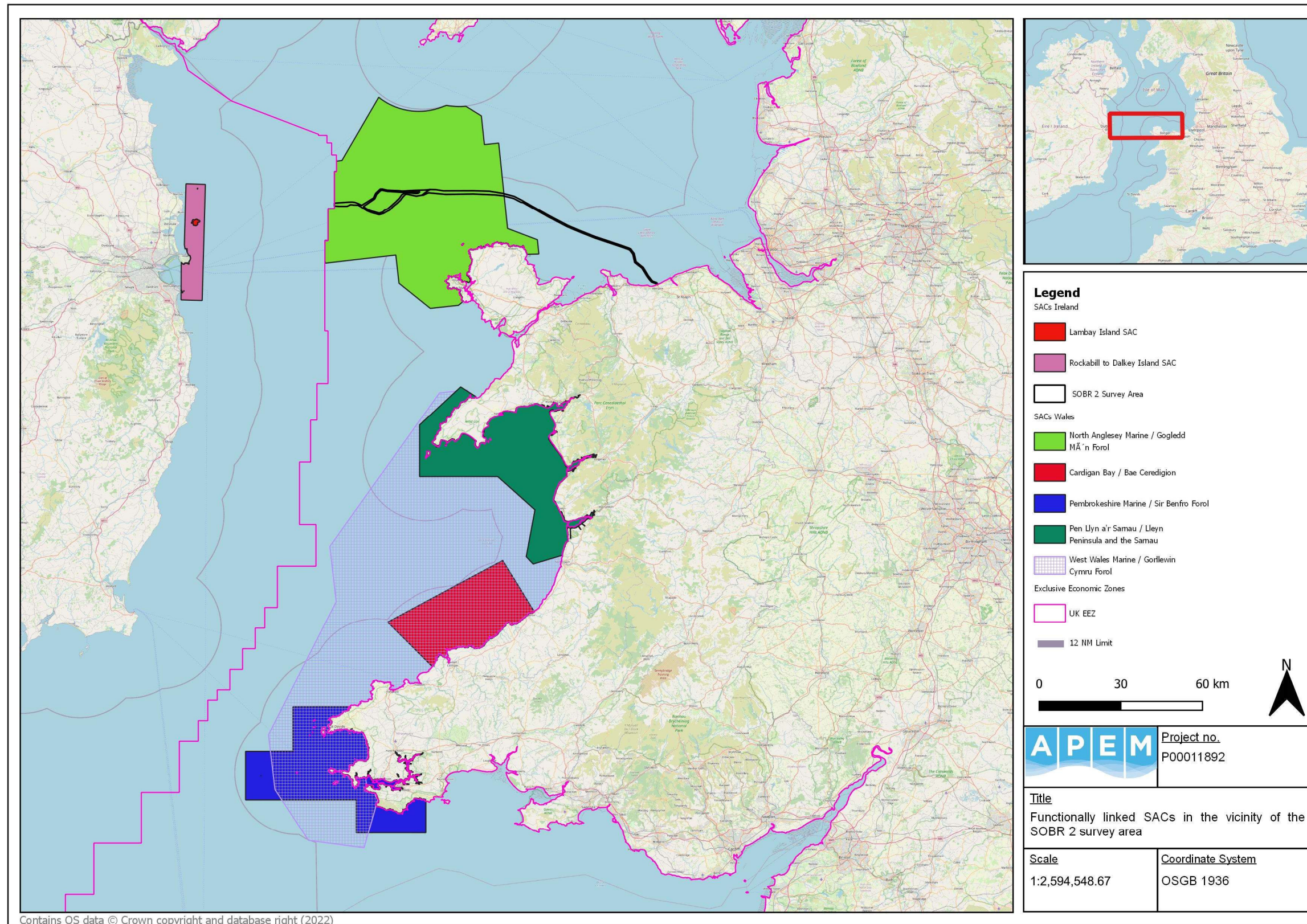


Figure 2. SACs scoped into the assessment based on NRW guidance and/or are within the ZOI (relevant to qualifying features) of the Site Investigation Survey Area.

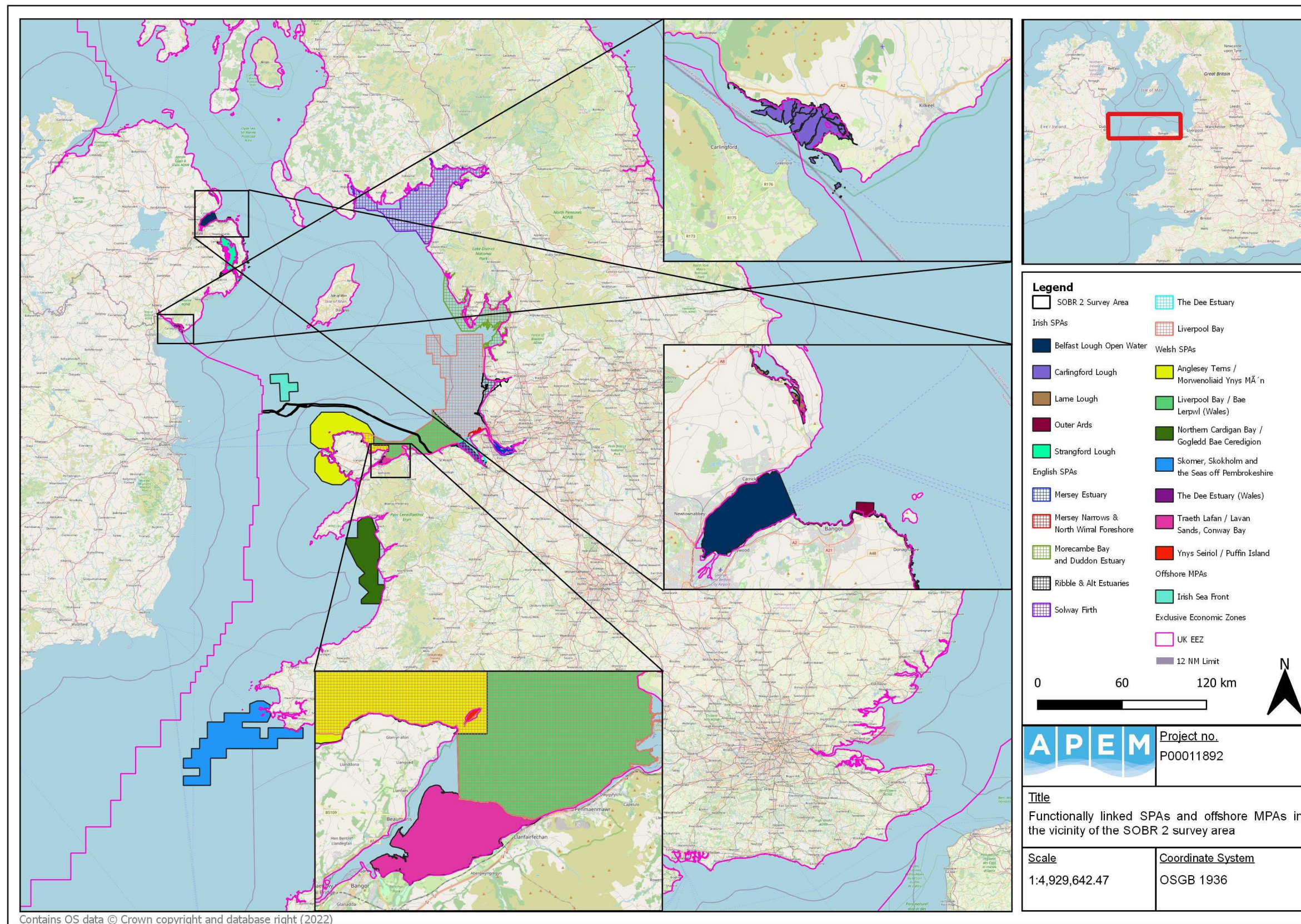


Figure 3. SPAs screened into the assessment based on NRW guidance and/or are within the ZoI (relevant to qualifying features) of the Site Investigation Survey Area.

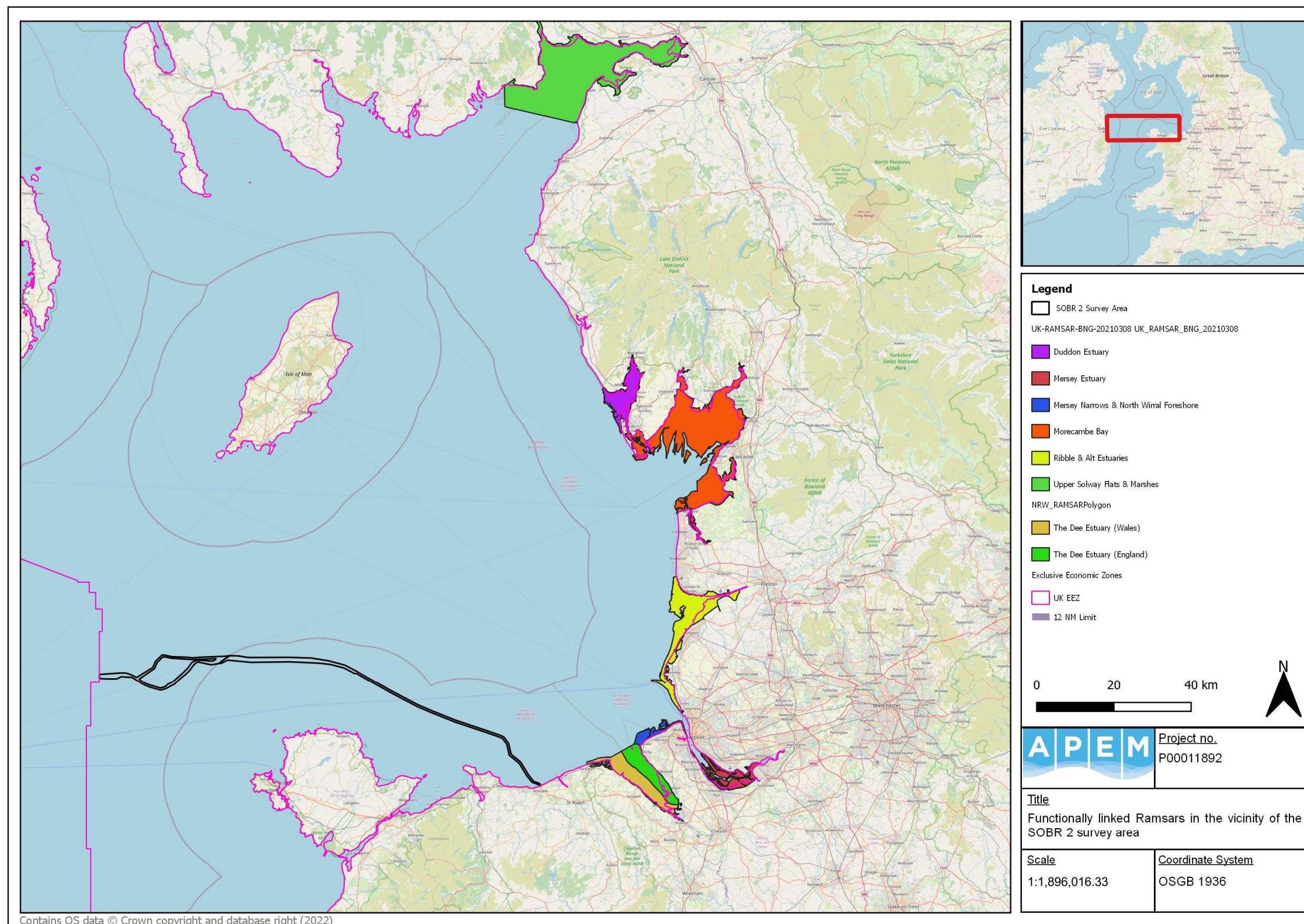


Figure 4. Ramsar Sites scoped into the assessment based on NRW guidance and/or are within the ZOI (relevant to qualifying features) of the Site Investigation Survey Area.

4.2 European Site features of interest

Qualifying features of the European and Ramsar Sites that fall within the scoping criteria and the distance of these sites from the S. I. Survey Area are indicated in Table 3.

Table 3. European and Ramsar Sites within the Zol of the S. I. Survey Area. *= Priority, numbers in brackets are site codes.

Site	Distance from S. I. Area (km)	Qualifying Features (Features screened in for assessment are in <u>bold</u>)
SACs		
Gogledd Mon Forol / North Anglesey Marine SAC (UK0030398)	0	[1351] Harbour Porpoise (<i>Phocoena phocoena</i>)
Pen Llyn a'r Sarnau / Llyn Peninsula and the Sarnau SAC (UK0013117)	49	[1110] Sandbanks which are slightly covered by seawater all the time [1130] Estuaries [1150] Coastal lagoons [1160] Large shallow inlets and bays [1170] Reefs [1140] Mudflats and sandflats not covered by seawater at low tide [1310] Salicornia and other annuals colonizing mud and sand [1330] Atlantic salt meadows (<i>Glaucopuccinellietalia maritima</i>) [8330] Submerged or partially submerged sea caves [1349] Bottlenose dolphin (<i>Tursiops truncatus</i>) [1355] Otter (<i>Lutra lutra</i>) [1364] Grey seal (<i>Halichoerus grypus</i>)

Site	Distance from S. I. Area (km)	Qualifying Features (Features screened in for assessment are in bold)
Gorllewin Cymru Forol / West Wales Marine SAC (UK0030397)	49	[1351] Harbour porpoise (<i>Phocoena phocoena</i>)
Bae Ceredigion / Cardigan Bay SAC (UK0012712)	134.9	[1110] Sandbanks which are slightly covered by seawater all the time [1170] Reefs [8330] Submerged or partially submerged sea caves [1095] Sea lamprey (<i>Petromyzon marinus</i>) [1099] River lamprey (<i>Lampetra fluviatilis</i>) [1349] Bottlenose dolphin (<i>Tursiops truncatus</i>) [1364] Grey seal (<i>Halichoerus grypus</i>)
Sir Benfro Forol / Pembrokeshire marine SAC (UK0013116)	175.2	[1364] Grey seal (<i>Halichoerus grypus</i>) [1130] Estuaries [1160] Large shallow inlets and bays [1170] Reefs [1110] Sandbanks which are slightly covered by sea water all the time [1140] Mudflats and sandflats not covered by seawater at low tide [1150] Coastal lagoons [1330] Atlantic salt meadows (<i>Glaucopuccinellietalia maritima</i>) [8330] Submerged or partially submerged sea caves [1441] Shore duck (<i>Rumex rupestris</i>) [1095] Sea lamprey (<i>Petromyzon marinus</i>) [1099] River lamprey (<i>Lampetra fluviatilis</i>)

Site	Distance from S. I. Area (km)	Qualifying Features (Features screened in for assessment are in bold)
		[1102] Allis shad (<i>Alosa alosa</i>) [[1103] Twaite shad (<i>Alosa fallax</i>) [1355] Otter (<i>Lutra lutra</i>)
Rockabill to Dalkey Island SAC (003000)	45.2	[1170] Reefs [1130] Estuaries [1160] Large shallow inlets and bays [1110] Sandbanks which are slightly covered [1351] Harbour porpoise (<i>Phocoena phocoena</i>)
Lambay Island SAC (000204)	47.5	[1170] Reefs [1230] Vegetated sea cliffs [1364] Grey seal (<i>Halichoerus grypus</i>) [1365] Harbour seal (<i>Phoca vitulina</i>)
SPAs		
Bae Lerpwl / Liverpool Bay SPA (UK9020294)	0	[A001] Red-throated diver (<i>Gavia stellata</i>) [A177] Little gull (<i>Larus minutus</i>) [A065] Common scoter (<i>Melanitta nigra</i>) [A195] Little tern (<i>Sterna albifrons</i>) [A193] Common tern (<i>Sterna hirundo</i>) [A999] Waterbird assemblages
Morwenoliaid Ynys Môn / Anglesey Terns SPA (UK9013061)	3.8	[A192] Roseate tern (<i>Sterna dougallii</i>) [A193] Common tern (<i>Sterna hirundo</i>) [A194] Arctic tern (<i>Sterna paradisaea</i>) [A191] Sandwich tern (<i>Sterna sandvicensis</i>)

Site	Distance from S. I. Area (km)	Qualifying Features (Features screened in for assessment are in bold)
Aber Dyfrdwy / Dee Estuary SPA (UK9013011)	13.3	[A054] Northern pintail (<i>Anas acuta</i>) [A052] Eurasian teal (<i>Anas crecca</i>) [A672] Dunlin (<i>Calidris alpina alpina</i>) [A143] Red knot (<i>Calidris canutus</i>) [A130] Eurasian oystercatcher (<i>Haematopus ostralegus</i>) [A157] Bar-tailed godwit (<i>Limosa lapponica</i>) [A616] Black-tailed godwit (<i>Limosa limosa islandica</i>) [A160] Eurasian curlew (<i>Numenius arquata</i>) [A141] Grey plover (<i>Pluvialis squatarola</i>) [A195] Little tern (<i>Sterna albifrons</i>) [A193] Common tern (<i>Sterna hirundo</i>) [A191] Sandwich tern (<i>Sterna sandvicensis</i>) [A048] Common shelduck (<i>Tadorna tadorna</i>)

Site	Distance from S. I. Area (km)	Qualifying Features (Features screened in for assessment are in bold)
		[A162] Common redshank (<i>Tringa tetanus</i>) [A999] Waterbird assemblages
Ynys Seiriol / Puffin Island SPA (UK9020285)	15.2	[A017] Cormorant (<i>Phalacrocorax carbo</i>)
Traeth Lafan / Lavan Sands, Conway Bay SPA (UK9013031)	19.9	[A130] Eurasian oystercatcher (<i>Haematopus ostralegus</i>) [A069] Red-breasted Merganser (<i>Mergus serrator</i>) [A160] Eurasian curlew (<i>Numenius arquata</i>) [A005] Great-crested grebe (<i>Podiceps cristatus</i>) [A162] Common redshank (<i>Tringa totanus</i>)
Mersey Narrows and North Wirral Foreshore SPA (UK9020287)	26.1	[A144] Sanderling (<i>Calidris alba</i>) [A672] Sanderling (<i>Calidris alpina alpina</i>) subspecies [A671] Sanderling (<i>Calidris canutus islandica</i>) subspecies [A130] Oystercatcher (<i>Haematopus Ostralegus</i>) [A177] Little Gull (<i>Larus minutus</i>) [A157] Bar-tailed Godwit (<i>Limosa lapponica</i>) [A017] Cormorant (<i>Phalacrocorax carbo</i>) [A141] Grey Plover (<i>Pluvialis squatarola</i>) [A193] Common Tern (<i>Sterna hirundo</i>) [A162] Redshank (<i>Tringa totanus</i>)
Ribble and Alt Estuaries SPA (UK9005103)	40.3	[A054] Northern pintail (<i>Anas acuta</i>) [A052] Eurasian teal (<i>Anas crecca</i>) [A050] Eurasian wigeon (<i>Anas penelope</i>)

Site	Distance from S. I. Area (km)	Qualifying Features (Features screened in for assessment are in bold)
		[A040] Pink-footed goose (<i>Anser brachyrhynchus</i>) [A062] Greater scaup (<i>Aythya marila</i>) [A144] Sanderling (<i>Calidris alba</i>) [A672] Dunlin (<i>Calidris alpina alpina</i>) [A143] Red knot (<i>Calidris canutus</i>) [A137] Ringed plover (<i>Charadrius hiaticula</i>) [A037] Tundra swan (<i>Cygnus columbianus bewickii</i>) [A038] Whooper swan (<i>Cygnus cygnus</i>) [A130] Eurasian oystercatcher (<i>Haematopus ostralegus</i>) [A183] Lesser black-backed gull (<i>Larus fuscus</i>) [A179] Black-headed gull (<i>Larus ridibundus</i>) [A157] Bar-tailed godwit (<i>Limosa lapponica</i>) [A616] Black-tailed godwit (<i>Limosa limosa islandica</i>) [A065] Common scoter (<i>Melanitta nigra</i>) [A160] Eurasian curlew (<i>Numenius arquata</i>) [A158] Whimbrel (<i>Numenius phaeopus</i>) [A017] Great cormorant (<i>Phalacrocorax carbo</i>) [A151] Ruff (<i>Philomachus pugnax</i>) [A140] European golden plover (<i>Pluvialis apricaria</i>) [A141] Grey plover (<i>Pluvialis squatarola</i>) [A193] Common tern (<i>Sterna hirundo</i>) [A048] Common shelduck (<i>Tadorna tadorna</i>)

Site	Distance from S. I. Area (km)	Qualifying Features (Features screened in for assessment are in bold)
		[A162] Common redshank (<i>Tringa totanus</i>) [A142] Northern lapwing (<i>Vanellus vanellus</i>)
Morecambe Bay and Duddon Estuary SPA (UK9020326)	74.6	[A054] Northern pintail (<i>Anas acuta</i>) [A040] Pink-footed goose (<i>Anser brachyrhynchus</i>) [A169] Turnstone (<i>Arenaria interpres</i>) [A144] Sanderling (<i>Calidris alba</i>) [A672] Dunlin (<i>Calidris alpina alpina</i>) [A143] Red knot (<i>Calidris canutus</i>) [A130] Eurasian oystercatcher (<i>Haematopus ostralegus</i>) [A137] Ringed plover (<i>Charadrius hiaticula</i>) [A038] Whooper swan (<i>Cygnus cygnus</i>) [A026] Little egret (<i>Egretta garzetta</i>) [A183] Lesser black-backed gull (<i>Larus fuscus</i>) [A184] Herring gull (<i>Larus argentatus</i>) [A176] Mediterranean gull (<i>Larus melanocephalus</i>) [A157] Bar-tailed godwit (<i>Limosa lapponica</i>) [A616] Black-tailed godwit (<i>Limosa limosa islandica</i>) [A160] Eurasian curlew (<i>Numenius arquata</i>) [A151] Ruff (<i>Philomachus pugnax</i>) [A140] European golden plover (<i>Pluvialis apricaria</i>) [A141] Grey plover (<i>Pluvialis squatarola</i>) [A195] Little tern (<i>Sterna albifrons</i>)

Site	Distance from S. I. Area (km)	Qualifying Features (Features screened in for assessment are in bold)
		[A193] Common tern (<i>Sterna hirundo</i>) [A191] Sandwich tern (<i>Sterna sandvicensis</i>) [A048] Common shelduck (<i>Tadorna tadorna</i>) [A162] Common redshank (<i>Tringa tetanus</i>)
Solway Firth SPA (UK9005012)	116.1	[A054] Northern pintail (<i>Anas acuta</i>) [A056] Ana clypeata (<i>Anas clypeata</i>) [A040] Pink-footed goose (<i>Anser brachyrhynchus</i>) [A169] Turnstone (<i>Arenaria interpres</i>) [A144] Sanderling (<i>Calidris alba</i>) [A672] Dunlin (<i>Calidris alpina alpina</i>) [A143] Red knot (<i>Calidris canutus</i>) [A130] Eurasian oystercatcher (<i>Haematopus ostralegus</i>) [A137] Ringed plover (<i>Charadrius hiaticula</i>) [A038] Whooper swan (<i>Cygnus cygnus</i>) [A026] Little egret (<i>Egretta garzetta</i>) [A183] Lesser black-backed gull (<i>Larus fuscus</i>) [A184] Herring gull (<i>Larus argentatus</i>) [A176] Mediterranean gull (<i>Larus melanocephalus</i>) [A157] Bar-tailed godwit (<i>Limosa lapponica</i>) [A616] Black-tailed godwit (<i>Limosa limosa islandica</i>) [A160] Eurasian curlew (<i>Numenius arquata</i>) [A151] Ruff (<i>Philomachus pugnax</i>)

Site	Distance from S. I. Area (km)	Qualifying Features (Features screened in for assessment are in bold)
		[A140] European golden plover (<i>Pluvialis apricaria</i>) [A141] Grey plover (<i>Pluvialis squatarola</i>) [A195] Little tern (<i>Sterna albifrons</i>) [A193] Common tern (<i>Sterna hirundo</i>) [A191] Sandwich tern (<i>Sterna sandvicensis</i>) [A048] Common shelduck (<i>Tadorna tadorna</i>) [A162] Common redshank (<i>Tringa tetanus</i>)
Strangford Lough SPA (UK9020111)	85.3	[A193] Common tern (<i>Sterna hirundo</i>) [A191] Sandwich tern (<i>Sterna sandvicensis</i>) [A194] Arctic tern (<i>Sterna paradisaea</i>) [A140] European golden plover (<i>Pluvialis apricaria</i>) [A157] Bar-tailed godwit (<i>Limosa lapponica</i>) [A046] Light-bellied Brent Goose (<i>Branta bernicla</i>) [A143] Red knot (<i>Calidris canutus</i>) [A162] Common redshank (<i>Tringa tetanus</i>) [A005] Great Crested Grebe (<i>Podiceps cristatus</i>) [A017] Great cormorant (<i>Phalacrocorax carbo</i>) [A043] Greylag goose (<i>Anser anser</i>) [A052] Eurasian teal (<i>Anas crecca</i>) [A050] Eurasian wigeon (<i>Anas penelope</i>) [A051] Gadwall (<i>Anas strepera</i>) [A053] Mallard (<i>Anas platyrhynchos</i>) [A054] Northern pintail (<i>Anas acuta</i>)

Site	Distance from S. I. Area (km)	Qualifying Features (Features screened in for assessment are in bold)
		[A056] Northern shoveler (<i>Anas clypeata</i>) [A067] Common goldeneye (<i>Bucephala clangula</i>) [A130] Eurasian oystercatcher (<i>Haematopus ostralegus</i>) [A069] Red-breasted Merganser (<i>Mergus serrator</i>) [A125] Eurasian coot (<i>Fulica atra</i>) [A141] Grey plover (<i>Pluvialis squatarola</i>) [A142] Northern lapwing (<i>Vanellus vanellus</i>) [A137] Common ringed Plover (<i>Charadrius hiaticula</i>) [A149] Dunlin (<i>Calidris alpina</i>) [A160] Eurasian curlew (<i>Numenius arquata</i>) [A169] Ruddy turnstone (<i>Arenaria interpres</i>) [A999] Wetland and waterbirds
Belfast Lough Open Water SPA (UK9020290)	127.5	[A005] Great Crested Grebe (<i>Podiceps cristatus</i>)
Outer Ards SPA (UK9020271)	87.8	[A194] Arctic Tern (<i>Sterna paradisaea</i>) [A140] European golden plover (<i>Pluvialis apricaria</i>) [A169] Ruddy turnstone (<i>Arenaria interpres</i>) [A046] Light-bellied Brent Goose (<i>Branta bernicla</i>)

Site	Distance from S. I. Area (km)	Qualifying Features (Features screened in for assessment are in bold)
		[A137] Common ringed Plover (<i>Charadrius hiaticula</i>)
Larne Lough SPA (UK9020042)	138.1	[A192] Roseate Tern (<i>Sterna dougalli</i>) [A193] Common Tern (<i>Sterna hirundo</i>) [A046] Light-bellied Brent Goose (<i>Branta bernicla</i>) [A191] Sandwich tern (<i>Thalasseus sandvicensis</i>) [A176] Mediterranean gull (<i>Larus melanocephalus</i>)
Carlingford Lough SPA (UK9020161)	73.7	[A193] Common Tern (<i>Sterna hirundo</i>) [A046] Light-bellied Brent Goose (<i>Branta bernicla</i>) [A191] Sandwich tern (<i>Thalasseus sandvicensis</i>)
Sgomer, Sgogwm a Moroedd Penfro / Skomer Skokholm and the Seas off Pembrokeshire SPA (UK9014051)	193.1	[A222] Short-eared owl (<i>Asio flammeus</i>) [A204] Atlantic puffin (<i>Fratercula arctica</i>) [A014] European storm petrel (<i>Hydrobates pelagicus</i>) [A183] Lesser black-backed gull (<i>Larus fuscus</i>) [A013] Manx shearwater (<i>Puffinus puffinus</i>) [A346] Red-billed chough (<i>Pyrrhocorax pyrrhocorax</i>)

Site	Distance from S. I. Area (km)	Qualifying Features (Features screened in for assessment are in bold)
Irish Sea Front SPA (UK9020328)	1.6	[A013] Manx shearwater (<i>Puffinus puffinus</i>)
Mersey Estuary SPA (UK9005131)	39.5	[A149] Dunlin (<i>Calidris alpina</i>) [A157] Bar-tailed Godwit (<i>Limosa lapponica</i>) [A162] Common redshank (<i>Tringa totanus</i>) [A140] European golden Plover (<i>Pluvialis apricaria</i>) [A054] Northern pintail (<i>Anas acuta</i>) [A048] Common shelduck (<i>Tadorna tadorna</i>) [A052] Eurasian teal (<i>Anas crecca</i>) [A999] Wetland and waterbirds
Gogledd Bae Ceredigion / Northern Cardigan Bay SPA (UK9020327)	59.2	[A001] Red-throated diver (<i>Gavia stellata</i>)
Ramsars		
The Dee Estuary Ramsar (Wales)	13.3	[A054] Northern pintail (<i>Anas acuta</i>) [A052] Eurasian teal (<i>Anas crecca</i>) [A672] Dunlin (<i>Calidris alpina alpina</i>) [A143] Red knot (<i>Calidris canutus</i>) [A130] Eurasian oystercatcher (<i>Haematopus ostralegus</i>) [A157] Bar-tailed godwit (<i>Limosa lapponica</i>) [A616] Black-tailed godwit (<i>Limosa limosa islandica</i>) [A160] Eurasian curlew (<i>Numenius arquata</i>) [A141] Grey plover (<i>Pluvialis squatarola</i>) [A195] Little tern (<i>Sterna albifrons</i>) [A193] Common tern (<i>Sterna hirundo</i>) [A191] Sandwich tern (<i>Sterna sandvicensis</i>) [A048] Common shelduck (<i>Tadorna tadorna</i>)

Site	Distance from S. I. Area (km)	Qualifying Features (Features screened in for assessment are in bold)
		[A162] Common redshank (<i>Tringa totanus</i>) [1140] Mudflats and sandflats not covered by sweater at low tide [1310] Salicornia and other annuals colonizing mud and sand [1330] Atlantic salt meadows (<i>Glaucopuccinellietalia maritimae</i>)
Duddon Estuary Ramsar (Site no. 938)	82.7	[A054] Northern pintail (<i>Anas acuta</i>) [A162] Common redshank (<i>Tringa totanus</i>) [A143] Red knot (<i>Calidris canutus</i>)
Mersey Estuary Ramsar (Site no. 785)	39.5	[A144] Sanderling (<i>Calidris alba</i>) [A672] Sanderling (<i>Calidris alpina alpina</i>) subspecies [A671] Sanderling (<i>Calidris canutus islandica</i>) subspecies [A130] Oystercatcher (<i>Haematopus ostralegus</i>) [A177] Little Gull (<i>Larus minutus</i>) [A157] Bar-tailed Godwit (<i>Limosa lapponica</i>) [A017] Cormorant (<i>Phalacrocorax carbo</i>) [A141] Grey Plover (<i>Pluvialis squatarola</i>) [A193] Common Tern (<i>Sterna hirundo</i>) [A162] Redshank (<i>Tringa totanus</i>)
Mersey Narrows and North Wirral Foreshore Ramsar (Site no. 2202)	26.1	[A157] Bar-tailed godwit (<i>Limosa lapponica</i>) [A193] Common tern (<i>Sterna hirundo</i>) [A143] Red knot (<i>Calidris canutus</i>) [A177] Little gull (<i>Hydrocoloeus minutus</i>)

Site	Distance from S. I. Area (km)	Qualifying Features (Features screened in for assessment are in bold)
		[A017] Great cormorant (<i>Phalacrocorax carbo</i>) [A130] Eurasian oystercatcher (<i>Haematopus ostralegus</i>) [A141] Grey Plover (<i>Pluvialis squatarola</i>) [A144] Sanderling (<i>Calidris alba</i>) [A149] Dunlin (<i>Calidris alpina</i>) [A162] Common redshank (<i>Tringa totanus</i>)
Morecambe Bay Ramsar (Site no. 863)	74.6	[A184] European herring gull (<i>Larus argentatus</i>) [A183] Lesser black-backed gull (<i>Larus fuscus</i>) [A191] Sandwich tern (<i>Thalasseus sandvicensis</i>) [A017] Great cormorant (<i>Phalacrocorax carbo</i>) [A054] Northern pintail (<i>Anas acuta</i>) [A048] Common shelduck (<i>Tadorna tadorna</i>) [A063] Northern Eider (<i>Somateria mollissima</i>) [A130] Eurasian oystercatcher (<i>Haematopus ostralegus</i>) [A141] Grey Plover (<i>Pluvialis squatarola</i>) [A137] Common ringed Plover (<i>Charadrius hiaticula</i>) [A144] Sanderling (<i>Calidris alba</i>) [A162] Common redshank (<i>Tringa totanus</i>) [A160] Eurasian curlew (<i>Numenius arquata</i>) [A005] Great Crested Grebe (<i>Podiceps cristatus</i>) [A040] Pink-footed goose (<i>Anser brachyrhynchus</i>)

Site	Distance from S. I. Area (km)	Qualifying Features (Features screened in for assessment are in bold)
		[A050] Eurasian wigeon (<i>Anas Penelope</i>) [A067] Common goldeneye (<i>Bucephala clangula</i>) [A069] Red-breasted merganser (<i>Mergus serrator</i>) [A140] European golden plover (<i>Pluvialis apricaria</i>) [A142] Northern lapwing (<i>Vanellus vanellus</i>) [A143] Red knot (<i>Calidris canutus</i>) [A149] Dunlin (<i>Calidris alpina</i>) [A157] Bar-tailed godwit (<i>Limosa lapponica</i>)
Ribble and Alt Estuaries Ramsar (Site no. 325)	40.3	[A054] Northern pintail (<i>Anas acuta</i>) [A052] Eurasian teal (<i>Anas crecca</i>) [A050] Eurasian wigeon (<i>Anas penelope</i>) [A040] Pink-footed goose (<i>Anser brachyrhynchus</i>) [A062] Greater scaup (<i>Aythya marila</i>) [A144] Sanderling (<i>Calidris alba</i>) [A672] Dunlin (<i>Calidris alpina alpina</i>) [A143] Red knot (<i>Calidris canutus</i>) [A137] Ringed plover (<i>Charadrius hiaticula</i>) [A037] Tundra swan (<i>Cygnus columbianus bewickii</i>) [A038] Whooper swan (<i>Cygnus cygnus</i>) [A130] Eurasian oystercatcher (<i>Haematopus ostralegus</i>) [A183] Lesser black-backed gull (<i>Larus fuscus</i>) [A179] Black-headed gull (<i>Larus ridibundus</i>)

Site	Distance from S. I. Area (km)	Qualifying Features (Features screened in for assessment are in bold)
		[A157] Bar-tailed godwit (<i>Limosa lapponica</i>) [A616] Black-tailed godwit (<i>Limosa limosa islandica</i>) [A065] Common scoter (<i>Melanitta nigra</i>) [A160] Eurasian curlew (<i>Numenius arquata</i>) [A158] Whimbrel (<i>Numenius phaeopus</i>) [A017] Great cormorant (<i>Phalacrocorax carbo</i>) [A151] Ruff (<i>Philomachus pugnax</i>) [A140] European golden plover (<i>Pluvialis apricaria</i>) [A141] Grey plover (<i>Pluvialis squatarola</i>) [A193] Common tern (<i>Sterna hirundo</i>) [A048] Common shelduck (<i>Tadorna tadorna</i>) [A162] Common redshank (<i>Tringa totanus</i>) [A142] Northern lapwing (<i>Vanellus vanellus</i>)
Upper Solway Flats and Marshes Ramsar (Site no. 341)	154.9	[A130] Eurasian oystercatcher (<i>Haematopus ostralegus</i>) [A038] Whooper swan (<i>Cygnus cygnus</i>) [A040] Pink-footed goose (<i>Anser brachyrhynchus</i>) [A045] Barnacle goose (<i>Branta leucopsis</i>) [A054] Northern pintail (<i>Anas acuta</i>) [A062] Greater scaup (<i>Aythya marila</i>) [A157] Bar-tailed godwit (<i>Limosa lapponica</i>) [A162] Common redshank (<i>Tringa totanus</i>) [A143] Red knot (<i>Calidris canutus</i>) [A160] Eurasian curlew (<i>Numenius arquata</i>) [A149] Dunlin (<i>Calidris alpina</i>)

Site	Distance from S. I. Area (km)	Qualifying Features (Features screened in for assessment are in <u>bold</u>)
		[A137] Common ringed Plover (<i>Charadrius hiaticula</i>) [A184] European herring gull (<i>Larus argentatus</i>) [A183] Lesser black-backed gull (<i>Larus fuscus</i>)

5. Potential effects of the proposed works

5.1 The Assessment Process

The process of testing for significant effects considers the adverse effects that might arise from the work activities and identifies whether or not there is a probability that each adverse effect can affect each European Sites and their interest features.

The process that is followed is to identify if the works will generate effects that could affect any of the interest features of the relevant European Sites. At this point, the pathway will be identified and what may reduce or prevent the effects reaching the relevant European Sites. Only when there is a source, a pathway and an effect that reaches the interest feature is it judged that there is an LSE that requires the more detailed assessment that is carried out at the Appropriate Assessment stage.

Potential adverse effects of the work activities on European Sites have been identified using a combination of:

- Conservation advice provided by Natural Resources Wales in fulfilment of Regulation 37 of the Conservation of Habitats and Species Regulation 2017 (2018)²;
- Natural England's Advice on Operations (AoO); and
- Professional judgement based on experience of conducting numerous assessments of similar work activities in the vicinity of European and Ramsar Sites.

In Section 6, a table is provided for the Screening Stage of the HRA which details the test for LSE and the following information:

- The pressures being considered (derived from the above sources of conservation advice and professional judgement);
- The features being assessed;
- Whether alone, or in-combination, there is an LSE for each pressure / feature combination; and
- Justification for the assessment.

² Accessed via <https://naturalresources.wales/guidance-and-advice/environmental-topics/wildlife-and-biodiversity/protected-areas-of-land-and-seas/conservation-advice-for-european-marine-sites/?lang=en>

Pressures indicated as being of medium-high risk which could be associated with the work activities and that could affect European Site features were considered in this screening. These pressures were as follows:

- Above water noise;
- Visual disturbance;
- Underwater noise changes and vibration;
- Collision below water and static or moving objects not naturally found in the marine environment;
- Pollution from vessels and equipment (Hydrocarbon & Polycyclic Aromatic Hydrocarbon (PAH) contamination); and
- Reduction in prey availability (all aspects of survey generating underwater noise and vibration).

The following medium-high risk pressures that were not anticipated to be associated with the proposed works and / or did not have the potential to affect designated site features were not included in the screening, in line with the AoO guidance:

- Abrasion / disturbance of the substrate on the surface of the seabed;
- Penetration and /or disturbance of the substratum below the surface of the seabed, including abrasion;
- Smothering and siltation rate changes (light);
- Introduction or spread of invasive non-native species (INNS);
- Barrier to species movement;
- Habitat structure changes – removal of substratum (extraction);
- Physical change (to another seabed type);
- Physical change (to another sediment type);
- Physical loss (to land or freshwater habitat); and
- Smothering and siltation rate changes (heavy).

The following low risk pressures were also not included in the screening, in line with the AoO guidance:

- Deoxygenation;
- Genetic modification & translocation of indigenous species;
- Introduction of light;
- Introduction of microbial pathogens;
- Introduction of other substances (solid, liquid or gas);
- Litter;

- Nutrient enrichment;
- Organic enrichment;
- Radionuclide contamination;
- Salinity decrease;
- Salinity increase;
- Synthetic compound contamination (inc. pesticides, antifoulants, pharmaceuticals);
- Temperature decrease;
- Temperature increase;
- Transition elements & organo-metal contamination;
- Water flow (tidal current) changes, including sediment transport considerations; and
- Wave exposure changes.

6. Screening: Testing for LSE

The table below details the test for LSE for the qualifying features within the European Sites taken forward for assessment (Table 4).

Table 4. HRA screening for European and Ramsar Sites within the vicinity of the Project.

Site name	Qualifying feature or species (include sub-features and supporting habitats)	Pressure	LSE?	Justification	Screened in / Screened out?
Gogledd Mon Forol / North Anglesey Marine SAC (UK0030398)	[1351] Harbour Porpoise (<i>Phocoena phocoena</i>)	Underwater noise and vibration	Yes	Survey activities could disturb harbour porpoise due to underwater noise and vibration, therefore there is potential for LSE.	Screened in Harbour porpoise
		Collision risk	No	The risk of and outcome (e.g., injury or mortality) of collision between marine mammals and vessels is directly influenced by the type of vessel and the speed at which it is travelling (Laist <i>et al.</i> 2001). Studies from the UK suggest that incidents of mortality or injury of harbour porpoise caused by vessels remain a very rare occurrence, although numerous instances are expected to remain unreported (Thompson <i>et al.</i> 2013; Deaville <i>et al.</i> 2018). Of 537 post-mortem examinations on stranded harbour porpoises in the UK between 2011 and 2017, 10 deaths (1.9%) were attributed to probable effect of a vessel collision (Deaville <i>et al.</i> 2018). A further 33 harbour porpoises died from physical trauma of unknown origin, which may be the result of vessel strike but could also be undiagnosed bycatch or caused by bottlenose dolphin attacks (Deaville <i>et al.</i> 2018). Given the slow speeds and predictable movement of the vessels on survey, the risk of collision is	

Site name	Qualifying feature or species (include sub-features and supporting habitats)	Pressure	LSE?	Justification	Screened in / Screened out?
				considered negligible and as such, there is no LSE from this impact pathway.	
		Pollution	No	Pollution will be controlled by adhering to relevant MARPOL guidance for pollution prevention and marine pollution legislation for which compliance is required by law. All vessels will be MARPOL compliant. Published guidelines and best working practices will be followed to ensure that the likelihood of accidental spills is extremely low. This compliance is a basic requirement under UK law and should be adhered to even when no European Sites are involved and is therefore not considered mitigation for the purposes of HRA. Furthermore, in the event of a spill, the volumes of potential contaminants released would likely be small and would rapidly disperse, thus any effects would be anticipated to be negligible, and therefore will have no LSE.	
		Reduction in prey availability (all aspects of survey generating underwater	No	Prey species of harbour porpoise may be affected by the survey activities due to disturbance; however, the number of individuals will be small in relation to the availability of prey in the wider area. The activity is relatively short in nature, meaning any displacement of prey is likely to be short term. Harbour porpoise are a highly mobile species and	

Site name	Qualifying feature or species (include sub-features and supporting habitats)	Pressure	LSE?	Justification	Screened in / Screened out?
		noise and vibration)		could move to other nearby prey patches, therefore, any potential impact on prey species is likely to have negligible to no effect and there would be no LSE.	
Pen Llyn a'r Sarnau/ Llyn Peninsula and the Sarnau SAC (UK0013117)	[1349] Bottlenose dolphin (<i>Tursiops truncatus</i>) [1355] Otter (<i>Lutra lutra</i>) [1364] Grey seal (<i>Halichoerus grypus</i>)	Underwater noise and vibration	Yes	Survey activities could disturb bottlenose dolphins and grey seals due to underwater noise and vibration, therefore there is potential for LSE.	Screened in Bottlenose dolphin
		Collision risk	No	The risk of and outcome (e.g. injury or mortality) of collision between marine mammals and vessels is directly influenced by the type of vessel and the speed at which it is travelling (Laist <i>et al.</i> 2001). A review of collisions between vessels and large marine megafauna did find reports of vessel collisions with grey seals (Schoeman <i>et al.</i> 2020). However, vessel collisions appear to be rare, although a lack of reporting and/or witnessing of such events should not be ruled out. Of 23 post-mortem examinations on stranded bottlenose dolphins in the UK between 2011 and 2017, no deaths were attributed to probable effect of a vessel collision, and one animal died from physical trauma of unknown origin (Deaville <i>et al.</i> 2018). Given the slow speeds and predictable movement of the vessels on survey, the risk of	Grey seal

Site name	Qualifying feature or species (include sub-features and supporting habitats)	Pressure	LSE?	Justification	Screened in / Screened out?
				collision is considered negligible and as such, there is no LSE from this impact pathway. Otters can be found near the coastline where there is a freshwater source. They can use the marine environment to forage; however, foraging is usually close to shore, often within 100 m (Watson 1986). Otters can travel a number of kilometres, ca. 5 km in coastal waters, however, this site is 49 km from the survey area. As such, they are unlikely to be in the survey area and it is considered that there will be no LSE to otters.	
		Pollution	No	Pollution will be controlled by adhering to relevant MARPOL guidance for pollution prevention and marine pollution legislation for which compliance is required by law. All vessels will be MARPOL compliant. Published guidelines and best working practices will be followed to ensure that the likelihood of accidental spills is extremely low. This compliance is a basic requirement under UK law and should be adhered to even when no European Sites are involved and is therefore not considered mitigation for the purposes of HRA. Furthermore, in the event of a spill, the volumes of potential contaminants released would likely be small and would rapidly disperse, thus any effects would be anticipated to be negligible, and therefore will have no LSE.	

Site name	Qualifying feature or species (include sub-features and supporting habitats)	Pressure	LSE?	Justification	Screened in / Screened out?
		Reduction in prey availability (all aspects of survey generating underwater noise and vibration)	No	Prey species of bottlenose dolphins and grey seals may be affected by the survey activities due to disturbance; however, the number of individuals will be small in relation to the availability of prey in the wider area. The activity is relatively short in nature, meaning any displacement of prey is likely to be short term. Bottlenose dolphins and grey seals are highly mobile and could move to other nearby prey patches, therefore, any potential impact on prey species is likely to have negligible to no effect and there will be no LSE.	
Gorllewin Cymru Sarnau / West Wales Marine SAC (UK0030397)	[1351] Harbour Porpoise (<i>Phocoena phocoena</i>)	Underwater noise and vibration	Yes	Survey activities could disturb harbour porpoise due to underwater noise and vibration, therefore there is potential for LSE.	Screened in Harbour porpoise
		Collision risk	No	The risk of and outcome (e.g. injury or mortality) of collision between marine mammals and vessels is directly influenced by the type of vessel and the speed at which it is travelling (Laist <i>et al.</i> 2001). Studies from the UK suggest that incidents of mortality or injury of harbour porpoise caused by vessels remain a very rare occurrence, although numerous instances are expected to remain unreported (Thompson <i>et al.</i> 2013; Deaville <i>et al.</i> 2018). Of 537 post-mortem examinations on stranded harbour porpoises in the UK between 2011 and 2017, 10 deaths (1.9%) were attributed to probable effect of a vessel collision (Deaville <i>et al.</i> 2018). A further 33 harbour porpoises died	

Site name	Qualifying feature or species (include sub-features and supporting habitats)	Pressure	LSE?	Justification	Screened in / Screened out?
				from physical trauma of unknown origin, which may be the result of vessel strike but could also be undiagnosed bycatch or caused by bottlenose dolphin attacks (Deaville <i>et al.</i> 2018). Given the slow speeds and predictable movement of the vessels on survey, the risk of collision is considered negligible and as such, there is no LSE from this impact pathway	
		Pollution	No	Pollution will be controlled by adhering to relevant MARPOL guidance for pollution prevention and marine pollution legislation for which compliance is required by law. All vessels will be MARPOL compliant. Published guidelines and best working practices will be followed to ensure that the likelihood of accidental spills is extremely low. This compliance is a basic requirement under UK law and should be adhered to even when no European Sites are involved and is therefore not considered mitigation for the purposes of HRA. Furthermore, in the event of a spill, the volumes of potential contaminants released would likely be small and would rapidly disperse, thus any effects would be anticipated to be negligible, and therefore will have no LSE.	
		Reduction in prey availability (all aspects)	No	Prey species of bottlenose dolphins and grey seals may be affected by the survey activities due to disturbance; however, the number of individuals will be small in relation to the availability of prey in	

Site name	Qualifying feature or species (include sub-features and supporting habitats)	Pressure	LSE?	Justification	Screened in / Screened out?
		of survey generating underwater noise and vibration)		the wider area. The activity is relatively short in nature, meaning any displacement of prey is likely to be short term. Bottlenose dolphins and grey seals are highly mobile and could move to other nearby prey patches, therefore, any potential impact on prey species is likely to have negligible to no effect and there will be no LSE.	
Bae Ceridigion / Cardigan Bay SAC (UK0012712)	[1364] Grey seal (<i>Halichoerus grypus</i>) [1349] Bottlenose dolphin (<i>Tursiops truncatus</i>)	Underwater noise and vibration	Yes	Survey activities could disturb bottlenose dolphins and grey seals due to underwater noise and vibration, therefore there is potential for LSE.	Screened In Bottlenose dolphin
		Collision risk	No	The risk of and outcome (e.g. injury or mortality) of collision between marine mammals and vessels is directly influenced by the type of vessel and the speed at which it is travelling (Laist <i>et al.</i> 2001). A review of collisions between vessels and large marine megafauna did find reports of vessel collisions with grey seals (Schoeman <i>et al.</i> 2020). However, vessel collisions appear to be rare, although a lack of reporting and/or witnessing of such events should not be ruled out. Of 23 post-mortem examinations on stranded bottlenose dolphins in the UK between 2011 and 2017, no deaths were attributed to probable effect of a vessel collision, and one animal died from physical trauma of unknown origin (Deaville <i>et al.</i> 2018). Given the slow speeds and predictable	Grey seal

Site name	Qualifying feature or species (include sub-features and supporting habitats)	Pressure	LSE?	Justification	Screened in / Screened out?
				movement of the vessels on survey, the risk of collision is considered negligible and as such, there is no LSE from this impact pathway	
		Pollution	No	Pollution will be controlled by adhering to relevant MARPOL guidance for pollution prevention and marine pollution legislation for which compliance is required by law. All vessels will be MARPOL compliant. Published guidelines and best working practices will be followed to ensure that the likelihood of accidental spills is extremely low. This compliance is a basic requirement under UK law and should be adhered to even when no European Sites are involved and is therefore not considered mitigation for the purposes of HRA. Furthermore, in the event of a spill, the volumes of potential contaminants released would likely be small and would rapidly disperse, thus any effects would be anticipated to be negligible, and therefore will have no LSE.	
		Reduction in prey availability (all aspects of survey generating underwater	No	Prey species of bottlenose dolphins and grey seals may be affected by the survey activities due to disturbance; however, the number of individuals will be small in relation to the availability of prey in the wider area. The activity is relatively short in nature, meaning any displacement of prey is likely to be short term. Bottlenose dolphins and grey seals are highly mobile and could move to other	

Site name	Qualifying feature or species (include sub-features and supporting habitats)	Pressure	LSE?	Justification	Screened in / Screened out?
		noise and vibration)		nearby prey patches, therefore, any potential impact on prey species is likely to have negligible to no effect and there will be no LSE.	
Sir Benfro Forol / Pembrokeshire Marine SAC (UK0013116)	[1364] Grey seal (<i>Halichoerus grypus</i>)	Underwater noise and vibration	Yes	Survey activities could disturb grey seals due to underwater noise and vibration, therefore there is potential for LSE.	Screened in Grey seal
		Collision risk	No	The risk of and outcome (e.g. injury or mortality) of collision between marine mammals and vessels is directly influenced by the type of vessel and the speed at which it is travelling (Laist <i>et al.</i> 2001). A review of collisions between vessels and large marine megafauna did find reports of vessel collisions with grey seals (Schoeman <i>et al.</i> 2020). However, vessel collisions appear to be rare, although a lack of reporting and/or witnessing of such events should not be ruled out. Given the slow speeds and predictable movement of the vessels on survey, the risk of collision is considered negligible and as such, there is no LSE from this impact pathway	
		Pollution	No	Pollution will be controlled by adhering to relevant MARPOL guidance for pollution prevention and marine pollution legislation for which compliance is required by law. All vessels will be MARPOL compliant. Published guidelines and best working	

Site name	Qualifying feature or species (include sub-features and supporting habitats)	Pressure	LSE?	Justification	Screened in / Screened out?
				practices will be followed to ensure that the likelihood of accidental spills is extremely low. This compliance is a basic requirement under UK law and should be adhered to even when no European Sites are involved and is therefore not considered mitigation for the purposes of HRA. Furthermore, in the event of a spill, the volumes of potential contaminants released would likely be small and would rapidly disperse, thus any effects would be anticipated to be negligible, and therefore will have no LSE.	
		Reduction in prey availability (all aspects of survey generating underwater noise and vibration)	No	Prey species of grey seals may be affected by the survey activities due to disturbance; however, the number of individuals will be small in relation to the availability of prey in the wider area. The activity is relatively short in nature, meaning any displacement of prey is likely to be short term. Bottlenose dolphins and grey seals are highly mobile and could move to other nearby prey patches, therefore, any potential impact on prey species is likely to have negligible to no effect and there will be no LSE.	
Rockabill to Dalkey Island SAC (003000)	[1351] Harbour porpoise (<i>Phocoena phocoena</i>)	Underwater noise and vibration	Yes	Survey activities could disturb harbour porpoise due to underwater noise and vibration, therefore there is potential for LSE.	Screened in

Site name	Qualifying feature or species (include sub-features and supporting habitats)	Pressure	LSE?	Justification	Screened in / Screened out?
		Collision risk	No	The risk of and outcome (e.g. injury or mortality) of collision between marine mammals and vessels is directly influenced by the type of vessel and the speed at which it is travelling (Laist <i>et al.</i> 2001). Studies from the UK suggest that incidents of mortality or injury of harbour porpoise caused by vessels remain a very rare occurrence, although numerous instances are expected to remain unreported (Thompson <i>et al.</i> 2013; Deaville <i>et al.</i> 2018). Of 537 post-mortem examinations on stranded harbour porpoises in the UK between 2011 and 2017, 10 deaths (1.9%) were attributed to probable effect of a vessel collision (Deaville <i>et al.</i> 2018). A further 33 harbour porpoises died from physical trauma of unknown origin, which may be the result of vessel strike but could also be undiagnosed bycatch or caused by bottlenose dolphin attacks (Deaville <i>et al.</i> 2018). Given the slow speeds and predictable movement of the vessels on survey, the risk of collision is considered negligible and as such, there is no LSE from this impact pathway	Harbour porpoise
		Pollution	No	Pollution will be controlled by adhering to relevant MARPOL guidance for pollution prevention and marine pollution legislation for which compliance is required by law. All vessels will be MARPOL compliant. Published guidelines and best working practices will be followed to ensure that the	

Site name	Qualifying feature or species (include sub-features and supporting habitats)	Pressure	LSE?	Justification	Screened in / Screened out?
				likelihood of accidental spills is extremely low. This compliance is a basic requirement under UK law and should be adhered to even when no European Sites are involved and is therefore not considered mitigation for the purposes of HRA. Furthermore, in the event of a spill, the volumes of potential contaminants released would likely be small and would rapidly disperse, thus any effects would be anticipated to be negligible, and therefore will have no LSE. Pollution will be controlled by adhering to relevant guidance for pollution prevention and marine pollution legislation for which compliance is required by law. Furthermore, in the event of a spill, the volumes of potential contaminants released would likely be small and would rapidly disperse, thus any effects would be anticipated to be negligible, and therefore will have no LSE.	
		Reduction in prey availability (all aspects of survey generating underwater noise and vibration)	No	Prey species of harbour porpoise may be affected by the survey activities due to disturbance; however, the number of individuals will be small in relation to the availability of prey in the wider area. The activity is relatively short in nature, meaning any displacement of prey is likely to be short term. Harbour porpoise are a highly mobile species and could move to other nearby prey patches, therefore, any potential impact on prey species is	

Site name	Qualifying feature or species (include sub-features and supporting habitats)	Pressure	LSE?	Justification	Screened in / Screened out?
				likely to have negligible to no effect and there would be no LSE.	
Lambay Island SAC (000204)	[1365] Harbour seal (<i>Phoca vitulina</i>) [1364] Grey seal (<i>Halichoerus grypus</i>)	Underwater noise and vibration	Yes	Survey activities could disturb grey and harbour seals due to underwater noise and vibration, therefore there is potential for LSE.	Screened in Grey seal Harbour seal
		Collision risk	No	The risk of and outcome (e.g. injury or mortality) of collision between marine mammals and vessels is directly influenced by the type of vessel and the speed at which it is travelling (Laist <i>et al.</i> 2001). A review of collisions between vessels and large marine megafauna did find reports of vessel collisions with grey seals (Schoeman <i>et al.</i> 2020). However, vessel collisions appear to be rare, although a lack of reporting and/or witnessing of such events should not be ruled out. Given the slow speeds and predictable movement of the vessels on survey, the risk of collision is considered negligible and as such, there is no LSE from this impact pathway	
		Pollution	No	Pollution will be controlled by adhering to relevant MARPOL guidance for pollution prevention and marine pollution legislation for which compliance is required by law. All vessels will be MARPOL	

Site name	Qualifying feature or species (include sub-features and supporting habitats)	Pressure	LSE?	Justification	Screened in / Screened out?
				compliant. Published guidelines and best working practices will be followed to ensure that the likelihood of accidental spills is extremely low. This compliance is a basic requirement under UK law and should be adhered to even when no European Sites are involved and is therefore not considered mitigation for the purposes of HRA. Furthermore, in the event of a spill, the volumes of potential contaminants released would likely be small and would rapidly disperse, thus any effects would be anticipated to be negligible, and therefore will have no LSE.	
		Reduction in prey availability (all aspects of survey generating underwater noise and vibration)	No	Prey species of grey and harbour seals may be affected by the survey activities due to disturbance; however, the number of individuals will be small in relation to the availability of prey in the wider area. The activity is relatively short in nature, meaning any displacement of prey is likely to be short term. Grey and harbour seals are highly mobile and could move to other nearby prey patches, therefore, any potential impact on prey species is likely to have negligible to no effect and there will be no LSE.	

Bae Lerpwl / Liverpool Bay SPA (UK9020294)	• [A001] Red-throated diver (<i>Gavia stellata</i>) • [A177] Little gull (<i>Larus minutus</i>) • [A195] Little tern (<i>Sterna albifrons</i>) • [A193] Common tern (<i>Sterna hirundo</i>) • [A999] Waterbird assemblages	Short term reduction in prey availability Visual and noise disturbance	No No	Survey work carried out for the proposed Mona Offshore wind farm which is close to S.I works area recorded few counts of these species, with red throated diver only observed in the northern section of the Liverpool Bay SPA from August onwards in low numbers. Tern species were observed through the breeding and post-breeding months in low numbers. Little gull was recorded predominantly to the north of the S.I works location with no recordings of Common scoter within the Mona OWF study Survey area. Its therefore concluded that while the proposed S.I. works location is within the mean max foraging range +1 S.D for some of the species under protection at this site these species occur at relatively low densities. The proposed slit trench geotechnical samples will likely cause short term disturbance within a small area of the SPA along foreshore and shoreline. This effect is expected to be negligible on the species listed as only a small area of habitat will be disturbed for a short period, with access to large areas of similar habitat unrestricted indicating there will be limited restrictions on resource access. The proposed work is not expected to significantly impact the foraging or breeding behaviour as a) the work is carried over short time scales intermittently over the breeding and post-breeding	Screened out
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				seasons, b) activities carry a low degree of disturbance effects, c) species which do avoid boats are unlikely to be excluded from significant proportions of the habitat, minimising effects on behaviours and foraging opportunities. Terns show minimal responses to boat presence and with the small increase in vessel numbers compared to the vessel traffic already present in the area it is unlikely the S.I. works will have any significant effect. It is therefore concluded that while the proposed S.I. works location is partially or fully within the mean max foraging range +1 S.D for tern species the proposed work is not expected to significantly impact the foraging or breeding behaviour as a) the work is carried over short time scales intermittently over the breeding and post-breeding seasons, b) activities carry a low degree of disturbance effects.	
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Site name	Qualifying feature or species (include sub-features and supporting habitats)	Pressure	LSE?	Justification	Screened in / Screened out?
Morwenoliaid Ynys Môn / Anglesey Terns SPA (UK9013061)	[A192] Roseate tern (<i>Sterna dougallii</i>) [A193] Common tern (<i>Sterna hirundo</i>) [A194] Arctic tern (<i>Sterna paradisaea</i>) [A191] Sandwich tern (<i>Sterna sandvicensis</i>)	Short term reduction in prey availability Visual and noise disturbance	No No	The majority of protected features are near shore/intertidal foraging species and therefore survey impacts are expected to be negligible. These species would only be potentially affected during the migratory period, please see section 6.1 below. Terns show minimal responses to boat presence and with the small increase in vessel numbers compared to the vessel traffic already present in the area it is unlikely the S.I. works will have any significant effect. Its therefore concluded that while the proposed S.I. works location is partially or fully within the within the mean max foraging range +1 S.D for tern species the proposed work is not expected to significantly impact the foraging or breeding behaviour as a) the work is carried over short time scales intermittently over the breeding and post-breeding seasons, b) activities carry a low degree of disturbance effects.	Screened out
Dee Estuary SPA (UK9013011)	[A195] Little tern (<i>Sterna albifrons</i>) [A193] Common tern (<i>Sterna hirundo</i>) [A191] Sandwich tern (<i>Sterna sandvicensis</i>)	Short term reduction in prey availability Visual and noise disturbance	No No	The proposed work is not expected to significantly impact the foraging or breeding behaviour as a) the work is carried over short time scales intermittently over the breeding and post-breeding seasons, b) activities carry a low degree of disturbance effects, c) there are low densities of these species over the majority of the S.I works area and d) the proposed work are unlikely to	Screened out

Site name	Qualifying feature or species (include sub-features and supporting habitats)	Pressure	LSE?	Justification	Screened in / Screened out?
	[A999] Waterbird assemblages			exclude the protected species from significant proportions of the habitat, minimising effects on behaviours and foraging opportunities. Terns show minimal responses to boat presence and with the small increase in vessel numbers compared to the vessel traffic already present in the area it is unlikely the S.I. works will have any significant effect. Its therefore concluded that while the proposed S.I. works location is partially or fully within the within the mean max foraging range +1 S.D for tern species the proposed work is not expected to significantly impact the foraging or breeding behaviour as a) the work is carried over short time scales intermittently over the breeding and post-breeding seasons, b) activities carry a low degree of disturbance effects.	
Ynys Seiriol / Puffin Island SPA (UK9020285)	[A017] Cormorant (<i>Phalacrocorax carbo</i>)	Short term reduction in prey availability Visual and noise disturbance	No No	The proposed S.I. works location is out with the mean max foraging range +1 S.D for the species under protection at this site. The proposed work is not expected to significantly impact the foraging or breeding behaviour as a) the work is carried over short time scales intermittently over the breeding and post-breeding seasons, b) activities carry a low degree of disturbance effects, c) there are low densities of these species over the majority of the S.I works area and d) the proposed work are unlikely to exclude the protected species from	Screened out

Site name	Qualifying feature or species (include sub-features and supporting habitats)	Pressure	LSE?	Justification	Screened in / Screened out?
				significant proportions of the habitat, minimising effects on behaviours and foraging opportunities.	
Traeth Lafan/Lavan Sands, Conway Bay SPA (UK9013031)	[A130] Eurasian oystercatcher (<i>Haematopus ostralegus</i>)	Short term reduction in prey availability Visual and noise disturbance	No No	This is a near shore/intertidal foraging species and therefore survey impacts are expected to be negligible. This species would only be potentially affected during the migratory period, please see section 6.1 below.	Screened out
Mersey Narrows and North Wirral Foreshore SPA (UK9020287)	[A130] Oystercatcher (<i>Haematopus</i> <i>Ostralegus</i>) [A177] Little Gull (<i>Larus minutus</i>) [A193] Common Tern (<i>Sterna hirundo</i>)	Short term reduction in prey availability	No	The majority of protected features are near shore/intertidal foraging and waterbird species and therefore survey impacts are expected to be negligible. These species would only be potentially affected during the migratory period, please see section 6.1 below. Terns show minimal responses to boat presence and with the small increase in vessel numbers compared to the vessel traffic already present in the area it is unlikely the S.I. works will have any significant effect. Gull species are wide ranging and rarely dive. They show minimal disturbance response to boat presence and are often attracted to them due to local fishing activities and with the small increase	Screened out

Site name	Qualifying feature or species (include sub-features and supporting habitats)	Pressure	LSE?	Justification	Screened in / Screened out?
				in vessel numbers compared to the vessel traffic already present in the area it is unlikely the S.I. works will have any significant effect. Its therefore concluded that while the proposed S.I. works location is partially or fully within the within the mean max foraging range +1 S.D for species at this site as the proposed work is not expected to significantly impact the foraging or breeding behaviour as a) the work is carried over short time scales intermittently over the breeding and post-breeding seasons, b) activities carry a low degree of disturbance effects.	
Ribble and Alt Estuaries SPA (UK9005103)	• [A183] Lesser black-backed gull (<i>Larus fuscus</i>) • [A179] Black-headed gull (<i>Larus ridibundus</i>) • [A193] Common tern (<i>Sterna hirundo</i>)	Short term reduction in prey availability Visual and noise disturbance	No	The majority of protected features are near shore/intertidal foraging species and therefore survey impacts are expected to be negligible. These species would only be potentially affected during the migratory period, please see section 6.1 below. Terns show minimal responses to boat presence and with the small increase in vessel numbers compared to the vessel traffic already present in the area it is unlikely the S.I. works will have any significant effect. Gull species are wide ranging and rarely dive. They show minimal disturbance response to boat	Screened out

Site name	Qualifying feature or species (include sub-features and supporting habitats)	Pressure	LSE?	Justification	Screened in / Screened out?
				presence and are often attracted to them due to local fishing activities and with the small increase in vessel numbers compared to the vessel traffic already present in the area it is unlikely the S.I. works will have any significant effect. Its therefore concluded that while the proposed S.I. works location is partially or fully within the within the mean max foraging range +1 S.D for species present on site as the proposed work is not expected to significantly impact the foraging or breeding behaviour as a) the work is carried over short time scales intermittently over the breeding and post-breeding seasons, b) activities carry a low degree of disturbance effects.	
Morecambe Bay and Duddon Estuary SPA (UK9020326)	• [A130] Eurasian oystercatcher (<i>Haematopus ostralegus</i>) • [A183] Lesser black-backed gull (<i>Larus fuscus</i>) • [A184] Herring gull (<i>Larus argentatus</i>) • [A176] Mediterranean gull (<i>Larus melanocephalus</i>) • [A195] Little tern (<i>Sterna albifrons</i>) • [A193] Common tern (<i>Sterna hirundo</i>)	Short term reduction in prey availability Visual and noise disturbance	No	The majority of protected features are near shore/intertidal foraging species and therefore survey impacts are expected to be negligible. These species would only be potentially affected during the migratory period, please see section 6.1 below. Terns show minimal responses to boat presence and with the small increase in vessel numbers compared to the vessel traffic already present in the area it is unlikely the S.I. works will have any significant effect.	Screened out

Site name	Qualifying feature or species (include sub-features and supporting habitats)	Pressure	LSE?	Justification	Screened in / Screened out?
	[A191] Sandwich tern (<i>Sterna sandvicensis</i>)			Gull species are wide ranging and rarely dive. They show minimal disturbance response to boat presence and are often attracted to them due to local fishing activities and with the small increase in vessel numbers compared to the vessel traffic already present in the area it is unlikely the S.I. works will have any significant effect. Its therefore concluded that while the proposed S.I. works location is partially or fully within the within the mean max foraging range +1 S.D for species present on site the proposed work is not expected to significantly impact the foraging or breeding behaviour as a) the work is carried over short time scales intermittently over the breeding and post-breeding seasons, b) activities carry a low degree of disturbance effects.	
Solway Firth SPA (UK9005012)	[A130] Eurasian oystercatcher (<i>Haematopus ostralegus</i>) [A183] Lesser black-backed gull (<i>Larus fuscus</i>) [A184] Herring gull (<i>Larus argentatus</i>) [A176] Mediterranean gull (<i>Larus melanocephalus</i>) [A195] Little tern (<i>Sterna albifrons</i>)	Short term reduction in prey availability Visual and noise disturbance	No	The majority of protected features are near shore/intertidal foraging species and therefore survey impacts are expected to be negligible. These species would only be potentially affected during the migratory period, please see section 6.1 below. Terns show minimal responses to boat presence and with the small increase in vessel numbers compared to the vessel traffic already present in	Screened out

Site name	Qualifying feature or species (include sub-features and supporting habitats)	Pressure	LSE?	Justification	Screened in / Screened out?
	[A193] Common tern (<i>Sterna hirundo</i>) [A191] Sandwich tern (<i>Sterna sandvicensis</i>)			the area it is unlikely the S.I. works will have any significant effect. Its therefore concluded that while the proposed S.I. works location is partially or fully within the within the mean max foraging range +1 S.D for the species present on site as the proposed work is not expected to significantly impact the foraging or breeding behaviour as a) the work is carried over short time scales intermittently over the breeding and post-breeding seasons, b) activities carry a low degree of disturbance effects.	
Strangford Lough SPA (UK9020111)	[A193] Common tern (<i>Sterna hirundo</i>) [A191] Sandwich tern (<i>Sterna sandvicensis</i>) [A194] Arctic tern (<i>Sterna paradisaea</i>) [A999] Wetland and waterbirds	Short term reduction in prey availability Visual and noise disturbance	No	The majority of protected features are near shore/intertidal foraging species and therefore survey impacts are expected to be negligible. These species would only be potentially affected during the migratory period, please see section 6.1 below. Terns show minimal responses to boat presence and with the small increase in vessel numbers compared to the vessel traffic already present in the area it is unlikely the S.I. works will have any significant effect. Its therefore concluded that while the proposed S.I. works location is partially or fully within the within the mean max foraging range +1 S.D for	Screened out

Site name	Qualifying feature or species (include sub-features and supporting habitats)	Pressure	LSE?	Justification	Screened in / Screened out?
				the species present on site as the proposed work is not expected to significantly impact the foraging or breeding behaviour as a) the work is carried over short time scales intermittently over the breeding and post-breeding seasons, b) activities carry a low degree of disturbance effects.	
Belfast Lough Open Water SPA (UK9020290)	[A005] Great Crested Grebe (<i>Podiceps cristatus</i>)	Short term reduction in prey availability Visual and noise disturbance	No	The proposed S.I. works location is out with the mean max foraging range +1 S.D for great crested grebe at this site. Great crested grebe are near shore/intertidal foraging species and therefore survey impacts are expected to be negligible. These species would only be potentially affected during the migratory period, please see section 6.1 below.	Screened out
Outer Ards SPA (UK9020271)	[A194] Arctic Tern (<i>Sterna paradisaea</i>)	Short term reduction in prey availability Visual and noise disturbance	No	Terns show minimal responses to boat presence and with the small increase in vessel numbers compared to the vessel traffic already present in the area it is unlikely the S.I. works will have any significant effect. Its therefore concluded that while the proposed S.I. works location is partially or fully within the within the mean max foraging range +1 S.D for tern species the proposed work is not expected to significantly impact the foraging or breeding behaviour as a) the work is carried over short time scales intermittently over the	Screened out

Site name	Qualifying feature or species (include sub-features and supporting habitats)	Pressure	LSE?	Justification	Screened in / Screened out?
				breeding and post-breeding seasons, b) activities carry a low degree of disturbance effects.	
Larne Lough SPA (UK9020042)	[A192] Roseate Tern (<i>Sterna dougallii</i>) [A193] Common Tern (<i>Sterna hirundo</i>) [A191] Sandwich tern (<i>Thalasseus sandvicensis</i>) [A176] Mediterranean gull (<i>Larus melanocephalus</i>)	Short term reduction in prey availability Visual and noise disturbance	No	The proposed S.I. works location is within the mean max foraging range +1 S.D for some of the species under protection at this site. The proposed work is not expected to significantly impact the foraging or breeding behaviour as a) the work is carried over short time scales intermittently over the breeding and post-breeding seasons, b) activities carry a low degree of disturbance effects, c) there are low densities of these species over the majority of the S.I works area and d) the proposed work are unlikely to exclude the protected species from significant proportions of the habitat, minimising effects on behaviours and foraging opportunities. Gull species are wide ranging and rarely dive. They show minimal disturbance response to boat presence and are often attracted to them due to local fishing activities and with the small increase in vessel numbers compared to the vessel traffic	Screened out

Site name	Qualifying feature or species (include sub-features and supporting habitats)	Pressure	LSE?	Justification	Screened in / Screened out?
				already present in the area it is unlikely the S.I. works will have any significant effect. Terns show minimal responses to boat presence and with the small increase in vessel numbers compared to the vessel traffic already present in the area it is unlikely the S.I. works will have any significant effect. Its therefore concluded that while the proposed S.I. works location is partially or fully within the within the mean max foraging range +1 S.D for tern species the proposed work is not expected to significantly impact the foraging or breeding behaviour as a) the work is carried over short time scales intermittently over the breeding and post-breeding seasons, b) activities carry a low degree of disturbance effects.	
Carlingford Lough SPA (UK9020161)	[A193] Common Tern (<i>Sterna hirundo</i>) [A191] Sandwich tern (<i>Thalasseus sandvicensis</i>)	Short term reduction in prey availability Visual and noise disturbance	No	The proposed S.I. works location is within the mean max foraging range +1 S.D for some of the species under protection at this site. The proposed work is not expected to significantly impact the foraging or breeding behaviour as a) the work is carried over short time scales intermittently over the breeding and post-breeding seasons, b) activities carry a low degree of disturbance effects, c) there are low densities of these species over the majority of the S.I works area and d) the proposed work are unlikely to exclude the protected species from significant	Screened out

Site name	Qualifying feature or species (include sub-features and supporting habitats)	Pressure	LSE?	Justification	Screened in / Screened out?
				proportions of the habitat, minimising effects on behaviours and foraging opportunities. Terns show minimal responses to boat presence and with the small increase in vessel numbers compared to the vessel traffic already present in the area it is unlikely the S.I. works will have any significant effect. Its therefore concluded that while the proposed S.I. works location is partially or fully within the within the mean max foraging range +1 S.D for tern species the proposed work is not expected to significantly impact the foraging or breeding behaviour as a) the work is carried over short time scales intermittently over the breeding and post-breeding seasons, b) activities carry a low degree of disturbance effects.	
Sgomer, Sgogwm a Moroedd Penfro / Skomer, Skokholm and the seas off Pembrokeshire SPA (UK9014051)	[A183] Lesser black-backed gull (<i>Larus fuscus</i>) [A013] Manx shearwater (<i>Puffinus puffinus</i>)	Short term reduction in prey availability Visual and noise disturbance	No	The proposed S.I. works location is within the mean max foraging range +1 S.D for Manx shearwater using this region. The proposed work is not expected to significantly impact the foraging or breeding behaviour as a) it is not directly with in the protected site and will likely cause less effects than natural variation (i.e. storms); b) the work is carried over short time scales intermittently over the breeding and post-breeding seasons, c) activities carry a low degree of disturbance effects, d) there are low densities of these species over the majority of the S.I works area and e) the	Screened out

Site name	Qualifying feature or species (include sub-features and supporting habitats)	Pressure	LSE?	Justification	Screened in / Screened out?
				proposed work are unlikely to exclude the protected species from significant proportions of the habitat, minimising effects on behaviours and foraging opportunities.	
Irish Sea Front SPA (UK9020328)	[A013] Manx shearwater (<i>Puffinus puffinus</i>)	Short term reduction in prey availability Visual and noise disturbance	No	The proposed S.I. works location is within the mean max foraging range +1 S.D for Manx shearwater using this region. The proposed work is not expected to significantly impact the foraging or breeding behaviour as a) it is not directly within the protected site and will likely cause less effects than natural variation (i.e. storms); b) the work is carried over short time scales intermittently over the breeding and post-breeding seasons, c) activities carry a low degree of disturbance effects, d) there are low densities of these species over the majority of the S.I works area and ed) the proposed work are unlikely to exclude the protected species from significant proportions of the habitat, minimising effects on behaviours and foraging opportunities.	Screened out
Mersey Estuary SPA (UK9005131)	[A999] Wetland and waterbirds	Habitat loss Visual and noise disturbance	No	The majority of protected features are near shore/intertidal foraging species and therefore survey impacts are expected to be negligible. These species would only be potentially affected during the migratory period, please see section 6.1 below.	Screened out

Site name	Qualifying feature or species (include sub-features and supporting habitats)	Pressure	LSE?	Justification	Screened in / Screened out?
Gogledd Bae Ceredigion / Northern Cardigan Bay SPA (UK9020327)	[A001] Red-throated diver (<i>Gavia stellata</i>)	Short term reduction in prey availability Visual and noise disturbance	No	The proposed S.I. works location is partially within the mean max foraging range +1 S.D for red throated diver. The approach and landfall location are within the 9km foraging range of the species. The proposed work is not expected to significantly impact the foraging or breeding behaviour as a) the work is carried over short time scales intermittently over the breeding and post-breeding seasons, b) activities carry a low degree of disturbance effects and red throated diver is known to avoid boats and there collision is very unlikely, c) there are low densities of these species over the majority of the S.I works area and d) the proposed work are unlikely to exclude the protected species from significant proportions of the habitat, minimising effects on behaviours and foraging opportunities.	Screened out
Ramsar Sites					
The Dee Estuary Ramsar (Wales; Site no. 298)	[A195] Little tern (<i>Sterna albifrons</i>) [A193] Common tern (<i>Sterna hirundo</i>) [A191] Sandwich tern (<i>Sterna sandvicensis</i>)	Short term reduction in prey availability Visual and noise disturbance	No	The proposed S.I. works location is within the mean max foraging range +1 S.D for some of the species under protection at this site. The proposed work is not expected to significantly impact the foraging or breeding behaviour as a) the work is carried over short time scales intermittently over the breeding and post-breeding seasons, b) activities carry a low degree of disturbance effects, c) there are low densities of	Screened out

Site name	Qualifying feature or species (include sub-features and supporting habitats)	Pressure	LSE?	Justification	Screened in / Screened out?
				these species over the majority of the S.I works area and d) the proposed work are unlikely to exclude the protected species from significant proportions of the habitat, minimising effects on behaviours and foraging opportunities. Terns show minimal disturbance responses to boat presence and with the small increase in vessel numbers compared to the vessel traffic already present in the area it is unlikely the S.I. works will have any significant effect. Its therefore concluded that while the proposed S.I. works location is partially or fully within the within the mean max foraging range +1 S.D for tern species the proposed work is not expected to significantly impact the foraging or breeding behaviour as a) the work is carried over short time scales intermittently over the breeding and post-breeding seasons, b) activities carry a low degree of disturbance effects.	
Duddon Estuary Ramsar (Site no. 938)	[A054] Northern pintail (<i>Anas acuta</i>) [A162] Common redshank (<i>Tringa totanus</i>) [A143] Red knot (<i>Calidris canutus</i>)	Short term reduction in prey availability Visual and noise disturbance	No	The proposed S.I. works location is within the mean max foraging range +1 S.D for some of the species under protection at this site. The proposed work is not expected to significantly impact the foraging or breeding behaviour as a) the work is carried over short time scales intermittently over the breeding and post-breeding seasons, b) activities carry a low degree of	Screened out

Site name	Qualifying feature or species (include sub-features and supporting habitats)	Pressure	LSE?	Justification	Screened in / Screened out?
				disturbance effects, c) there are low densities of these species over the majority of the S.I works area and d) the proposed work are unlikely to exclude the protected species from significant proportions of the habitat, minimising effects on behaviours and foraging opportunities.	
Mersey Estuary Ramsar (Site no. 785)	[A177] Little Gull (<i>Larus minutus</i>) [A193] Common Tern (<i>Sterna hirundo</i>)	Short term reduction in prey availability Visual and noise disturbance	No	The proposed S.I. works location is within the mean max foraging range +1 S.D for some of the species under protection at this site. The proposed work is not expected to significantly impact the foraging or breeding behaviour as a) the work is carried over short time scales intermittently over the breeding and post-breeding seasons, b) activities carry a low degree of disturbance effects, c) there are low densities of these species over the majority of the S.I works area and d) the proposed work are unlikely to exclude the protected species from significant proportions of the habitat, minimising effects on behaviours and foraging opportunities. Gull species are wide ranging and rarely dive. They show minimal disturbance response to boat presence and are often attracted to them due to local fishing activities and with the small increase in vessel numbers compared to the vessel traffic	Screened out

Site name	Qualifying feature or species (include sub-features and supporting habitats)	Pressure	LSE?	Justification	Screened in / Screened out?
				already present in the area it is unlikely the S.I. works will have any significant effect. The majority of protected features are near shore/intertidal foraging species and therefore survey impacts are expected to be negligible. These species would only be potentially affected during the migratory period, please see section 6.1 below. Terns show minimal responses to boat presence and with the small increase in vessel numbers compared to the vessel traffic already present in the area it is unlikely the S.I. works will have any significant effect. Its therefore concluded that while the proposed S.I. works location is partially or fully within the within the mean max foraging range +1 S.D for tern species the proposed work is not expected to significantly impact the foraging or breeding behaviour as a) the work is carried over short time scales intermittently over the breeding and post-breeding seasons, b) activities carry a low degree of disturbance effects.	

Site name	Qualifying feature or species (include sub-features and supporting habitats)	Pressure	LSE?	Justification	Screened in / Screened out?
Mersey Narrows and North Wirral Foreshore Ramsar (Site no. 2202)	[A193] Common tern (<i>Sterna hirundo</i>) [A177] Little gull (<i>Hydrocoloeus minutus</i>)	Short term reduction in prey availability Visual and noise disturbance	No	Gull species are wide ranging and rarely dive. They show minimal disturbance response to boat presence and are often attracted to them due to local fishing activities and with the small increase in vessel numbers compared to the vessel traffic already present in the area it is unlikely the S.I. works will have any significant effect. The majority of protected features are near shore/intertidal foraging species or waterbirds and therefore survey impacts are expected to be negligible. These species would only be potentially affected during the migratory period, please see section 6.1 below. Terns show minimal responses to boat presence and with the small increase in vessel numbers compared to the vessel traffic already present in the area it is unlikely the S.I. works will have any significant effect. Its therefore concluded that while the proposed S.I. works location is partially or fully within the within the mean max foraging range +1 S.D for tern species the proposed work is not expected to significantly impact the foraging or breeding behaviour as a) the work is carried over short time scales intermittently over the	Screened out

Site name	Qualifying feature or species (include sub-features and supporting habitats)	Pressure	LSE?	Justification	Screened in / Screened out?
				breeding and post-breeding seasons, b) activities carry a low degree of disturbance effects. The proposed S.I. works location is within the mean max foraging range +1 S.D for some of the species under protection at this site. The proposed work is not expected to significantly impact the foraging or breeding behaviour as a) the work is carried over short time scales intermittently over the breeding and post-breeding seasons, b) activities carry a low degree of disturbance effects, c) there are low densities of these species over the majority of the S.I works area and d) the proposed work are unlikely to exclude the protected species from significant proportions of the habitat, minimising effects on behaviours and foraging opportunities.	
Morecambe Bay Ramsar (Site no. 863)	[A183] Lesser black-backed gull (<i>Larus fuscus</i>) [A191] Sandwich tern (<i>Thalasseus sandvicensis</i>)	Short term reduction in prey availability Visual and noise disturbance	No	Gull species are wide ranging and rarely dive. They show minimal disturbance response to boat presence and are often attracted to them due to local fishing activities and with the small increase in vessel numbers compared to the vessel traffic already present in the area it is unlikely the S.I. works will have any significant effect. The majority of protected features are near shore/intertidal foraging species and waterbirds and therefore survey impacts are expected to be	Screened out

Site name	Qualifying feature or species (include sub-features and supporting habitats)	Pressure	LSE?	Justification	Screened in / Screened out?
				negligible. These species would only be potentially affected during the migratory period, please see section 6.1 below. Terns show minimal responses to boat presence and with the small increase in vessel numbers compared to the vessel traffic already present in the area it is unlikely the S.I. works will have any significant effect. Its therefore concluded that while the proposed S.I. works location is partially or fully within the within the mean max foraging range +1 S.D for tern species the proposed work is not expected to significantly impact the foraging or breeding behaviour as a) the work is carried over short time scales intermittently over the breeding and post-breeding seasons, b) activities carry a low degree of disturbance effects. The proposed S.I. works location is within the mean max foraging range +1 S.D for some of the species under protection at this site. The proposed work is not expected to significantly impact the foraging or breeding behaviour as a) the work is carried over short time scales intermittently over the breeding and post-breeding seasons, b) activities carry a low degree of disturbance effects, c) there are low densities of these species over the majority of the S.I works	

Site name	Qualifying feature or species (include sub-features and supporting habitats)	Pressure	LSE?	Justification	Screened in / Screened out?
				area and d) the proposed work are unlikely to exclude the protected species from significant proportions of the habitat, minimising effects on behaviours and foraging opportunities.	
Ribble and Alt Estuaries Ramsar (Site no. 325)	[A183] Lesser black-backed gull (<i>Larus fuscus</i>) [A179] Black-headed gull (<i>Larus ridibundus</i>) [A193] Common tern (<i>Sterna hirundo</i>)	Short term reduction in prey availability Visual and noise disturbance	No	Gull species are wide ranging and rarely dive. They show minimal disturbance response to boat presence and are often attracted to them due to local fishing activities and with the small increase in vessel numbers compared to the vessel traffic already present in the area it is unlikely the S.I. works will have any significant effect. The majority of protected features are near shore/intertidal foraging species or waterbirds and therefore survey impacts are expected to be negligible. These species would only be potentially affected during the migratory period, please see section 6.1 below. Terns show minimal responses to boat presence and with the small increase in vessel numbers compared to the vessel traffic already present in the area it is unlikely the S.I. works will have any significant effect. Its therefore concluded that while the proposed S.I. works location is partially or fully within the within the mean max foraging	Screened out

Site name	Qualifying feature or species (include sub-features and supporting habitats)	Pressure	LSE?	Justification	Screened in / Screened out?
				range +1 S.D for tern species the proposed work is not expected to significantly impact the foraging or breeding behaviour as a) the work is carried over short time scales intermittently over the breeding and post-breeding seasons, b) activities carry a low degree of disturbance effects. The proposed S.I. works location is within the mean max foraging range +1 S.D for some of the species under protection at this site. The proposed work is not expected to significantly impact the foraging or breeding behaviour as a) the work is carried over short time scales intermittently over the breeding and post-breeding seasons, b) activities carry a low degree of disturbance effects, c) there are low densities of these species over the majority of the S.I works area and d) the proposed work are unlikely to exclude the protected species from significant proportions of the habitat, minimising effects on behaviours and foraging opportunities.	
Upper Solway Flats and Marshes Ramsar (Site no. 341)	[A184] European herring gull (<i>Larus argentatus</i>) [A183] Lesser black-backed gull (<i>Larus fuscus</i>)	Short term reduction in prey availability	No	Gull species are wide ranging and rarely dive. They show minimal disturbance response to boat presence and are often attracted to them due to local fishing activities and with the small increase in vessel numbers compared to the vessel traffic	Screened out

Site name	Qualifying feature or species (include sub-features and supporting habitats)	Pressure	LSE?	Justification	Screened in / Screened out?
		Visual and noise disturbance		already present in the area it is unlikely the S.I. works will have any significant effect. The majority of protected features are near shore/intertidal foraging species and waterbirds and therefore survey impacts are expected to be negligible. These species would only be potentially affected during the migratory period, please see section 6.1 below. The proposed S.I. works location is within the mean max foraging range +1 S.D for some of the species under protection at this site. The proposed work is not expected to significantly impact the foraging or breeding behaviour as a) the work is carried over short time scales intermittently over the breeding and post-breeding seasons, b) activities carry a low degree of disturbance effects, c) there are low densities of these species over the majority of the S.I works area and d) the proposed work are unlikely to exclude the protected species from significant proportions of the habitat, minimising effects on behaviours and foraging opportunities.	

6.1 Migratory birds

It is possible that most of the ornithological species of interest will pass through the survey area at the time of the proposed activity. However, site specific migratory pathways for many species are largely unknown and challenging to identify. Those that are most likely to pass throughout the Zol are listed in Table 5Table 5. This is based upon the migratory timing of these species, the locations in which they breed within UK and Ireland, and whether the wider area that includes the Zol is included in the descriptions of migratory pathways in Wright *et al* (2012).

It is also possible that 34 bird species will be present within the Zol during the proposed activity time but the estimated migratory pathways for these species cover a much larger area and therefore confidence in the likelihood of presence of these species within the Zol during their migratory period is low. These species are listed in Table 5Table 5.

Some species are not expected to be migrating through the Zol during the proposed activity timeframe due to their likely migratory pathway not including the Zol or due to the timing of their migratory season. Finally, waders and little gull may be present but there is limited data to confirm their migratory distributions in the UK. Further quantification of the migratory destination of migratory individuals passing through the Zol to local sites is largely unknown, however the timing of the passage period and the low level of additional sources of impact (i.e. number of likely vessels) is not considered to significantly contribute to light levels to cause migratory disturbance.

Table 5. Summary of migratory pathways for ornithological feature of interest within the Zol.

Species	Mean max foraging range (S.D. in brackets) (km) (if applic.)	Migratory pathway
Red-throated diver	9 ± NA	Possible presence but migratory range large
Manx shearwater	1346.8 ± 1019.3	Possible presence but migratory range large
Fulmar	542.3 ± 657.9	Possible presence but migratory range large
Gannet	315.2 ± 194.2	Possible presence but migratory range large
Cormorant	25.6 ± 8.3	Likely to be within the Zol. Migration routes noted to be concentrated in the Irish sea
Kittiwake	156.1 ± 144.5	Possible presence but migratory range large
Common gull	50 ± NA	Possible presence but migratory range large
Herring gull	58.8 ± 26.8	Possible presence but migratory range large
Lesser black-backed gull	127 ± 109	Possible presence but migratory range large

Species	Mean max foraging range (S.D. in brackets) (km) (if applic.)	Migratory pathway
Great black-backed gull	73 ± NA	Possible presence but migratory range large
Little gull	NA ± NA	No data
Sandwich tern	34.3 ± 23.2	Possible presence but migratory range large
Little tern	5 ± NA	Likely within the Zol given the Irish Sea is noted as a possible migratory route
Common tern	18 ± 26.9	Possible presence but migratory range large
Arctic tern	25.7 ± 14.8	Possible presence but migratory range large
Guillemot	73.2 ± 80.5	Likely within the Zol due to dispersive nature of species
Razorbill	88.7 ± 164.6	Possible presence but migratory range large
Black-headed gull	18.5 ± NA	Possible presence but migratory range large
Waders	NA	No data
Great skua	443.3 ± 931.2	Likely within the Zol given the west coast of UK is noted as a possible migratory route
Arctic skua	2 ± 2.7	Possible presence but migratory range large
Puffin	137.1 ± 128.3	Possible presence but migratory range large
Storm petrel	336 ± NA	Possible presence but migratory range large
Roseate tern	12.6 ± 23.2	Likely as individuals are known to congregate within the Irish Sea prior to migration in Sept/Oct
Oystercatcher	NA	Likely within the Zol given the west coast of UK is noted as a possible migratory route
Redshank	NA	Possible presence but migratory range large
Curlew	NA	Migration routes not considered to be within the Zol
Common shelduck	NA	Possible presence but migratory range large
Grey plover	NA	Likely within the Zol given the west coast of UK is noted as a possible migratory route
Knot	NA	Possible presence but migratory range large
Dunlin	NA	Possible presence but migratory range large
Black-tailed godwit	NA	Migration routes not considered to be within the Zol
Common scoter	NA	Possible presence but migratory range large
Red-breasted merganser	NA	Likely within the Zol given the west coast of UK is noted as a possible migratory route

The presence of additional ships in what is considered a high traffic area is unlikely to have a significant adverse impact on the migratory bird species that may be present in the Zol during the proposed activity.

6.2 LSE Conclusion

European Sites determined to have no LSE and therefore not taken through to AA were:

SPAs

- Bae Lerpwl / Liverpool Bay (UK9020294)
- Morwenoliaid Ynys Môn / Anglesey Terns (UK9013061)
- Dee Estuary (UK9013011)
- Ynys Seiriol / Puffin Island (UK9020285)
- Traeth Lafan / Lavan Sands, Conway Bay (UK9013031)
- Mersey Narrows and North Wirral Foreshore (UK9020287)
- Ribble and Alt Estuaries (UK9005103)
- Morecambe Bay and Duddon Estuary (UK9020326)
- Solway Firth (UK9005012)
- Strangford Lough (UK9020111)
- Belfast Lough Open Water (UK9020290)
- Outer Ards (UK9020271)
- Larne Lough (UK9020042)
- Carlingford Lough (UK9020161)
- Sgomer, Sgogwm a Moroedd Penfro / Skomer Skokholm and the Seas off Pembrokeshire (UK9014051)
- Irish Sea Front (UK9020328)
- Mersey Estuary (UK9005131)
- Gogledd Bae Ceredigion / Northern Cardigan Bay (UK9020327)

Ramsars

- The Dee Estuary (Wales; Site 298)
- Duddon Estuary (Site no. 938)
- Mersey Estuary (Site no. 785)
- Mersey Narrows and North Wirral Foreshore (Site no. 2202)
- Morecambe Bay (Site. 863)
- Ribble and Alt Estuaries (Site no. 325)
- Upper Solway Flats and Marshes (Site no 341)

European Sites determined to have potential for LSE and therefore taken through to AA are presented in Table 6.

Table 6. European Sites screened through to Stage 2 AA

Site name	Qualifying features screened into AA	Impact Pathway
Gogledd Mon Forol / North Anglesey Marine SAC (UK0030398)	Harbour porpoise	Underwater noise and vibration
Pen Llyn a'r Sarnau/ Lleyn Peninsula and the Sarnau SAC (UK0013117)	Bottlenose dolphin	
	Grey Seal	
Gorllewin Cymru Sarnau / West Wales Marine SAC (UK0030397)	Harbour porpoise	
Bae Ceridigion / Cardigan Bay SAC (UK0012712)	Bottlenose dolphin	
	Grey seal	
Sir Benfro Forol / Pembrokeshire Marine SAC (UK0013116)	Grey seal	
Rockabill to Dalkey Island SAC (IE003000)	Harbour porpoise	
Lambay Island SAC (IE000204)	Grey seal	
	Harbour seal	

7. Appropriate Assessment

7.1 Introduction

As described in Section 3, European Sites and their qualifying features were progressed to AA (Stage 2) where it was not possible to exclude potential for LSE. Information to inform the AA is provided below and includes a description of the European sites and the qualifying features under consideration. An assessment of potential effects on site integrity in light of the Conservation Objectives has been conducted.

AA (Stage 2) requires the consideration of impacts on the integrity of a European Site, in relation to the site's structure and function and its Conservation Objectives which aim to define favourable conservation condition for particular habitats and species. As such, the assessment below considers the Conservation Objectives of the European Sites included for assessment.

7.1.1 Underwater noise and vibration

It is widely documented that marine mammals are sensitive to underwater sound (Richardson *et al.*, 1995; Nowacek *et al.*, 2007; OSPAR, 2009; Southall *et al.*, 2019; Southall *et al.*, 2021). A wealth of evidence indicates that many anthropogenic sound sources, such as vessel sound (Pirrotta *et al.*, 2012; Culloch *et al.*, 2016; Dunlop, 2016; Wisniewska *et al.*, 2018) and geophysical surveys (Pirrotta *et al.*, 2014; Stone *et al.*, 2017) can have impacts on marine mammals. In addition, indirect impacts may occur due to direct impacts, such as disturbance, on prey species (Sivle *et al.*, 2021).

These impacts have varying degrees of severity, ranging from masking (i.e. affecting communication and listening space, and/or locating prey; Pirrotta *et al.*, 2012; Dunlop, 2016; Erbe *et al.*, 2016; Heiler *et al.*, 2016; Wisniewska *et al.*, 2018; Pine *et al.*, 2019; Basran *et al.*, 2020), to behavioural displacement and disturbance responses (Brandt *et al.*, 2011; Pirrotta *et al.*, 2014; Culloch *et al.*, 2016; Stone *et al.*, 2017; Graham *et al.*, 2019) to injury and even mortality for high intensity sound sources (Schaffeld *et al.*, 2019).

In total seven sites were screened into Stage 2 Appropriate Assessment due to potential LSE from underwater noise and vibration on marine mammals (Table 7Table 7).

Table 7. Sites screened into Appropriate Assessment for underwater noise and vibration.

Site	Qualifying Features Screened into AA
Gogledd Mon Forol / North Anglesey Marine SAC (UK0030398)	Harbour Porpoise (<i>Phocoena phocoena</i>)
Pen Llyn a'r Sarnau/ Llyn Peninsula and the Sarnau (UK0013117)	Bottlenose dolphin (<i>Tursiops truncatus</i>) Grey seal (<i>Halichoerus grypus</i>)
Gorllewin Cymru Forol / West Wales Marine (UK0030397)	Harbour porpoise (<i>Phocoena phocoena</i>)
Bae Ceridigion / Cardigan Bay SAC (UK0012712)	Bottlenose dolphin (<i>Tursiops truncatus</i>) Grey seal (<i>Halichoerus grypus</i>)
Sir Benfro Forol / Pembrokeshire Marine SAC (UK0013116)	Grey seal (<i>Halichoerus grypus</i>)
Rockabill to Dalkey Island SAC (003000)	Harbour porpoise (<i>Phocoena phocoena</i>)
Lambay Island SAC (000204)	Grey seal (<i>Halichoerus grypus</i>) Harbour seal (<i>Phoca vitulina</i>)

Species ecology

Harbour porpoises are the only porpoise species in the North Atlantic. This species is the smallest, most numerous and widespread cetacean in Welsh waters and is present year-round (Baines and Evans, 2012). Hot spots of higher density in proximity to the S. I. Survey Area exist off north and west Anglesey, particularly around Holyhead, and Point Lynas and South Stacks (Baines and Evans, 2012).

Harbour porpoises have a broad distribution, found around areas of open coast, shallow bays, estuaries, sea lochs, tidal channels, and occasionally up rivers. Being a small species in a cold-water environment, harbour porpoises have high feeding rates and a varied diet, which primarily includes small shoaling fish from pelagic and demersal habitats (Santos and Pierce 2003). In any one area, diet composition may be primarily two to four species of fish which includes, but is not limited to, herring (*Clupea harengus*) and sprat (*Sprattus sprattus*), sandeel (*Ammodytidae*) and members of the cod family (*Gadidae*) (Santos and Pierce, 2003). The current conservation status and overall trend for harbour porpoise within UK waters are unknown, due to insufficient data for the species (JNCC 2019c).

Harbour porpoises are dependent on sound to detect their prey and are sensitive to anthropogenic induced underwater noise. Noise exposure criteria outlined in Southall *et al.* (2019) grouped all marine mammals into functional hearing groups (FHGs) based on their hearing ability (Table 8). With respect to their classification within the FHGs, harbour porpoises are defined as very high frequency (VHF) cetaceans, with a vocal repertoire (and hearing range) ranging between 275 Hz to 160 kHz (NMFS, 2018; Southall *et al.*, 2019; Table 8) including their very high frequency (VHF), short-range and narrow-band (NBHF) echolocation clicks. The hearing sensitivity of harbour porpoise is greatest in the higher part of this range. The peak sound pressure level (SPL) for temporary threshold shift (TTS) in hearing is 196 dB 1 μ Pa @ 1 m and permanent threshold shift (PTS) in hearing is 202 dB 1 μ Pa @ 1 m (Table 8). Their high sensitivity to sound, coupled with this species being the most abundant cetacean in UK and Irish waters, means they are often a key species of concern when assessing risks of impacts from impulsive sound sources, such as geophysical surveys.

Harbour porpoises are a qualifying feature of the North Anglesey Marine SAC, which is estimated to support 2.4 % of the Celtic and Irish Seas management unit (MU) population. This site provides a good foraging ground and may also be used for breeding and calving (JNCC, 2019a); this SAC is considered especially important to porpoise during summer months (Heinänen and Skov, 2015; JNCC, 2019a). The West Wales Marine SAC features one of the top 10% of persistent high-density areas for harbour porpoise in UK waters during both winter and summer seasons (NRW and JNCC, 2017). The site is estimated to support 5.4 % of the Celtic and Irish Seas MU population. The Rockabill to Dalkey Island SAC in Irish waters is also

highlighted as an area of importance to harbour porpoise for foraging, breeding and calving, with surveys recording harbour porpoise year-round at this site (NPWS, 2014a). Given that it is well documented that porpoise avoid vessels (e.g. Benhemma-Le Gall *et al.* 2021; Culloch *et al.* 2016), and considering the wider area available to these animals, the risk of injury is negligible if the JNCC mitigation guidelines for geophysical surveys are followed (JNCC, 2017).

As noted in section 4.1.3 for elusive species such as harbour porpoise, where studying the species at the individual-level is challenging, protected sites are often identified as areas with higher densities of the species compared to other regions. In these cases, the protected site is considered to be more important to the species as compared to neighbouring areas. Consequently, targets relating to the overarching Conservation Objective relate to ensuring that spatial and temporal use of the protected site by harbour porpoises is maintained (JNCC 2019a; 2019b).

Bottlenose dolphins are the second most frequently recorded cetacean in Welsh waters, with a predominantly coastal distribution. Bottlenose dolphins are defined as high frequency (HF) cetaceans, with respect to their classification within the FHGs, with a hearing range of 150 Hz – 160 kHz (NMFS 2018, Southall *et al.* 2019; Table 8). The peak SPL for TTS in hearing is 224 dB 1 μ Pa @ 1 m and PTS in hearing is 230 dB 1 μ Pa @ 1 m (Table 8). Bottlenose dolphins are dependent on sound to detect their prey and are sensitive to underwater noise. They are generalist and opportunistic feeders, eating a wide range of pelagic and benthic (demersal) fish, crustaceans, and molluscs, making them highly adaptable with respect to diet and feeding strategy (NRW 2018a). The Llyn Peninsula and the Sarnau SAC contains important potential feeding areas for bottlenose dolphins, with individuals often observed feeding whilst within the waters of the SAC (NRW 2018a). They are considered of significant importance within Llyn Peninsula and the Sarnau SAC and are part of a wider population that ranges across the Irish Sea, and the Cardigan Bay SAC, which supports a semi-resident population of bottlenose dolphins (NRW 2018b). This has been confirmed through photographic-identification studies, which show dolphins associated with the Cardigan Bay SAC population move into and through the Llyn Peninsula and the Sarnau SAC (Feingold and Evans 2013) and up to the Shannon Estuary SAC to the west of Ireland and the Moray Firth SAC on the east coast of Scotland (Cheney *et al.*, 2013; Robinson *et al.*, 2012). Bottlenose dolphins in this region are commonly sighted within 10 miles (*ca.* 16 km) of the coast in summer, but range more widely in winter (Baines and Evans 2012; NRW 2018a). The current conservation status and overall trend for bottlenose dolphin within UK waters are unknown, due to insufficient data for the species (JNCC 2019d).

For true seals (phocids, which includes grey seal and harbour seal) the generalised underwater hearing range is between 50 Hz – 86 kHz (Table 8). The peak SPL for TTS in hearing is 212 dB 1 μ Pa @ 1 m and PTS in hearing is 218 dB 1 μ Pa @ 1m (Table 8). Neurophysiological

studies have reported that grey seals have an underwater hearing range of <1.4 kHz – 100 kHz (Southall *et al.* 2019). Grey seals are most sensitive during the breeding season (August to November) and when moulting (December-April), when they spend most or all their time hauled out (SCOS 2021; NRW 2018a). During these times, activities close to the SAC (within 500 m) that may startle grey seals and cause them to return to the sea, for example, are often regarded as the greatest risk. Telemetry tagging studies have shown, when at sea, grey seals can travel over 100 km from haul out sites to forage, can cover large areas when foraging, and are able to move between prey patches (SCOS 2020; Carter *et al.* 2020; 2022). Local tracking data has shown that seals moved from haul out sites on Bardsey Island, situated within Llyn Peninsula and the Sarnau SAC, to the east coast of Ireland, Inner Hebrides, and Pembrokeshire (NRW 2018a). Therefore, it is likely that the individuals breeding within the Llyn Peninsula and the Sarnau SAC are part of a wider population that extends to southwest Wales and to the southeast and eastern Irish coasts (NRW 2018a). Grey seals within Cardigan Bay SAC are also part of a wider population, with a small number making long foraging trips up the Irish Sea to deeper waters (NRW 2018b). Pembrokeshire Marine SAC is an important breeding site for grey seals, representing over 2% of annual UK pup production (SCOS, 2021; NRW, 2022). Outside of the pupping season, individuals are less site faithful. Due to this, there is a seasonal difference in grey seal population distribution and individuals will be more susceptible to disturbance during pupping and moulting periods. Grey seals have a ‘favourable’ conservation status in the UK due to their improving population trend (JNCC, 2019e).

In Irish waters, Lambay Island SAC supports the main breeding colony of grey seals on the east coast (NPWS, 2014b). Grey seals are present year-round within the SAC, using the site for breeding, moulting, resting, and foraging (NPWS, 2013).

Behavioural studies have reported that harbour seals have an underwater hearing range of <0.1 kHz – 79 kHz (Southall *et al.* 2019). Harbour seals are most sensitive during the breeding season (June-July) and when moulting (August-September), when they spend most or all their time hauled out. During these times, activities within 500 m to the SAC that may startle harbour seals and cause them to return to the sea, for example, are often regarded as the greatest risk. Although telemetry tagged harbour seals have been recorded to travel >100 km to forage, foraging trips typically remain within 50 km from their preferred haul-out sites (Carter *et al.* 2022). There are no SACs in Welsh waters for which harbour seals are a qualifying feature. However, they are a qualifying feature of Lambay Island SAC, in Irish waters, where they are present throughout the year, using the site for breeding, moulting, resting, and foraging (NPWS, 2013).

Table 8. Generalised hearing ranges and noise exposure criteria from Southall *et al.* (2019) for Temporary Threshold Shift (TTS) and Permanent Threshold Shift (PTS) in hearing for the functional hearing groups Phocid in Water (PW), High Frequency cetaceans (HF), and Very High Frequency cetaceans (VHF), (NMFS 2018, Southall *et al.* 2019).

Functional hearing group	Relevant species	Generalised hearing range	Estimated peak region of sensitivity	Noise exposure criteria					
				Impulsive				Non-impulsive	
				TTS		PTS		TTS	PTS
				SEL	Peak SPL	SEL	Peak SPL	SEL	SEL
Phocids in water	Grey and harbour seal	50 Hz – 86 kHz	1.9 – 30 kHz	170	212	185	218	181	201
High Frequency Cetaceans	Bottlenose dolphin	150 Hz – 160 kHz	8.8 – 110 kHz	170	224	185	230	178	198
Very High Frequency Cetaceans	Harbour porpoise	275 Hz – 160 kHz	12 – 140 kHz	140	196	155	202	153	173

Underwater noise assessment

It is widely documented that marine mammals are sensitive to underwater noise (Richardson *et al.*, 1995; Nowacek *et al.*, 2007; OSPAR 2009, Southall *et al.*, 2019, Southall *et al.* 2021). A large body of evidence indicates that many anthropogenic sound sources, such as vessel noise (Pirodda *et al.*, 2012; Dunlop 2016; Wisniewska *et al.*, 2018) and seismic surveys (Pirodda *et al.*, 2014; Stone *et al.*, 2017) can have negative impacts on marine mammals. In addition, indirect impacts may occur due to direct impacts on prey species (Sivle *et al.*, 2021).

These impacts have varying degrees of observed and/or predicted severity, ranging from changes in behaviour and masking such as, affecting communication and listening space, and/or locating prey (Pirodda *et al.*, 2012; Dunlop 2016; Erbe *et al.*, 2016; Heiler *et al.*, 2016; Wisniewska *et al.*, 2018; Pine *et al.*, 2019; Basran *et al.*, 2020), to displacement and disturbance (Brandt *et al.*, 2011; Pirodda *et al.* 2014; Culloch *et al.*, 2016; Stone *et al.*, 2017; Graham *et al.*, 2019) to injury and even mortality (Schaffeld *et al.*, 2019).

With respect to noise assessments, using the criteria outlined in Southall *et al.* (2019), there are often two types of impacts which are considered: TTS and PTS, the latter of which is typically regarded as injury. To assess this, sound sources are typically divided into two categories, 'impulsive' and 'non-impulsive', based on attributes of the sound source:

- **Impulsive sound sources**, such as impact pile driving and seismic airguns, are transient and brief (less than a second), broadband and typically consist of high peak pressure with rapid rise time and decay.
- **Non-impulsive sound sources**, such as shipping, cone penetration testing (CPT), rotary core borehole (BH), and vibrocores, can be broadband, narrowband or tonal, brief or prolonged, continuous or intermittent and typically do not have a high peak pressure with rapid rise time.

Behavioural responses are challenging to assess, therefore deriving disturbance thresholds is often not possible, and recent research has shown that attempting to derive simple all-or-nothing thresholds for behavioural responses to noise exposure across broad taxonomic groups and sound sources can lead to significant errors in predicting effects (Southall *et al.*, 2021). Therefore, assessment of disturbance is often qualitative, taking into consideration what we know about the ecology and behaviour of the species, and the activity being assessed.

The noise level thresholds outlined in Table 8 are peak Sound Pressure Level (SPL), which is the maximum absolute value, which is used to assess the potential risk of instantaneous TTS or PTS. These are based on the animal being close to the sound source (within 1 m), which is unlikely and, therefore, extremely precautionary. The cumulative Sound Exposure Level (SEL_{cum}) is used to assess the potential risk of TTS or PTS through exposure to noise accumulated over time.

The VHF FHG is the most sensitive to impulsive (e.g. geophysical surveys) and non-impulsive (e.g. vessel/engine noise) sound sources. Consequently, all the exposure criteria for this FHG are lower than those of the other FHGs for the respective sound source and exposure criteria. In the context of the proposed S. I. surveys, the only VHF cetacean species in this site is the harbour porpoise, which is the most abundant cetacean species in UK and Irish waters (Baines and Evans, 2012; Wall *et al.* 2013; Rogan *et al.* 2018; Hague *et al.* 2020).

Indicative SPLs associated with different types of marine S. I. surveys are presented in Table 9. Geophysical survey equipment types incorporated in the S. I. surveys are multi beam echosounder (MBES), side scan sonar (SSS), sub-bottom profiler (SBP), magnetometer survey, and the ultra-short baseline (USBL) subsea positioning. Geophysical survey equipment is typically an impulsive sound source, which is broadly regarded as a higher risk to marine mammals, as compared to non-impulsive sound sources. One exception in the S. I. surveys, whilst often included in geophysical survey equipment lists, is magnetometers, which are a completely passive device, meaning they do not produce any sound while in operation. The MBES and SSS operate outside of the hearing range of the marine mammal species included in this

assessment. As there is no impact pathway associated with MBES, SSS, and magnetometer surveys, they have been scoped out of this assessment.

The operating frequency of the SBP is within the generalised hearing range of seals in water, bottlenose dolphin, and harbour porpoise, and within the estimated peak region of sensitivity of bottlenose dolphin and harbour porpoise (Table 9Table 8Table 9). Although the operating frequency of the SBP is outside the estimated peak region of sensitivity of seals in water, it is concluded that the SBP may cause instantaneous PTS and TTS in grey and harbour seals following a precautionary approach to assessment. The operating frequency of the USBL system is within the generalised hearing range and estimated region of peak sensitivity of seals in water, bottlenose dolphin, and harbour porpoise, but the SPL is not likely to cause instantaneous PTS or TTS in grey and harbour seals, bottlenose dolphins, and harbour porpoise (Table 9Table 9). Therefore, the only activity involved in the geophysical S. I. works that may cause an instantaneous PTS in grey and harbour seals, bottlenose dolphins, and harbour porpoise is the SBP (Table 9Table 9).

Although these sound sources (e.g. SBP) can be relatively loud with high duty cycles, they are typically highly directional with expected low levels of propagation both vertically and horizontally, with many of these devices operating at high frequencies and therefore subject to high transmission loss (Crocker and Frantantonio 2016; Crocker *et al.* 2019). Directionality must also be considered, as well as propagation. For example, sound propagation through the water column on the horizontal for side-scanning sonar is minimal; therefore, the noise level decreases rapidly with distance from the source (Trabant 2013). Once the sound pulse has been emitted, the intensity is greatly reduced within a few metres due to scattering and absorption (Medwin 1970; Deane and Stokes 2010; Farcas *et al.*, 2016).

Table 9. Marine survey noise sources and the risk of an instantaneous TTS and PTS in hearing from impulsive noise sources for each of the functional hearing groups where Y (red) indicates onset is possible and N (green) indicates that it is not.

Noise Source	Frequency (kHz)	Sound Pressure Level (dB re 1µPa @ 1m)	PCW		HF		VHF	
			TTS	PTS	TTS	PTS	TTS	PTS
Innomar Medium-100 SBP	85 to 100 (primary)	247	Y	Y	Y	Y	Y	Y
	2 to 22 (secondary)	247	Y	Y	Y	Y	Y	Y
Kongsberg µPAP 201-H USBL system	20 to 30*	190*	N	N	N	N	N	N

*Information taken from online specification (Kongsberg Maritime, 2023)

The geotechnical equipment and activities associated with the proposed S. I. surveys are vibrocorer and CPT. There are few estimates of operating frequencies and SPLs of these equipment and activities published in the public domain. For all activities the SPL range is between 118 and 187.4 dB re 1µPa @1m (Table 10), and in the case of the operating frequencies, both the vibrocorer and CPT are outside the generalised hearing ranges of harbour porpoise, bottlenose dolphin, and seals in water (Table 10). As such, it is concluded that there is no risk of instantaneous or cumulative TTS or PTS to harbour porpoises, bottlenose dolphins or seals during the geotechnical surveys.

With respect to disturbance, as the activities are transient and short in duration, any disturbance effects would be negligible, particularly given the extensive suitable foraging habitat elsewhere in the Irish Sea and beyond.

Table 10. Marine survey noise sources and marine mammal hearing ranges (Table 8) where red indicates the equipment can operate within the peak sensitivity range of the relevant functional hearing group, orange indicates it is in the hearing range but not in the peak sensitivity range and green indicates that it is not in the hearing range.

Noise Source	Frequency (Hz)	Sound Pressure Level (dB re 1µPa @ 1m)	PCW	HF	VHF
FT0551 Vibrocorer ¹	30	187.4			
Geomil Manta 100DW CPT ²	28	118-145			

¹ Values taken from (LGL, 2010)

² Values taken from (Campanella *et al.*, 1986; BOEM, 2012; EIRGRID, 2014)

In summary, magnetometers are passive devices which do not emit sound waves and the MBES, SSS, vibrocorer and CPT operate outwith the hearing frequencies of marine mammals and therefore pose no risk of injury or disturbance to marine mammals. The USBL emits sound frequencies within hearing ranges of marine mammals but the SPL and SEL are not likely to cause instantaneous PTS or TTS to species of concern. The SBP is the only equipment used in the survey with the potential for instantaneous PTS and is therefore the only sound source taken through to further assessment.

North Anglesey Marine SAC (UK0030398)

This site was screened into AA due to the potential for LSE on harbour porpoise from underwater noise and vibration.

The Conservation Objectives for harbour porpoise for North Anglesey Marine SAC, and individual attributes with targets are provided in Table 11.

Table 11. Conservation Objective information for harbour porpoise in North Anglesey Marine SAC (UK0030398) (JNCC 2019a).

Conservation Objective information for: North Anglesey Marine SAC (UK0030398)		
[1351] Harbour porpoise		
To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining Favourable Conservation Status (FCS) for harbour porpoise in UK waters, which is defined by the following list of attributes and targets:		
Attribute	Target	Notes

Conservation Objective information for: North Anglesey Marine SAC (UK0030398)		
Species is a viable component of the site	Maintained or restored in the long term – subject to natural change	Not applicable
Disturbance	No significant disturbance of the species	Not applicable
Habitats and processes	Habitats and processes relevant to harbour porpoise and its prey are maintained or restore in the long term – subject to natural change	Not applicable

A portion of the SAC and the S. I. Survey Area overlap (Figure 2) therefore, porpoise located within the SAC could be affected by S. I. surveys. If an individual were to be that close to the source, any event of injury would be to that sole individual and would not incur a population level effect as it is an extremely unlikely event. Harbour porpoise also show evasion behaviour to vessel presence so the likelihood that individuals spend a prolonged period near the S.I. survey vessel is considered highly unlikely. There is extensive suitable foraging habitat elsewhere in the Irish Sea and beyond enabling harbour porpoise to avoid the survey area if required. The S. I. surveys are also anticipated to be relatively short term (over a four-month period across the whole survey area in Irish and UK waters), and the duration of the survey within, and in close proximity to, the SAC would be considerably shorter than this. Therefore, short-term localised disturbances, such as the S. I. surveys proposed here would have negligible to no impact on porpoise in the SAC.

Conclusion

Consequently, it is considered that targets, with respect to the Conservation Objectives indicated in Table 11 would not be significantly affected and that there would be **no adverse effects on integrity (AEol)** for harbour porpoise in North Anglesey Marine SAC due to the S. I. surveys.

Mitigation

Although it has been assessed there would be no AEol on North Anglesey Marine SAC, to further reduce any risk of potential injury to individuals, mitigation measures will be applied to reduce the impact of underwater noise and vibration on harbour porpoise. Best practice geophysical acoustic survey guidance, as specified in 'JNCC guidelines for minimising the risk of injury to marine mammals from geophysical surveys' (2017) will be followed during all impulsive surveys (including: SBP). These guidelines specify procedures including, but not limited to a 'soft start' procedure which shall be used to ensure that any animals in the vicinity will have chance to leave. With the implementation of these guidelines there will be a negligible risk of disturbance to marine mammals (see Appendix 1 for Marine Mammal Observer protocols as recommended in the JNCC guidance).

Lleyn Peninsula and the Sarnau SAC (UK0013117)

This site was screened into AA due to a possible LSE on bottlenose dolphin and grey seal from underwater noise and vibration.

The Conservation Objectives for bottlenose dolphin and grey seal for Lleyn Peninsula and the Sarnau SAC, and individual attributes with targets are provided in Table 12.

Table 12. Conservation Objective information for bottlenose dolphin and grey seal in Lleyn Peninsula and the Sarnau SAC (UK0013117) (NRW 2018a).

Conservation Objective information for Lleyn Peninsula and the Sarnau SAC (UK0013117)			
[1349] Bottlenose dolphin			
To maintain (or restore) the habitat and species features, as a whole, at (or to) favourable conservation status (FCS) within the site. To achieve favourable conservation status all the following attributes and targets, subject to natural processes, need to be fulfilled and maintained in the long-term			
Attribute	Measure	Target	Notes
Population	Size, structure, production and physiological health.	The population is maintaining itself on a long-term basis as a viable component of its natural habitat.	As part of this objective, it should be noted that for bottlenose dolphin, contaminant burdens derived from human activity are below levels that may cause physiological damage, or immune or reproductive suppression
Range	Areas of the site which the population/individuals use.	The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future.	As part of this objective, it should be noted that for bottlenose dolphin their range within the SAC and adjacent inter-connected areas is not constrained or hindered, there are appropriate and sufficient food resources within the SAC and beyond.
Supporting habitats and species	Distribution and extent, structure, function and quality and prey availability and quality.	The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and populations dynamics of the species within the site and population beyond the site is stable or increasing.	Not applicable.
[1364] Grey seal			
To maintain (or restore) the habitat and species features, as a whole, at (or to) favourable conservation status (FCS) within the site. To achieve favourable conservation status all the			

following attributes and targets, subject to natural processes, need to be fulfilled and maintained in the long-term			
Attribute	Measure	Target	Notes
Population	Size, structure, production and physiological health.	The population is maintaining itself on a long-term basis as a viable component of its natural habitat.	As part of this objective, it should be noted that for grey seal, contaminant burdens derived from human activity are below levels that may cause physiological damage, or immune or reproductive suppression. Grey seal populations should not be reduced as a consequence of human activity.
Range	Areas of the site which the population/individuals use.	The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future.	As part of this objective, it should be noted that for grey seal, their range within the SAC and adjacent inter-connected areas is not constrained or hindered, there are appropriate and sufficient food resources within the SAC and beyond
Supporting habitats and species	Distribution and extent, structure, function and quality and prey availability and quality.	The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and populations dynamics of the species within the site and population beyond the site is stable or increasing.	Not applicable.

Overall, it is considered highly unlikely there will be an AEoI of the populations of bottlenose dolphin and grey seal within Llyn Peninsula and the Sarnau SAC which is 49 km from the S. I. Survey Area. As mentioned previously sound attenuates increasingly from the source and, the individual would have to be extremely close to the source at the time of maximum output. If an individual were to be that close to the source, any event of injury would be to that sole individual and would not incur a population level effect as it is an extremely unlikely event. There is extensive suitable foraging and haul-out (seal specific) habitat elsewhere enabling both bottlenose dolphin and grey seal to avoid the survey area if required. The S. I. survey is also anticipated to be relatively short term (over a four-month period across the whole survey area in Irish and UK waters) and is transient, meaning exposure to underwater noise will be short-term, both spatially and temporally. Therefore, short-term localised disturbances, such as the S. I. surveys proposed here would have negligible to no impact on bottlenose dolphins or grey seals in the SAC.

Conclusion

Consequently, it is considered that targets, with respect to Conservation Objectives, indicated in Table 12 and Table 15 would not be significantly affected and that there would be **no AEoI** on bottlenose dolphin and grey seal in the Llyn Peninsula and the Sarnau SAC due to the S. I. surveys.

Mitigation

Although it has been assessed there would be no AEoI on Llyn Peninsula and the Sarnau SAC, to further reduce any risk of potential injury to individuals, mitigation measures will be applied to reduce the impact of underwater noise and vibration on porpoise. Geophysical acoustic survey guidance, as specified in 'JNCC guidelines for minimising the risk of injury to marine mammals from geophysical surveys' (2017) and will be followed during all impulsive surveys (including: SBP). These guidelines specify procedures including, but not limited to a 'soft start' procedure which shall be used to ensure that any animals in the vicinity will have chance to leave. With the implementation of these guidelines there will be a negligible risk of disturbance to marine mammals (see Appendix 1 for Marine Mammal Observer protocols as recommended in the JNCC guidance).

West Wales Marine SAC (UK0030397)

This site was screened into AA due to a possible LSE on harbour porpoise from underwater noise and vibration.

The Conservation Objectives for harbour porpoise for West Wales Marine SAC, and individual attributes with targets are provided in Table 13 Table 13.

Table 13. Conservation Objective information for harbour porpoise in West Wales Marine SAC (UK0030397) (JNCC 2019b).

Conservation Objective information for West Wales Marine SAC (UK0030397)		
[1351] Harbour porpoise		
To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining Favourable Conservation Status (FCS) for harbour porpoise in UK waters, which is defined by the following list of attributes and targets:		
Attribute	Target	Notes
Species is a viable component of the site	Maintained or restored in the long term – subject to natural change	Not applicable
Disturbance	No significant disturbance of the species	Not applicable

Conservation Objective information for West Wales Marine SAC (UK0030397)		
Habitats and processes	Habitats and processes relevant to harbour porpoise and its prey are maintained or restore in the long term – subject to natural change	Not applicable

Overall, it is considered highly unlikely there will be an AEoI on the population of harbour porpoise within West Wales Marine SAC which is 49 km from the S. I. Survey Area. Harbour porpoise show evasion behaviour to vessel presence so the likelihood that individuals spend a prolonged period near the S.I. survey vessel is unlikely. There is extensive suitable foraging habitat elsewhere in the Irish Sea and beyond enabling harbour porpoise to avoid the survey area if required. If an individual were to be that close to the source, any event of injury would be to that sole individual and would not incur a population level effect as it is an extremely unlikely event. The S. I. surveys are also anticipated to be relatively short term (over a four-month period across the whole survey area in Irish and UK waters) and is transient, meaning exposure to underwater noise will be short-term, both spatially and temporally. Therefore, short-term localised disturbances, such as the S. I. surveys proposed here would have negligible to no impact on porpoise in the SAC.

Conclusion

Consequently, it is considered that targets, with respect to Conservation Objectives, indicated in Table 13 would not be significantly affected and that there would be **no AEoI** on harbour porpoise in West Wales Marine SAC due to the S. I. surveys.

Mitigation

Although it has been assessed there would be no AEoI on West Wales Marine SAC, to further reduce any risk of potential injury to individuals, mitigation measures will be applied to reduce the impact of underwater noise and vibration on porpoise. Geophysical acoustic survey guidance, as specified in 'JNCC guidelines for minimising the risk of injury to marine mammals from geophysical surveys' (2017) and will be followed during all impulsive surveys (including: SBP). These guidelines specify procedures including, but not limited to a 'soft start' procedure which shall be used to ensure that any animals in the vicinity will have chance to leave. With the implementation of these guidelines there will be a negligible risk of disturbance to marine mammals (see Appendix 1 for Marine Mammal Observer protocols as recommended in the JNCC guidance).

Cardigan Bay SAC (UK0012712)

This site was screened into AA due to a possible LSE on bottlenose dolphin and grey seal from underwater noise and vibration.

The Conservation Objectives for bottlenose dolphin and grey seal for Cardigan Bay SAC, and individual attributes with targets are provided in Table 14.

Table 14. Conservation Objective information for bottlenose dolphin and grey seal in Cardigan Bay SAC (UK0012712) (NRW 2018b).

Conservation Objective information for Cardigan Bay SAC (UK0012712)			
[1349] Bottlenose dolphin			
To maintain (or restore) the habitat and species features, as a whole, at (or to) favourable conservation status (FCS) within the site. To achieve favourable conservation status all the following attributes and targets, subject to natural processes, need to be fulfilled and maintained in the long-term			
Attribute	Measure	Target	Notes
Population	Size, structure, production, condition, of the species within the site.	The population is maintaining itself on a long-term basis as a viable component of its natural habitat.	As part of this objective, it should be noted that for bottlenose dolphin, contaminant burdens derived from human activity are below levels that may cause physiological damage, or immune or reproductive suppression.
Range	Areas of the site which the population/individuals use.	The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future.	As part of this objective, it should be noted that, for bottlenose dolphin, their range within the SAC and adjacent inter-connected areas is not constrained or hindered, there are appropriate and sufficient food resources within the SAC and beyond, and the sites and amount of supporting habitat used by these species are accessible and their extent and quality is stable or increasing.
Supporting habitats and species	Distribution, extent, structure, function and quality of habitat, and prey availability and quality.	The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and populations dynamics of the species within the site and population beyond the site is stable or increasing.	As part of this objective, it should be noted that the abundance of prey species subject to existing commercial fisheries needs to be equal to or greater than that required to achieve maximum sustainable yield and secure in the long term; the management and control of activities or operations likely to adversely affect the species feature is appropriate for maintaining

			it in favourable condition and is secure in the long term; contamination of potential prey species should be below concentrations potentially harmful to their physiological health; and disturbance by human activity is below levels that suppress reproductive success, physiological health or long-term behaviour. As part of this objective it should be noted that for the bottlenose dolphin populations should be increasing.
[1364] Grey seal			
To maintain (or restore) the habitat and species features, as a whole, at (or to) favourable conservation status (FCS) within the site. To achieve favourable conservation status all the following attributes and targets, subject to natural processes, need to be fulfilled and maintained in the long-term			
Attribute	Measure	Target	Notes
Population	Size, structure, production, condition, of the species within the site.	The population is maintaining itself on a long-term basis as a viable component of its natural habitat.	As part of this objective, it should be noted that for grey seal, contaminant burdens derived from human activity are below levels that may cause physiological damage, or immune or reproductive suppression. For grey seal populations should not be reduced as a consequence of human activity.
Range	Areas of the site which the population/individuals use.	The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future.	As part of this objective, it should be noted that, for grey seal, their range within the SAC and adjacent inter-connected areas is not constrained or hindered, there are appropriate and sufficient food resources within the SAC and beyond, and the sites and amount of supporting habitat used by these species are accessible and their extent and quality is stable or increasing.
Supporting habitats and species	Distribution, extent, structure, function and quality of habitat, and	The presence, abundance, condition and diversity of habitats and species	As part of this objective, it should be noted that the abundance of prey species

	prey availability and quality.	required to support this species is such that the distribution, abundance and populations dynamics of the species within the site and population beyond the site is stable or increasing.	subject to existing commercial fisheries needs to be equal to or greater than that required to achieve maximum sustainable yield and secure in the long term; the management and control of activities or operations likely to adversely affect the species feature is appropriate for maintaining it in favourable condition and is secure in the long term; contamination of potential prey species should be below concentrations potentially harmful to their physiological health; and disturbance by human activity is below levels that suppress reproductive success, physiological health or long-term behaviour.
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Overall, it is considered highly unlikely there will be an AEoI of the populations of bottlenose dolphin and grey seal within Cardigan Bay SAC which is 134.9 km from the S. I. Survey Area. As mentioned previously sound attenuates increasingly from the source and, the individual would have to be extremely close to the source at the time of maximum output. If an individual were to be that close to the source, any event of injury would be to that sole individual and would not incur a population level effect as it is an extremely unlikely event. There is extensive suitable foraging and haul-out (seal specific) habitat elsewhere enabling both bottlenose dolphin and grey seal to avoid the survey area if required. The S. I. survey is also anticipated to be relatively short term (over a four-month period across the whole survey area in Irish and UK waters) and is transient, meaning exposure to underwater noise will be short-term, both spatially and temporally. Therefore, short-term localised disturbances, such as the S. I. surveys proposed here would have negligible to no impact on bottlenose dolphins or grey seals in the SAC.

Conclusion

Consequently, it is considered that targets, with respect to Conservation Objectives, indicated in Table 14 would not be significantly affected and that there would be **no AEoI** on bottlenose dolphin and grey seal in Cardigan Bay SAC due to the S. I. surveys.

Mitigation

Although it has been assessed there would be no AEoI on Cardigan Bay SAC, to further reduce any risk of potential injury to individuals, mitigation measures will be applied to reduce the impact of underwater noise and vibration on porpoise. Geophysical acoustic survey guidance, as specified in 'JNCC guidelines for minimising the risk of injury to marine mammals from geophysical surveys' (2017) and will be followed during all impulsive surveys (including: SBP). These guidelines specify procedures including, but not limited to a 'soft start' procedure which shall be used to ensure that any animals in the vicinity will have chance to leave. With the implementation of these guidelines there will be a negligible risk of disturbance to marine mammals (see Appendix 1 for Marine Mammal Observer protocols as recommended in the JNCC guidance).

Pembrokeshire Marine SAC (UK0013116)

This site was screened into AA due to a possible LSE on grey seal from underwater noise and vibration.

The Conservation Objectives for grey seal in Pembrokeshire Marine SAC, and individual attributes with targets are provided in Table 15.

Table 15. Conservation Objective information for grey seal in Pembrokeshire Marine SAC (UK0013116; NRW, 2018c).

Conservation Objective information for: Pembrokeshire Marine SAC (UK0013116)			
[1364] Grey seal			
To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining Favourable Conservation Status (FCS) for grey seal in UK waters, which is defined by the following list of attributes and targets:			
Attribute	Measure	Target	Notes
Population	Size, structure, production and physiological health.	The population is maintaining itself on a long-term basis as a viable component of its natural habitat.	As part of this objective, it should be noted that for grey seal, contaminant burdens derived from human activity are below levels that may cause physiological damage, or immune or reproductive suppression. Grey seal populations should not be reduced as a consequence of human activity.
Range	Areas of the site which the population/individuals use.	The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future.	As part of this objective, it should be noted that for grey seal, their range within the SAC and adjacent inter-connected areas is not constrained or hindered, there are appropriate and sufficient

Conservation Objective information for: Pembrokeshire Marine SAC (UK0013116)			
			food resources within the SAC and beyond
Supporting habitats and species	Distribution and extent, structure, function and quality and prey availability and quality.	The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and populations dynamics of the species within the site and population beyond the site is stable or increasing.	Not applicable.

Overall, it is considered highly unlikely there will be an AEoI of the population of grey seal within Pembrokeshire Marine SAC which is 175.2 km from the S. I. Survey Area. As mentioned previously sound attenuates increasingly from the source and, the individual would have to be extremely close to the source at the time of maximum output. If an individual were to be that close to the source, any event of injury would be to that sole individual and would not incur a population level effect as it is an extremely unlikely event. There is extensive suitable foraging and haul-out habitat elsewhere enabling grey seals to avoid the survey area if required. The S. I. survey is also anticipated to be relatively short (over a four-month period across the whole survey area in Irish and UK waters) and is transient, meaning exposure to underwater noise will be short-term, both spatially and temporally. Therefore, short-term localised disturbances, such as the S. I. surveys proposed here would have negligible to no impact on grey seals in the SAC.

Conclusion

Consequently, it is considered that targets, with respect to Conservation Objectives, indicated in Table 15 would not be significantly affected and that there would be **no AEoI** on grey seal in the Pembrokeshire Marine SAC due to the S. I. surveys.

Mitigation

Although it has been assessed there would be no AEoI on Pembrokeshire Marine SAC, to further reduce any risk of potential injury to individuals, mitigation measures will be applied to reduce the impact of underwater noise and vibration on grey seals. Geophysical acoustic survey guidance, as specified in 'JNCC guidelines for minimising the risk of injury to marine mammals from geophysical surveys' (2017) and will be followed during all impulsive surveys (including: SBP). These guidelines specify procedures including, but not limited to a 'soft start' procedure which shall be used to ensure that any animals in the vicinity will have chance to leave. With the implementation of these guidelines there will be a negligible risk of

disturbance to marine mammals (see Appendix 1 for Marine Mammal Observer protocols as recommended in the JNCC guidance).

Rockabill to Dalkey Island SAC (IE003000)

This site was screened into AA due to a possible LSE on harbour porpoise from underwater noise and vibration.

The Conservation Objectives for harbour porpoise for Rockabill to Dalkey Island SAC, and individual attributes with targets are provided in Table 16.

Table 16. Conservation Objective information for harbour porpoise in Rockabill to Dalkey Island SAC (IE003000) (NPWS 2014a).

Conservation Objective information for Rockabill to Dalkey Island SAC (IE003000)			
[1351] Harbour Porpoise			
To maintain the favourable conservation condition of harbour porpoise in Rockabill to Dalkey Island SAC, which is defined by the following list of attributes and targets:			
Attribute	Measure	Target	Notes
Access to suitable habitat	Number of artificial barriers	Species range within the site should not be restricted by artificial barriers to site use.	Not applicable.
Disturbance	Level of impact	Human activities should not occur at levels that do not adversely affect the harbour porpoise community at the site.	Not applicable.

Overall, it is considered highly unlikely there will be an AEoI on the population of harbour porpoise within Rockabill to Dalkey Island SAC which is 45.2 km from the S. I. Survey Area. Harbour porpoise show evasion behaviour to vessel presence so the likelihood that individuals spend a prolonged period near the S.I. survey vessel is unlikely. If an individual were to be that close to the source, any event of injury would be to that sole individual and would not incur a population level effect as it is an extremely unlikely event. There is extensive suitable foraging habitat elsewhere in the Irish Sea and beyond enabling harbour porpoise to avoid the survey area if required. The S. I. surveys are also anticipated to be relatively short term (over a four-month period across the whole survey area in Irish and UK waters) and is transient, meaning exposure to underwater noise will be short-term, both spatially and temporally. Therefore, short-term localised disturbances, such as the S. I. surveys proposed here would have negligible to no impact on porpoise in the SAC.

Conclusion

Consequently, it is considered that targets, with respect to Conservation Objectives, indicated in Table 16 would not be significantly affected and that there would be **no AEol** on harbour porpoise in Rockabill to Dalkey Island SAC due to the S. I. surveys.

Mitigation

Although it has been assessed there would be no AEol on Rockabill to Dalkey Island SAC, to further reduce any risk of potential injury to individuals, mitigation measures will be applied to reduce the impact of underwater noise and vibration on porpoise. Geophysical acoustic survey guidance, as specified in 'JNCC guidelines for minimising the risk of injury to marine mammals from geophysical surveys' (2017) and will be followed during all impulsive surveys (including: SBP). These guidelines specify procedures including, but not limited to a 'soft start' procedure, which shall be used to ensure that any animals in the vicinity will have chance to leave. With the implementation of these guidelines there will be a negligible risk of disturbance to marine mammals (see Appendix 1 for Marine Mammal Observer protocol) as recommended in the JNCC guidance).

Lambay Island SAC (IE000204)

This site was screened into AA due to a possible LSE on harbour seals and grey seals from underwater noise and vibration.

The Conservation Objectives for harbour seal and grey seal for Lambay Island SAC, and individual attributes with targets are provided in Table 17.

Table 17. Conservation Objective information for harbour seal and grey seal in Lambay Island SAC (IE000204) (NPWS 2014b).

Conservation Objective information for: Lambay Island SAC (IE000204)			
[1365] Harbour seal			
To maintain the favourable conservation condition of harbour seal in Lambay Island SAC, which is defined by the following list of attributes and targets:			
Attribute	Measure	Target	Notes
Access to suitable habitat	Number of artificial barriers	Species range within the site should not be restricted by artificial barriers to site use.	Not applicable
Breeding behaviour	Breeding sites	Conserve the breeding sites in a natural condition.	Attribute and target based on background knowledge of Irish breeding populations, review of data summarised by

Conservation Objective information for: Lambay Island SAC (IE000204)			
			Summers <i>et al.</i> (1980), Harrington (1990), Lyons (2004) and unpublished NPWS records.
Moulting behaviour	Moult haul-out sites	Conserve the moult haul-out sites in a natural condition.	Attribute and target based on background knowledge of Irish populations, review of data from Lyons (2004), Cronin <i>et al.</i> (2004), and unpublished NPWS records.
Resting behaviour	Resting haul-out sites	Conserve the resting haul-out sites in a natural condition.	Attribute and target based on background knowledge of Irish populations, review of data from Lyons (2004) and unpublished NPWS records.
Disturbance	Level of impact	Human activities should occur at levels that do not adversely affect the harbour seal population at the site	Not applicable
[1364] Grey seal			
To maintain the favourable conservation condition of grey seal in Lambay Island SAC, which is defined by the following list of attributes and targets:			
Attribute	Measure	Target	Notes
Access to suitable habitat	Number of artificial barriers	Species range within the site should not be restricted by artificial barriers to site use.	Not applicable
Breeding behaviour	Breeding sites	Conserve the breeding sites in a natural condition.	Not applicable

Conservation Objective information for: Lambay Island SAC (IE000204)			
Moulting behaviour	Moult haul-out sites	Conserve the moult haul-out sites in a natural condition.	Attribute and target based on background knowledge of Irish populations, review of data from Lyons (2004), Cronin <i>et al.</i> (2004), and unpublished NPWS records.
Resting behaviour	Resting haul-out sites	Conserve the resting haul-out sites in a natural condition.	Attribute and target based on background knowledge of Irish populations, review of data from Lyons (2004) and unpublished NPWS records.
Disturbance	Level of impact	Human activities should occur at levels that do not adversely affect the harbour seal population at the site	Not applicable

Overall, it is considered highly unlikely there will be an AEoI of the populations of harbour seal and grey seal within Lambay Island SAC which is 47.5 km from the S. I. Survey Area. As mentioned previously sound attenuates increasingly from the source and, the individual would have to be extremely close to the source at the time of maximum output. If an individual were to be that close to the source, any event of injury would be to that sole individual and would not incur a population level effect as it is an extremely unlikely event. There is extensive suitable foraging and haul-out (seal specific) habitat elsewhere enabling harbour seals and grey seals to avoid the survey area if required. The S. I. survey is also anticipated to be relatively short term (over a four-month period across the whole survey area in Irish and UK waters) and is transient, meaning exposure to underwater noise will be short-term, both spatially and temporally. Therefore, short-term localised disturbances, such as the S. I. surveys proposed here would have negligible to no impact on harbour seals or grey seals in the SAC.

Conclusion

Consequently, it is considered that targets, with respect to Conservation Objectives, indicated in Table 17 would not be significantly affected and that there would be **no AEoI** on harbour seal and grey seal in Lambay Island SAC due to the S. I. surveys.

Mitigation

Although it has been assessed there would be no AEoI on Llyn Peninsula and the Sarnau SAC, to further reduce any risk of potential injury to individuals, mitigation measures will be applied to reduce the impact of underwater noise and vibration on porpoise. Geophysical acoustic survey guidance, as specified in 'JNCC guidelines for minimising the risk of injury to marine mammals from geophysical surveys' (2017) will be followed during all impulsive surveys (including: SBP). These guidelines specify procedures including, but not limited to a 'soft start' procedure which shall be used to ensure that any animals in the vicinity will have chance to leave. With the implementation of these guidelines there will be a negligible risk of disturbance to marine mammals (see Appendix 1 for Marine Mammal Observer protocols as recommended in the JNCC guidance).

7.2 AA Conclusion

The appropriate assessment has concluded, based on consideration of the proposed works, no Adverse Effect on Integrity (AEoI) for those European Sites screened into Stage 2 of the assessment.

8. In-combination Assessment

8.1 Projects considered

The identification of plans and projects to include in the in-combination assessment is based on:

- Approved plans or projects with relevant ongoing activities;
- Approved but as yet unconstructed projects; and
- Projects for which an application has been made, are currently under consideration and will be consented before the proposed works begin.

To identify the projects or plans, a combination of the NRW Public register, Data Map Wales and local knowledge was used. Five projects were identified that are within the vicinity (10 km) of the works and have the potential to have an in-combination effect with the work activities. Distances to the proposed works are provided within brackets:

RML2201 – Geotechnical Surveys, Mona Offshore Wind Farm, North Wales (0 km)

Geophysical surveys in the Mona bidding area, zone of influence around the bidding area and along the potential export cable corridor routes will consist of 155 grab samples and 110 vibrocore samples. Grab samples will remove a maximum of 0.1 m³ of sediment per sample and either a 0.1 m² Day Grab or 0.1 m² mini Hamon grab will be used. Vibrocores will penetrate no more than 6 m deep into the sediment and the corer will have a diameter of 7.5 cm. The samples will be taken at 1 km intervals. This work is expected to be complete by the 30th of September 2023. Given the short duration of the SI works for SOBR2, this project is not expected to have any in-combination effects with any of the involved activities and there is therefore no potential for LSE.

RML2247 - Irish sea benthic sampling by Briggs Marine (4.5 km)

This work involves benthic sampling at sites in the Irish Sea to provide tools to inform offshore wind planning for the Offshore Wind Strategic Environmental Impact Decisions project. There will be 182 sample stations, at each of which, two grab samples will be collected and later analysed for macrofauna, sediment particle size, organic carbon as well as eDNA. Works are due to be completed by the 3rd of July 2023. There is no direct spatial overlap of this survey with the SOBR 2 survey area and given the short duration of the SI works for SOBR2, this project is not expected to have any in-combination effects with any of the involved activities and there is therefore no potential for LSE.

CML2149 – Colwyn Bay Waterfront Project (3.6 km)

Colwyn Bay Waterfront Project will involve the extension of three existing outfalls, the modification of an existing rock control structure as well as the importation of approximately 1 million tonnes of dredged sand. Works for this project are expected to complete around the 14th of March 2024. Given the short duration of the SI works for SOBR2, this project is not expected to have any in-combination effects with any of the involved activities and there is therefore no potential for LSE.

CML2159 – Penrhyn Bay Coastal Defence and Public Realm Improvements (7.05 km)

The proposed scheme comprises of a T-shaped rock groyne structure approximately 100m long by 90m in width at the crest and associated beach nourishment. The rock groyne is suited to the local area, which already comprises other rock groynes and the beach nourishment will be comprised of similar material to existing at the eastern end of the bay. There will also be repairs to the concrete sea wall. This work is due to be completed on the 31st of May 2024. Given the nature of the works associated with this project, and the short duration of the SI works for SOBR2, this project is not expected to have any in-combination effects with any of the involved activities and there is therefore no potential for LSE.

CML1820 – RNLI West Division – Low Impact Maintenance Activities (8.19 km)

The RNLI's maintenance activities will be split into six main categories: maintenance to moorings (including replacement of fittings), maintenance to pontoon berths (and associated pilings, link-spans, quay walls and approach structures), minor beach re-profiling works (and launch route clearance works or minor re-charge works), maintenance to lifeboat station boathouses (and associated slipways, quay walls, pilings *etc*), maintenance works associated with other infrastructure and then the installation, removal and maintenance of beach lifeguard units. This work is due to be completed on the 18th of April 2029. Given the nature of the works associated with this project, and the short duration of the SI works for SOBR2, this project is not expected to have any in-combination effects with any of the involved activities and there is therefore no potential for LSE.

8.2 In-combination assessment conclusion

The in-combination assessment of potential effects arising from identified projects, in-combination with the proposed works, concluded that the work activities would not act in-combination to give rise to an LSE on any European Sites.

9. Conclusions

There is the potential for the proposed Site Investigation works to interact with European and Ramsar sites. This assessment has identified European Sites within the vicinity of the proposed works and individually considered their interest features. The screening methodology followed the conceptual 'source-pathway-receptor' model, which was used to identify potential impact pathways as a consequence of the proposed works.

Consideration was given to the relevant guidance issued by a number of governmental, statutory and industry bodies including, but not limited to, Welsh Government and NRW guidance on Habitat Regulations Assessments, NRW online guidance on HRA in the marine licensing process, Natural England's Advice on Operations, and NRW's position on the use of Marine Mammal Management Units for screening and assessment in Habitats Regulations Assessments for Special Areas of Conservation with marine mammal features. Following reference to this guidance, the following impact pathways were assessed:

- Underwater noise and vibration
- Collision risk
- Pollution
- Visual and noise disturbance
- Reduction in prey availability

The test for LSE indicated that the following sites were potentially susceptible to the following pressures (relevant designated features are provided in brackets):

- North Anglesey Marine
 - Underwater noise and vibration (marine mammal features)
- Pen Llyn a'r Sarnau/ Llyn Peninsula and the Sarnau SAC (UK0013117)
 - Underwater noise and vibration (marine mammal features)
- West Wales Marine / Gorllewin Cymru Sarnau SAC (UK0030397)
 - Underwater noise and vibration (marine mammal features)
- Cardigan Bay/ Bae Ceridigion SAC (UK0012712)
 - Underwater noise and vibration (marine mammal features)
- Pembrokeshire Marine/ Sir Benfro Forol SAC (UK0013116)
 - Underwater noise and vibration (marine mammal features)
- Rockabill to Dalkey Island SAC (003000)
 - Underwater noise and vibration (marine mammal features)
- Lambay Island SAC (000204)
 - Underwater noise and vibration (marine mammal features)

These sites were then taken through into the Stage 2 Appropriate Assessment for consideration of adverse effects on site integrity (AEoI). The Appropriate Assessment considered the potential effects on site integrity and concluded no AEoI without the requirement for mitigation measures. However, JNCC guidelines for geophysical surveys shall be followed to reduce the risk of adverse effects on individual marine mammals.

The in-combination assessment concluded no LSE or AEoI on any of the sites resulting from a combination of the projects considered.

10. References

- Baines, M.E. and Evans, P.G. (2009) Atlas of the marine mammals of Wales. Countryside Council for Wales.
- Basran, C.J., Woelfing, B., Neumann, C., and Rasmussen, M.H. (2020) Behavioural responses of humpback whales (*Megaptera novaeangliae*) to two acoustic deterrent devices in a northern feeding ground off Iceland. *Aquatic Mammals*, 46(6):584-602.
- Benhemma-Le Gall, A., Graham, I.M., Merchant, N. & Thompson, P.M (2021). Broad-scale responses of harbor porpoises to pile-driving and vessel activities during offshore windfarm construction. *Frontiers in Marine Science*: 8, 664724.
- Bureau of Ocean Energy Management (BOEM) Office of Renewable Energy Programs (2012) Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore Massachusetts, Environmental Assessment. Published by U.S. Department of the Interior. October 2012.
- Brandt, M.J., Diederichs, A., Betke, K., & Nehls, G. (2011) Responses of harbour porpoises to pile driving at the Horns Rev II offshore wind farm in the Danish North Sea. *Marine Ecology Progress Series*, 42: 205-216.
- Campanella R.G., Robertson P.K. and Gillespie D. (1986) A Seismic Cone Penetrometer for Offshore Applications. In: *Oceanology. Advances in Underwater Technology, Ocean Science and Offshore Engineering*, vol 6.
- Carter, M. I. D., Boehme, L., Duck, C.D., Grecian, W.J., Hastie, G.D., McConnell, B.J., Miller, D.L., Morris, C.D., Moss, S.E.W., Thompson, D., Thompson, P.M., & Russell D.J.F. (2020) Habitat-based predictions of at-sea distribution for grey and harbour seals in the British Isles. Sea Mammal Research Unit, University of St Andrews, Report to BEIS, OESEA-16-76/OESEA-17-78.
- Carter, M. I. D., Boehme, L., Cronin, M.A., Duck, C.D., Grecian, W.J., Hastie, G.D., Jessopp, M., Matthiopoulos, J., McConnell, B.J., Miller, D.L., Morris, C.D., Moss, S.E.W., Thompson, D., Thompson, P.M., and Russell, D.J.F. (2022) Sympatric seals, satellite tracking and protected areas: habitat-based distribution estimates for conservation and management. *Frontiers in Marine Science*, 9:875869.
- Chapman, C. & Tyldesley, D. 2016. Functional linkage: How areas that are functionally linked to European sites have been considered when they may be affected by plans and projects - a review of authoritative decisions. Natural England Commissioned Reports, Number 207.
- Cheney, B., Thompson, P.M., Ingram, S.N., Hammond, P.S., Stevick, P.T., Durban, J.W., Culloch, R.M., Elwen, S.H., Mandleberg, L., Janik, V.M. and Quick, N.J. (2013) Integrating multiple data sources to

assess the distribution and abundance of bottlenose dolphins *Tursiops truncatus* in Scottish waters. *Mammal Review*, 43(1), pp.71-88.

Crocker, S.E. and Fratantonio, F.D. (2016) Characteristics of high-frequency sounds emitted during high-resolution geophysical surveys. OCS Study, BOEM 2016-44, NUWC-NPT Technical Report 12, 203pp.

Crocker, S. E., Fratantonio, F.D., Hart, P.E., Foster, D.S., O'Brien, T.F. and Labak, S. (2019) Measurement of Sounds Emitted by Certain High-Resolution Geophysical Survey Systems. *IEEE Journal of Oceanic Engineering*, 44: 796-813, doi.org/10.1109/JOE.2018.2829958

Culloch, R. M., Anderwald, P., Brandecker, A., Haberlin, D., McGovern, B., Pinfield, R., Visser, F., Jessopp, M. and Cronin, M. (2016) Effect of construction-related activities and vessel traffic on marine mammals. *Marine Ecology Progress Series*, 549, pp.231-242.

Deane, G.B. and Stokes, M.D., (2010) Model calculations of the underwater noise of breaking waves and comparison with experiment. *The Journal of the Acoustical Society of America*, 127(6): 3394-3410.

Deaville, R., Jepson, P.D., Perkins, M., Brownlow, A., Davison, N., ten Doeschate, M., Smith, B., Allan, L., Clery, M., Swindells, K., Wilson, S., Sabin, R.C., Penrose, R., Barnett, J.E.F., Astley, K., Clear, N., Crosby, A., & Williams, R. (2018) UK Cetacean Strandings Investigation Programme final contract report to Defra (MB0111 2011-2017).

Department for Environment, Food and Rural Affairs (DEFRA) (2021) North West Marine Plan Habitats Regulations Assessment: Appropriate Assessment 2021, DEFRA, London.

Dunlop, R.A. (2016) The effect of vessel noise on humpback whale, *Megaptera novaeangliae*, communication behaviour. *Animal Behaviour*, 111: 13-21.

EIRGRID PLC. (2014) Celtic Interconnector Project: Marine Mammal Risk Assessment. Produced by Intertek Energy and Water consultancy services. Report Reference: Attachment F_P1812_R3691_REV1.

EMODnet broad-scale seabed habitat map for Europe (v2021), licensed under CC-BY 4.0 from the European Marine Observation and Data Network (EMODnet) Seabed Habitats initiative (www.emodnet-seabedhabitats.eu), funded by the European Commission. Accessed: 28/01/2023.

Erbe, C., Reichmuth, C., Cunningham, K., Lucke, K. and Dooling R. (2016) Communication masking in marine mammals: A review and research strategy. *Marine Pollution Bulletin*, 103:15-38.

Farcas, A., Thompson, P.M. and Merchant, N.D. (2016) Underwater noise modelling for environmental impact assessment. *Environmental Impact Assessment Review*, 57:114-122. Doi: 10.1016/j.eiar.2015.11.012

Feingold, D. and Evans, P.G.H. (2013) Bottlenose Dolphin and Harbour Porpoise Monitoring in Cardigan Bay and Pen Llŷn a'r Sarnau Special Areas of Conservation 2011 – 2013. NRW Evidence Report No. 04.

Graham, I.M., Merchant, N.D., Farcas, A., Barton, T.R., Cheney, B., Bono, S., and Thompson, P.M. (2019) Harbour porpoise responses to pile-driving diminish over time. Royal Society Open Science, 6(6). Doi:10.1098/rsos.190335

Hague, E. L., Sinclair, R. R., and Sparling, C. E. (2020) Regional baselines for marine mammal knowledge across the North Sea and Atlantic areas of Scottish waters. Scottish Marine and Freshwater Science.

Heiler, J., Elwen, S.H., Kriesell, H.J., and Gridley, T. (2016) Changes in bottlenose dolphin whistle parameters related to vessel presence, surface behaviour and group composition. Animal Behaviour, 117:167-177.

Heinänen, S. and Skov, H. (2015) The identification of discrete and persistent areas of relatively high harbour porpoise density in the wider UK marine area. Peterborough: JNCC.

JNCC (2017) JNCC guidelines for minimising the risk of injury to marine mammals from geophysical surveys. Accessed 31/05/23. Available from: <https://data.jncc.gov.uk/data/e2a46de5-43d4-43f0-b296-c62134397ce4/jncc-guidelines-seismicsurvey-aug2017-web.pdf>.

JNCC (2019a) Harbour Porpoise (*Phocoena phocoena*) Special Area of Conservation: North Anglesey Marnie/ Gogledd Môn Forol: Conservation Objectives and Advice. Accessed 30th May 2023. Available from: <https://data.jncc.gov.uk/data/f4c19257-2341-46b3-8e29-49665cd8f3d2/NorthAnglesey-Conservation-Advice.pdf>.

JNCC (2019b) Harbour Porpoise (*Phocoena phocoena*) Special Area of Conservation: West Wales Marine / Gorllewin Cymru Forol: Conservation Objectives and Advice. Accessed 31st May 2023. Available from: <https://data.jncc.gov.uk/data/029e40f3-5f67-4168-b10d-8730f2c40e0a/WWM-conservation-advice.pdf>.

JNCC (2019c) Conservation status assessment for the species: S1351 - Harbour porpoise (*Phocoena phocoena*), European Community Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora (92/43/EEC) Fourth Report by the United Kingdom under Article 17 on the implementation of the Directive from January 2013 to December 2018, United Kingdom.

JNCC (2019d) Conservation status assessment for the species: S1349 - Bottlenose dolphin (*Tursiops truncatus*), European Community Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora (92/43/EEC) Fourth Report by the United Kingdom under Article 17 on the implementation of the Directive from January 2013 to December 2018, United Kingdom.

JNCC (2019e) Conservation status assessment for the species: S1364 - Grey seal (*Halichoerus grypus*), European Community Directive on the Conservation of Natural Habitats and of Wild Fauna

and Flora (92/43/EEC) Fourth Report by the United Kingdom under Article 17 on the implementation of the Directive from January 2013 to December 2018, United Kingdom.

Kongsberg Maritime (2023) μ PAP PORTABLE ACOUSTIC POSITIONING. Accessed 01/06/2023. Available from: [cNODE MiniS Data sheet \(kongsberg.com\)](https://www.kongsberg.com/cnode-mini-s-data-sheet).

Laist, D.W., Knowlton, A.R., Mead, J.G., Collet, A.S., & Podesta, M. (2001) Collisions between ships and whales. *Marine Mammal Science*, 17: 3-75.

Langley, I., Rosas da Costa Oliver, T., Hiby, L., Stringell, T.B., Morris, C.W., O’Cadhla, O., Morgan, L., Lock, K., Perry, S., Westcott, S. and Boyle, D. (2020) Site use and connectivity of female grey seals (*Halichoerus grypus*) around Wales. *Marine Biology*, 167, pp.1-15.

LGL Alaska Research Associates and Jasco Applied Sciences (2010) Marine Mammal Monitoring and Mitigation during Marine Geophysical Surveys by Shell Offshore Inc. in the Alaskan Chukchi and Beaufort Seas, July – October 2010:90-Day Report

Lusseau, D. (2003) Effects of tour boats on the behaviour of bottlenose dolphins: using Markov chains to model anthropogenic impacts. *Conservation Biology*, 17(6): 1785-1793.

Lusseau, D., Lusseau, S. M., Bejder, L., and Williams, R. (2006) An individual-based model to infer the impact of whale watching on cetacean population dynamics. *SC/58/WW7*.

MDM, 2023, Application for foreshore licence for marine survey & site investigation works.

Medwin, H., (1970) In situ acoustic measurements of bubble populations in coastal ocean waters. *Journal of Geophysical Research*, 75(3): 599-611.

Ministry of Housing, Communities and Local Government (MHCLG) (2019) National Planning Policy Framework. MHCLG, London.

Mitchell, C. (2012). Mapping the distribution of feeding Pink-footed and Iceland Greylag Geese in Scotland. Wildfowl & Wetlands Trust / Scottish Natural Heritage Report, Slimbridge. 108pp.

National Marine Fisheries Service (NMFS) (2018) 2018 Revisions to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0): Underwater Thresholds for Onset of Permanent and Temporary Threshold Shifts. U.S. Dept. of Commer., NOAA. NOAA Technical Memorandum NMFS-OPR-59.

National Parks and Wildlife Service (NPWS) (2013) Lambay Island SAC (site code: 0204) Conservation objectives supporting document -Marine Habitats and Species, Unpublished report. Available from: https://www.npws.ie/sites/default/files/publications/pdf/000204_Lambay%20Island%20SAC%20Conservation%20Supporting%20Doc_V1.pdf

National Parks and Wildlife Service (NPWS) (2014a) Site Synopsis: Rockabill to Dalkey Island SAC 003000. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

National Parks and Wildlife Service (NPWS) (2014b). Site Synopsis: Lambay Island SAC 000204. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

Natural Resources Wales (NRW) (2015) MCA 9 Holy Island West & Penrhos Bay, *Marine Character Areas*, Available at: https://cyfoethnaturiol.cymru/media/674487/mca-09-holy-island-west-and-penrhos-bay_final.pdf

Natural Resources Wales (NRW) (2018a) Pen Llŷn a'r Sarnau / Llyn Peninsula and the Sarnau Special Area of Conservation: Advice provided by Natural Resources Wales in fulfilment of Regulation 37 of the Conservation of Habitats and Species Regulations 2017.

Natural Resources Wales (NRW) (2018b) Cardigan Bay/ Bae Ceredigion Special Area of Conservation: Advice provided by Natural Resources Wales in fulfilment of Regulation 37 of the Conservation of Habitats and Species Regulations 2017.

Natural Resources Wales (NRW) (2022) Position statement: NRW's position on the use of Marine Mammal Management Units for screening and assessment in Habitats Regulations Assessments for Special Areas of Conservation with marine mammal features, PS006, Marine Programme Planning and Delivery Group, Natural Resources Wales. Available from: <https://cdn.cyfoethnaturiol.cymru/media/695250/ps006-mmmus-in-hra-position-statement-may22.pdf>

NRW and JNCC (2017) SAC Selection Assessment Document: West Wales Marine / Gorllewin Cymru Forol. January, 2017. Natural Resources Wales and Joint Nature Conservation Committee, UK. Available from: <http://jncc.defra.gov.uk/page-7343>

Nowacek, D.P., Thorne, L.H., Johnston, D.W., and Tyack, P.L. (2007) Responses of cetaceans to anthropogenic noise. *Mammal Review*, 37(2): 81-115.

OSPAR (2009) Overview of the impacts of anthropogenic underwater sound in the marine environment. OSPAR Biodiversity Series. Accessed 31/05/23 Available at: <https://www.ospar.org/about/publications>].

Pine, M.K., Schmitt, P., Culloch, R.M., Lieber, L., and Kregting, L.T. (2019) Providing ecological context to anthropogenic subsea noise: Assessing listening space reductions of marine mammals from tidal energy devices. *Renewable and Sustainable Energy Reviews*, 103: 49-57.

Pirotta, E., Milor, R., Quick, N., Moretti, D., Di Marzio, N., Tyack, P., Boyd, I. and Hastie, G. (2012) Vessel noise affects beaked whale behavior: results of a dedicated acoustic response study.

Pirotta, E., Brookes, K.L., Graham, I.M. and Thompson, P.M. (2014) Variation in harbour porpoise activity in response to seismic survey noise. *Biology letters*, 10(5), p.20131090.

Richardson, W.J., Greene, C.R., Malme, C.I. and Thomson, D.H. (1995) Marine mammals and noise. Academic Press, San Diego, CA.

Robinson, K.P., O'Brien, J., Berrow, S., Cheney, B., Costa, M., Elsfeld, S.M., Haberlin, D., Mandleberg, L., O'donovan, M., Oudejans, M.G. & O'Connor, I. (2012) Discrete or not so discrete: Long distance movements by coastal bottlenose dolphins in UK and Irish waters. *Journal of Cetacean Research and Management*.

Rogan, E., Breen, P., Mackey, M., Cañadas, A., Scheidat, M., Geelhoed, S. and Jessopp, M. (2018) Aerial surveys of cetaceans and seabirds in Irish waters: Occurrence, distribution and abundance in 2015-2017. Department of Communications, Climate Action & Environment and National Parks and Wildlife Service (NPWS), Department of Culture, Heritage and the Gaeltacht, Dublin, Ireland. 297pp.

Santos, M.B. and Pierce, G.J. (2003) The diet of harbour porpoise (*Phocoena phocoena*) in the northeast Atlantic: A review, *Oceanography and Marine Biology: An Annual Review*, 41: 363-369.

Schaffeld, T., Ruser, A., Woelfing, B., Baltzer, J., Kristensen, J.H., Larsson, J., Schnitzler, J.G., and Siebert, U. (2019) The use of seal scarers as a protective mitigation measure can induce hearing impairment in harbour porpoises. *The Journal of the Acoustical Society of America*, 146(6):4288-4298.

Schoeman, R.P., Patterson-Abrolat, C., and Plön, S. (2020). A global review of vessel collisions with marine animals. *Frontiers in Marine Science*, 7: 292.

Sivle, L.D., Vereide, E.H., de Jong, K., Forland, T.N., Dalen, J., and Wehde, H. (2021) Effects of sound from seismic surveys on fish reproduction, the management case from Norway. *Journal of Marine Science and Engineering*, 9:436.

SNH (2016) Interim guidance on apportioning impacts from marine renewable developments to breeding seabird populations in special protected areas. In.

Southall, B.L., Finnerman, J.J., Reichmuth, C., Nachtigall P.E., Ketten, D.R., Bowles, A.E., Ellison, W.T., Nowacek, D.P. and Tyack, P.L. (2019) Marine mammal noise exposure criteria: updated scientific recommendations for residual hearing effects. *Aquatic Mammals*, 45(2): 125-232.

Southall, B.L., Nowacek, D.P., Bowles, A.E. Senigaglia, V., Bejder, L., and Tyack, P. (2021) Marine mammal noise exposure criteria: assessing the severity of marine mammal behavioral responses to human noise. *Aquatic Mammals*, 47(5): 421-464.

Special Committee on Seals (SCOS) (2020) Scientific advice on matters related to the management of seal populations: 2020. Special Committee on Seals (SCOS) Main Advice Report.

SCOS (2021) Scientific advice on matters related to the management of seal populations: 2021.
NERC: Special Committee on Seals (SCOS) Main Advice Report.

Stone, C.J., Hall, K., Mendes, S., and Tasker, M.L. (2017) The effects of seismic operations in UK waters: analysis of marine mammal observer data. *Journal of Cetacean Research and Management*, 16: 71-85.

The International Convention for the Prevention of Pollution from Ships 1973 as modified by the Protocol of 1978 (MARPOL 73/78).

Thompson, P. M., Mackay, A., Tollit, D. J., Enderby, S. and Hammond, P. S. (1998) The influence of body size and sex on the characteristics of harbour seal foraging trips. *Can. J. Zool.* 76, 1044–1053

Thompson, K.F., Millar, C.D., Baker, C.S., Dalebout, M., Steel, D., van Helden, A.L., & Constantine, R. (2013) A novel conservation approach provides insights into the management of rare cetaceans. *Biological conservation*, 157, pp. 331-340.

Trabant, P.K. (2013) Applied high-resolution geophysical methods: offshore geoengineering hazards. Springer Science & Business Media

Wall, D., Murray, C., O'Brien, J., Kavanagh, L., Wilson, C., Ryan, C., Glanville, B., Williams, D., Enlander, I., O'Connor, I., McGrath, D., Whooley, P. and Berrow, S. (2013) Atlas of the distribution and relative abundance of marine mammals in Irish offshore waters 2005 - 2011. Irish Whale and Dolphin Group, Kilrush, Co. Clare. 63pp.

Watson, H.C. (1986) The feeding ecology of the European otter (*Lutra lutra* L.) in a marine environment, Durham theses, Durham University. Available at Durham E-Theses Online: <http://etheses.dur.ac.uk/6777/>

Wilson, R. P., Liebsch, N., Gomez-Laich, A., Kay, W. P., Bone, A., Hobson, V. J., and Siebert, U. (2015). Options for modulating intra-specific competition in colonial pinnipeds: the case of harbour seals (*Phoca vitulina*) in the Wadden Sea. *PeerJ*, 3, e957.

Wisniewska, D.M., Johnson, M., Teilmann, J., Siebert, U., Galatius, A., Dietz, R., and Madsen, P.T. (2018) High rates of vessel noise disrupt foraging in wild harbour porpoises (*Phocoena phocoena*). *Proceedings of the Royal Society B: Biological Sciences*, 285(1872), doi:10.1098/rspb.2017.2314.

Woodward, I., Thaxter, C.B., Owen, E. and Cook, A.S.C.P. (2019) Desk-based revision of seabird foraging ranges used for HRA screening. *BTO research report*, (724).

Wright, L.J., Ross-Smith, V.H., Austin, G.E., Massimino, D., Dadam, D., Cook, A.S.C.P., Calbrade, N.A. and Burton, N.H.K. (2012) Assessing the risk of offshore wind farm development to migratory birds designated as features of UK Special Protection Areas (and other Annex 1 species).

Appendix 1 – Geophysical surveys operational guidance (JNCC, 2017)

1. Qualified and experienced marine mammal observers (MMO) and passive acoustic monitoring (PAM) operators shall be appointed to monitor for marine mammals and to log all relevant events using standardised data forms. Sufficient personnel should be employed considering the size and location of the survey, the number of line changes and soft starts required, the duration of daylight hours and the requirement for night-time operations to prevent observer fatigue and to meet health and safety requirements.
2. 'The MMO/PAM operative will monitor the agreed mitigation zone and advise if any marine mammals are within it. The standard radius of the mitigation zone is 500m, estimated from the centre of the airgun array or noise source location (noting comments in 0). If the size of the mitigation zone is adjusted for any reason, this will be stipulated within the survey consent or licence conditions.'
3. 'If marine mammals are detected within the mitigation zone during the pre-shooting search (visually or acoustically), the soft-start must be delayed until their passage, or the transit of the vessel, results in them being outside of the mitigation zone. There must be a minimum of a 20-minute delay from the time of the last detection within the mitigation zone and the commencement of the soft-start, to allow animals unavailable for detection (i.e. not re-surfacing in that time) to have moved outside of the mitigation zone. A full soft-start must be undertaken after any delay due to the presence of marine mammals within the mitigation zone. If marine mammals are detected within the mitigation zone whilst the airguns are firing, either during the soft-start procedure or when at full power, there is no requirement to stop firing.'

Section 2: Mitigation

Standard Airgun Mitigation Procedures

The following guidelines apply to all geophysical surveys that use airguns.

Pre-shooting search

Clear communication channels between the MMO/PAM operator and relevant crew must be established prior to the commencement of any operations. The MMO/PAM operator must be aware of the timings of the proposed operations. The crew must inform the MMO/PAM

operators (or nominated lead) sufficiently in advance of airgun firing so that a full pre-shooting search can be completed prior to the soft start commencing.

Location of MMO/PAM

All monitoring (visual and PAM) should be undertaken from the source vessel (where the noise source is deployed from) unless alternative arrangements have been agreed with the Regulator. The MMO should be positioned on a high platform with a clear view of the horizon, mitigation zone and ahead of the vessel. The PAM operator should be positioned in the most appropriate location to allow them to monitor the PAM equipment for acoustic detections and maintain contact with both the MMO and relevant crew, for both mitigation purposes and ensuring the PAM equipment is deployed correctly.

Mitigation zone

The MMO/PAM operative will monitor the agreed mitigation zone and advise if any marine mammals are within it. The standard radius of the mitigation zone is 500 m, estimated from the centre of the airgun array or noise source location (noting comments in 0). If the size of the mitigation zone is adjusted for any reason, this will be stipulated within the survey consent or licence conditions.

Duration of search

The MMO must monitor the mitigation zone for the full duration of the pre-shooting search and soft-start procedure. Where PAM is being used in conjunction with or in place of visual surveys, acoustic monitoring must also occur for the full duration of the pre-shooting search and soft-start procedure. Once the soft start has ended and data acquisition begins, monitoring can cease.

The duration of the pre-shooting search is determined as follows:

- Waters less than 200 m deep: 30 minutes prior to the use of any airguns.
- Waters greater than 200 m deep: 60 minutes prior to the use of any airguns.

The longer search period is to allow for deep diving species (e.g. sperm whale and beaked whale) which are known to dive for longer than 30 minutes. PAM may also be required on all pre-shooting searches in deeper waters (i.e. to complement visual surveys) to increase the potential to detect species with long dive times.

Due to the longer pre-shooting search time required in deeper waters, pre-shooting searches can commence before the end of a preceding survey line (whilst the airguns are still firing) IF line changes will take less time than the pre-shooting search and soft-start combined (i.e. 80 mins).

If marine mammals are detected within the mitigation zone

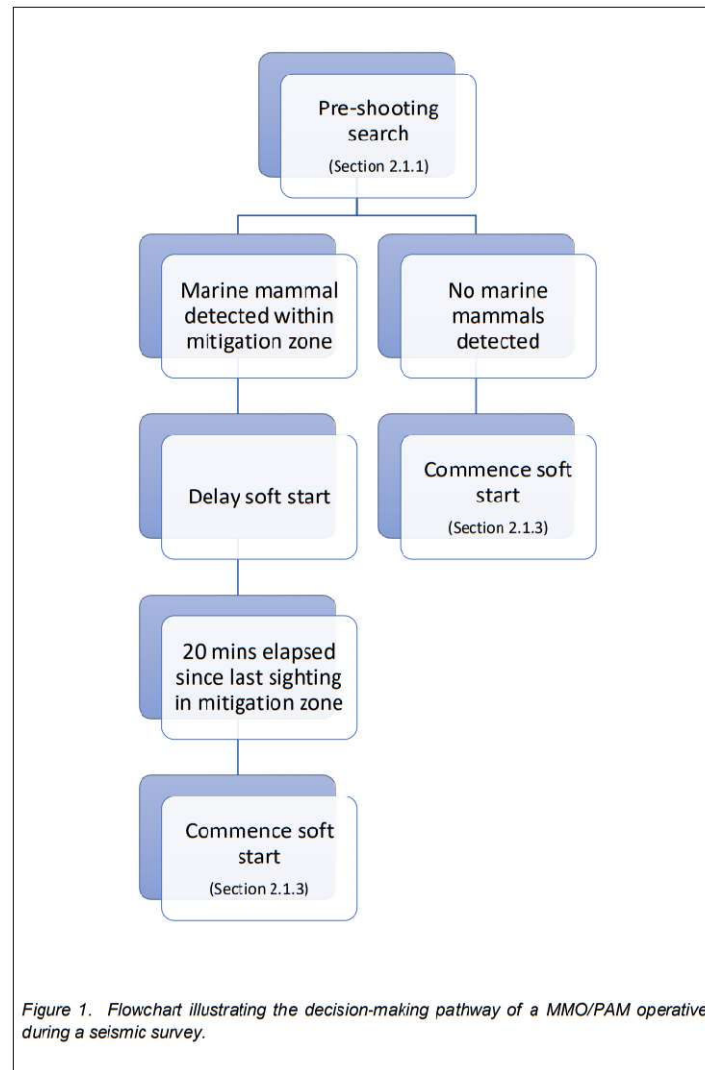
If marine mammals are detected within the mitigation zone during the pre-shooting search (visually or acoustically), the soft-start must be delayed until their passage, or the transit of the vessel, results in them being outside of the mitigation zone. There must be a minimum of a 20-minute delay from the time of the last detection within the mitigation zone and the commencement of the soft-start, to allow animals unavailable for detection (i.e. not re-surfacing in that time) to have moved outside of the mitigation zone.

A full soft-start must be undertaken after any delay due to the presence of marine mammals within the mitigation zone.

In situations where seal(s) are congregating around a fixed platform within a survey area, the soft-start should commence at a location at least 500 m from the platform.

If marine mammals are detected within the mitigation zone whilst the airguns are firing, either during the soft-start procedure or when at full power, there is no requirement to stop firing.

Figure 1 below illustrates a typical seismic survey with decision making pathways in the event a marine mammal is detected.



Soft-start

Two criteria define the standard duration of a soft start:

- From the start of the soft-start until full operational power: minimum of 20 minutes;
- From the start of the soft-start until the start of the survey line: maximum of 40 minutes.

One exception to these criteria is for surveys where the maximum airgun volume is <180 cubic inches, in which case:

- From the start of the soft-start until full operational power: minimum of 15 minutes;
- From the start of the soft-start until the start of the survey line: maximum of 25 minutes.

Regardless of duration, power should be built up gradually, in uniform stages from a low energy start-up (e.g. increasing the number of airguns starting with the smallest airgun in the array or increasing the airgun pressure).

There should be a soft-start every time the airguns are scheduled to be used, the only exceptions being for certain types of airgun testing, and the use of a 'mini-airgun' (single gun volume equal to or less than 10 cubic inches). Mini airguns do not require a soft start.

Surveys operations should be planned to avoid unnecessary firing at operational power before commencement of a survey line and to time operations to commence data collection as soon as possible once full operational power is achieved.

Line changes

Seismic data is usually collected along predetermined survey lines. Line change or line turn is the term used to describe the activity of turning the vessel at the end of one survey line prior to commencement of the next.

The following procedures depend on the duration of the line change. If an operator determines that an effective line change cannot be achieved using these procedures, then they should contact the Regulator and appropriate SNCB(s) at the earliest possible opportunity to discuss a proposed alternative. Details of any agreed alternative procedures should be described during the application process and reiterated, if appropriate, in the survey consent or licence conditions.

One example of airgun use that does not require a line change is Vertical Seismic Profiling (VSP), a technique where measurements are made at a series of depths in the wellbore using geophones inside the wellbore and an airgun source at the surface near the well. In this instance, the breaks in operations required to reposition geophones are treated in the same manner as line changes.

If monitoring operations are being undertaken using PAM and difficulties are encountered when deploying the PAM equipment, the line changes should be extended to allow the full pre-shooting search and soft start to be completed using PAM.

a) If line changes are expected to take longer than 40 minutes:

If line changes (or geophone repositioning) are expected to take longer than 40 minutes, regardless of airgun volume:

- Firing is to be terminated at the end of the survey line (or during geophone repositioning);

- A pre-shooting search is to be undertaken during the scheduled line change (or geophone repositioning);
- The soft-start is to be delayed if marine mammals are seen within the mitigation zone during the pre-shooting search and
- A full 20-minute soft-start is to be undertaken before the start of the next line or VSP data collection.

Most seismic surveys with airgun array volumes of 500 cubic inches or more and extensive hydrophone arrays are not able to complete their line changes within 40 minutes (Stone, 2015b) and should therefore follow the procedures outlined above.

b) If line changes are expected to take less than 40 minutes:

If line changes (or geophone repositioning) are expected to be completed within 40 minutes, regardless of airgun volume:

- Airgun firing can continue during the line change only if power is reduced to 180 cubic inches (or as close as is practically feasible) at standard pressure. Airgun volumes of less than 180 cubic inches can continue to fire at their operational volume and pressure; AND
- The Shot Point Interval (SPI) is increased to provide a longer duration between shots, with the SPI not to exceed 5 minutes; AND
- The power is increased and the SPI is decreased in uniform stages during the final 10 minutes of the line change (or geophone repositioning), prior to data collection recommencing (i.e. a form of mini soft start).

If the above is not practical, and an alternative procedure has not been agreed with the Regulator, then airgun firing should be terminated and a pre-shooting search and soft-start implemented prior to the start of the next line.

Airgun testing

Airgun tests may be required to trial new equipment or to test damaged or misfiring airguns following repair. Individual airguns or several airguns may need testing and the airguns may also be tested at varying power levels. The following guidance is provided to clarify when a soft-start is required for airgun testing:

- If the intention is to test a single airgun, a soft-start is not required.

- If the intention is to test multiple airguns, a soft-start is required. This should be carried out over a time period proportional to the number and/or volume of guns being tested and should not exceed 20 minutes in duration. Airguns should be tested in order of volume, smallest first.
- A pre-shooting search must be undertaken before any instances of airgun testing.

Where feasible, it is recommended that airgun testing is incorporated into the soft start procedure and conducted before the start of a survey line to reduce the total amount of noise being introduced into the marine environment.

Undershoot operations

The MMO/PAM operatives should be located on the source vessel to ensure they are close enough to the airguns to effectively monitor the mitigation zone. If this is not possible, e.g. for logistical or health and safety reasons, the operator should explain this during the application process and suggest and agree any alternative mitigation arrangements with the Regulator.

A pre-shooting search and soft-start procedure must be followed prior to undertaking all undershoot operations.

Breaks in operations

Unplanned breaks: This refers to instances where the airguns cease firing unexpectedly during data acquisition, e.g. a technical problem or breakdown. In such circumstances, it is imperative the MMO/PAM operatives begin to monitor the mitigation zone as quickly as possible after an unplanned break has occurred.

Unplanned breaks of less than 10 minutes: If the airguns can be restarted and data acquisition resumed in less than 10 minutes, there is no requirement for a soft-start and firing can recommence at the same power level as at prior to the break (or lower), provided no marine mammal(s) have been detected in the mitigation zone during the breakdown period.

If a marine mammal is detected in the mitigation zone during the breakdown period, the MMO/PAM operative will advise to delay recommencement of the airgun firing until their passage, or the transit of the vessel, results in the marine mammals being outside of the mitigation zone. There must be a minimum of a 20-minute delay from the time of the last detection within the mitigation zone and a soft-start must then be undertaken.

Unplanned breaks of longer than 10 minutes: If it takes longer than 10 minutes to restart the airguns, a full pre-shooting search and soft-start should be carried out before the survey re-

commences. If an MMO/PAM operative has been monitoring during the breakdown period, this time can contribute to the pre-shooting search time (30 or 60 minutes as appropriate).

If the breakdown occurs at night or during daylight conditions not conducive for a visual search, the mitigation zone should be monitored as described above using PAM. If PAM is not available, the survey must be delayed until conditions are suitable for visual observations.

Planned breaks: If breaks in data acquisition other than during a line change are required (e.g. to avoid a structure), these should be considered within the application to allow the Regulator and SNCB to fully understand the survey procedure.

The same procedures as above (for unplanned breaks) can be applied. However, if the planned break will be for less than 10 minutes, the MMO/PAM operatives **must** begin monitoring 20 minutes prior to the planned break and continue for the duration of the break.

Appendix 2 – Survey Vessels and Equipment

The Roman Rebel

The Roman Rebel is a purpose-built survey platform and is considered a top-of-the line vessel for its class. This vessel's unique design enables this boat to provide the performance of a much larger survey vessel in a smaller, more agile hull. She is a purpose-built survey platform with a semi-SWATH (Small Waterplane Area Twin Hull) hull design that optimises stability. The survey equipment plan essentially enables this vessel to be operated as two identical, harmonised platforms during survey work, ensuring the most productive hydrographic data collection while maintaining precision and efficiency.



Roman Rebel

Vessel Data (v2)



General

Builder:	Socarenam Boulogne, France
Designer:	Bureau Mauric, Marseilles
Launched:	2014
Length:	27.5 m
Beam:	10.0 m
Draught:	3.5 m
Tonnage:	134 GT
Ops Code:	UK MCA SCV Category 1 (150 miles)
Class:	Lloyd's Register 100A1SSC Catamaran, G6, DP1
Flag:	UK
Previous name:	Bibby Athena

Propulsion

Main:	2 x Cummins KTA19 M3 447 kW each (600 hp) marine diesels
Main Propellers:	5 blade fixed pitch
Main Gearbox:	MG516C twin disk hydraulic gearboxes
Survey:	2 x Schottel SPJ57 azimuth pump jets 175 kW (235 hp)
Bow Thrusters:	2 x Schottel SPJ15 azimuth pump jets 60 kW (80 hp)
Max speed:	12 knots
Cruising speed:	10 knots
Survey speed:	3.5 – 6.0 knots

Generators

Main:	2 x Scania DI13-074M (340 kVA each)
Harbour:	1 x Cummins Onan 35 kVA
Deck Connection:	1 x 175 kVA and 1 x 50 kVA

Manning and Endurance

Berths:	16
Safe manning:	5
Endurance:	10 days (with 16 crew)

Capacities

Gas oil:	24 m ³
Fresh water:	8 m ³
Water maker:	2 m ³

Fuel Consumption

Transit:	2.5 m ³ · day ⁻¹
Survey:	1.2 m ³ · day ⁻¹
DP:	1.8 m ³ · day ⁻¹

Nav aids

Radar:	2 x 94m Furuno FAR 2117 Black Box
Autopilot:	Navico AP50 with remote control
ECDIS:	Navmaster
AIS:	Furuno FA150
dGPS:	C&C Tech C-Nav 3050 and Furuno GP150
Echosounder:	Furuno FE700
Heading INS Gyro:	iXBlue Quadrans
Secondary Heading:	2x iXBlue Hydrans
Speed log:	Skipper Electromagnetic
Navtex:	Furuno700B
Weather:	2 x Furuno WS200
VHF:	2x Icom 603 DSC
MF:	Furuno FS1570
Sat Comms:	Furuno 250 Fleet Broadband; Furuno Felcom 15 Sat C
GNSS:	C-NAV and Hemisphere

Dynamic Positioning (DP1)

System:	Sirehna EasyDP BV - AM/AT
Modes:	Station keeping, ROV follow, slow speed line keeping, high speed line keeping, Auto heading
Ref Sensors:	2 x dGPS, 2 x MRU (Hydrans and Quadrans), dual axis log, 2 x wind sensors, Sonardyne Mini-Ranger 2 USBL acoustic navigation system

Roman Rebel

Vessel Data (v3)



Deck Equipment

Crane:	Palfinger PK23500-M, 5,450 kg at 4.2 m, 8 m reach
Crane remote:	Full function radio control
A-Frame:	Hydraulic 8,000 kg SWL with 6.5m deck clearance
A-Frame outriggers:	Full beam width for towing geophysical sensors
Lifting winch:	Hydraulic 8,000 kg line pull
Moonpool:	2.05 m x 2.30 m central moonpool
Main Survey Winch:	MacArtney "Cormac" 4 1,500 m of 8.2 mm coax cable
Secondary survey winch:	2x STR ESW-1500 600 m of 11.4 mm coax cable
Sonar well:	2x 600 mm x 540 mm
USBL well:	310 mm diameter
Capstan:	2 x deck mounted 2000 kg line pull

Survey Positioning

GNSS 1:	C&C Tech C-Nav 3050
GNSS 2:	Hemisphere R330
INS:	2x iXBlue Hydrans

Underwater Positioning

USBL transceiver:	Sonardyne HPT 3000 ("Mini Ranger 2")
Surface unit:	Sonardyne Hub
Transponder:	Sonardyne WSM 6+

Safety

Liferaft capacity:	2x 16 man
Lifejackets:	16x emergency; 8x deck work
Survival suits:	16x neoprene immersion suits
Emergency positioning:	EPIRB 406 kHz
Other:	2x SAR transponders

Multibeam Echosounder

Sonar heads:	2x Teledyne SeaBat T50-R (total 2,048 beams per ping)
Processor:	2x Teledyne Reson T50 IDH processor
SV sensor:	2x Reson SVP-70

Sub-Bottom Profilers

Pinger Transducer:	4x Neptune T335
Parametric Transducer:	Innomar Medium-100; 2-22 kHz secondary frequencies; vertical resolution better than 5 cm
Surface unit 1:	Kongsberg Geoacoustics Geopulse 5430A
Surface unit 2:	2x Coda DA4G Acquisition Unit - Simultaneous A/D System
Surface unit 3:	Innomar Medium topside

Side-Scan Sonar

Towfish:	EdgeTech 4205
Processor:	EdgeTech 701-DL

Magnetometers

Magnetometer:	Geomatrix G-882
TVG frames:	Geomatrix carbon fibre with telemetry
Gradiometer setups:	up to 3x 2-sensor TVG frames (6 sensors); up to 3x EIVA 4-sensor scanfish (12 sensors)

Deck space

Available:	7 m x 5 m (35 m ²)
Surface:	wooden planks
Typical uses:	ROV LARS systems; shallow coring and grabs; 20' storage container

Roman Rebel
Vessel Data (v3)

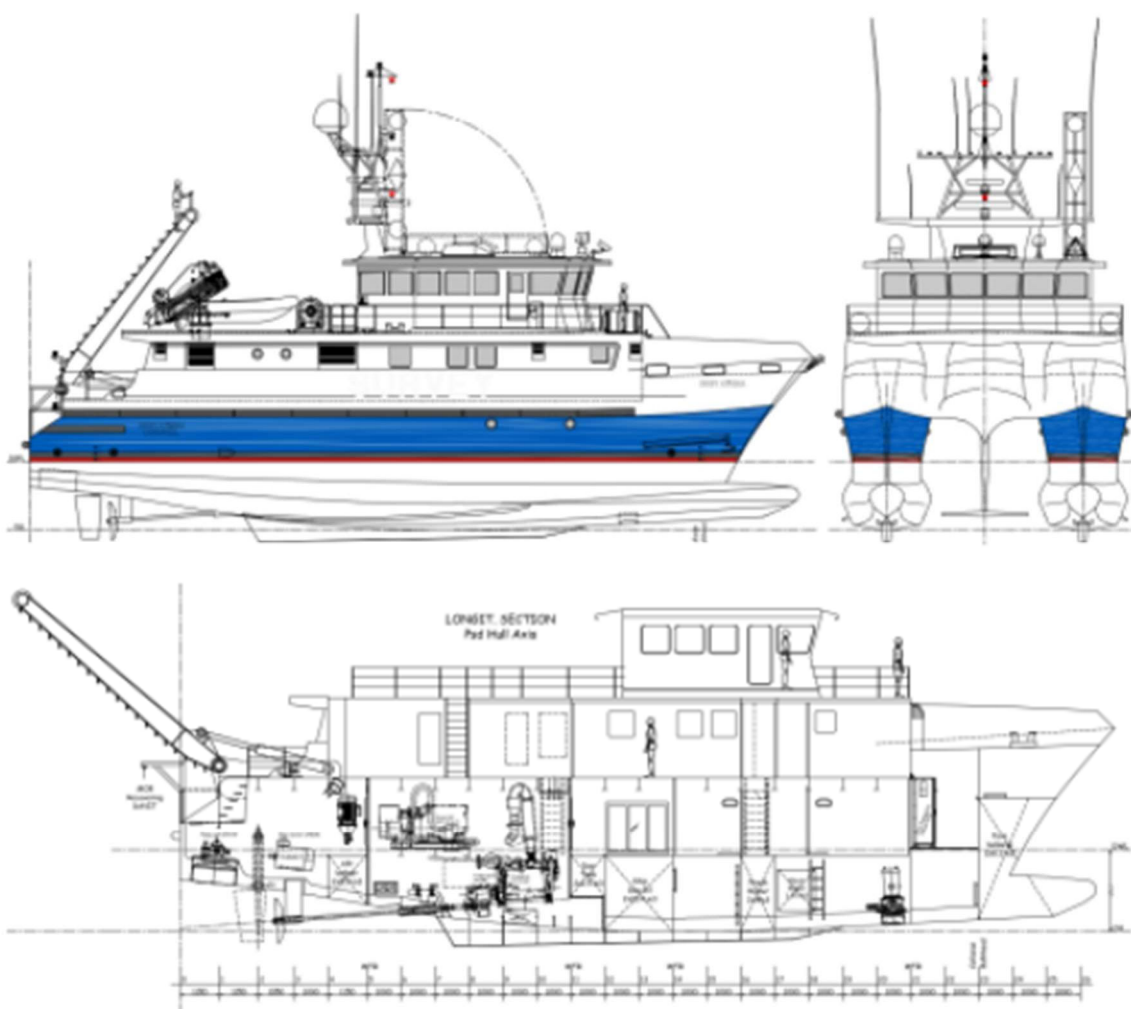


Specifications

Name:	Roman Rebel
Call Sign:	2ICAS
Lloyd's Register	Oceanographic Survey
Class:	Vessel, DP(AM)
IMO Number:	9714824

Inquiries

Contact:	Jared Peters
Email:	info@greenrebel.ie



The Lady Kathleen

The Lady Kathleen is a state-of-the-art 14 m survey vessel that provides a stable platform for reliable, cutting-edge sensor deployment. The vessel is purpose-built for hydrographic and geophysical data acquisition. She is a cutting-edge survey platform with exceptional manoeuvrability both at low and high speed and can conduct nearshore work in a wide range of water depths from 100 m. With top speeds of 25 knots, Lady Kathleen can get to site fast and brings a fuel consumption of 10 L per hour on survey operations.



LADY KATHLEEN

Technical Specifications

General Vessel Information		Propulsion & Generator	
Builder:	Blyth Workboats	Main Engines:	Twin Cummins QSC8.3
Designer:	Blyth Workboats	Gearbox:	ZF with PTO
Launched:	2021	Generator:	Fisher Panda 8KW
Length:	14 m	Max Speed:	25 knots
Beam:	5 m	Cruise:	15 knots
Draught:	1.4 m	Survey:	3.5 – 6 knots
Flag / License:	Irish – MSO P5 30nm	Prop(s):	Twin 5 blade

General Safety Information		Survey Equipment	
Duration:	12 hour Day or Night	MBES:	Teledyne SeaBat T50-R
Safe Manning:	Master & Deckhand	Processor:	Teledyne Reason T50 IDH
Limitations:	30nm to sea	SV Sensor:	Reason SVP-70
Liferaft:	1x 8man Port & Stb	SSS:	Edge Tech 4205
Lif jackets:	8x Solas	Magnetometer:	Geomatix G-882
EPIRB:	Yes	Gradiometers:	2-sensor TVG Frame
SART:	Yes	Parametric SBP:	Innomar SES-2000
		USBL:	GAPS M5
		Navigation:	QPS QINSy 9.5.0
		SV Profiler:	Valeport Swift (x2)
		Attitude/Heading:	Applanix Integrated INS
			Teledyne Type-30 IMU
		GNSS:	Applanix Integrated INS
			Trimble AT1675-540TS (x2)

Deck Equipment	
Winch 1:	1T Hydraulic Tugger Winch
Winch 2:	STR ESW 500 – 500m Coax
Winch 3:	STR ESW 500 – 500m Coax
A Frame:	Hydraulic 1T SWL
Moonpool:	700mm x 700mm
Side Pole:	SS Duel Mount
Side Winch:	1x 1T Capstan

Navigation Equipment	
Plotter:	2x Axiom Pro RVX 16"
Auto Pilot:	Simrad AP70
AIS:	Class A
DSC VHF:	2x Icom GM600 GMDSS
DSC MF/HF:	1x Icom GM800 GMDSS
Navtex:	Yes
Internet:	4G Broadband

Hydrographic Equipment

The Roman Rebel runs a dual-head MBES system driven by dual SeaBat RSP+ processors. A multi-unit Inertial Navigation System (INS) feeds positional data to the MBES (and other geophysical systems). An extremely dense array of 2,048 sound beams per ping is produced by two Teledyne SeaBat T50-R (TC2181 transmitter and EM2781 receiver) MBES sonar heads

that each use their own SeaBat RSP+ processing computer (Table 18). This setup maximises survey efficiency and precision.

Table 18. Teledyne Seabat T50-R MBES specifications.

Characteristic	Teledyne T50 (EM7218)
Low frequency (kHz)	190
High frequency (kHz)	420
Frequency adjustability	10 kHz steps
Swath coverage (°)	170
Beam width (° at 400 kHz)	0.5
Shortest pulse (µs)	15
Max depth at low frequency (m)	575
Max ping rate (pings/s, i.e. Hz)	66
Beams/swath	1,024 (per head, 2,048 per swath)

Local sound velocity will be recorded continuously at the surface (at the MBES heads using Teledyne SVP70s) and periodically through the water column. Water column measurements will be collected using a Valeport Swift prior to the initiation of data acquisition operations and whenever significant changes are observed in the surface sound velocity. Equipment specifications are provided in Table 19.

Table 19. SVP Specifications

Device	Deployment	Depth rating (m)	Resolution (m/s)	Accuracy (m/s)
Teledyne SVP70	Fixed at heads	6,000	0.01	± 0.05
Valeport Swift	Dips	500	0.001	± 0.02

Sub-bottom profiler (SBP)

A hull-mounted Innomar Medium-100 parametric SBP system is used from the Roman Rebel (Figure 4). This parametric system generates two simultaneous sound signals that create a controlled, subsequent signal (secondary frequency) that yields better penetration than comparable SBPs (Table 20). Data products can reach 70 m of penetration with vertical resolutions better than 5 cm.

Table 20. Innomar Medium-100 SBP specifications.

Characteristic	Innomar Medium - 100
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Primary frequencies	Low frequency (kHz)	85
	High frequency (kHz)	100
Secondary frequencies	Low frequency (kHz)	2
	High frequency (kHz)	22
Source level (dB// μ Pa re 1 m)		247
Maximum depth (m)		2,000
Penetration in mud (m)		70
Vertical resolution (cm)		Better than 5

Side-Scan Sonar (SSS)

Green Rebel proposes the use of a motion tolerant, multipulse EdgeTech 4205 SSS system capable of simultaneous dual-frequency operation. Variable signal frequencies allow range to be balanced with resolution to fit local conditions and survey needs while motion tolerance and multi-pulse capabilities ensure quality in demanding conditions. This unit is depth rated for use in up to 2,000 meters of water. Details are provided in Table 21.

Table 21. EdgeTech 4205 SSS Specifications.

Characteristic	Edgetech 4205
Low frequency (kHz)	230
High frequency (kHz)	850
Frequency adjustability	Dual
Horizontal beam width	0.70° @ 120 kHz; 0.44° @ 230 kHz; 0.28° @ 410 kHz; 0.26° @ 540 kHz; 0.23° @ 850 kHz
Best resolution across track (cm)	1
Worst resolution across track (cm)	8
Vertical beam width (°)	50
Towfish weight (kg in air)	52
Max depth (m)	2,000
Piggyback capabilities	Magnetometer or Gradiometer

Magnetometer

The Roman Rebel and Lady Kathleen will tow a single Geomatrix G-882 magnetometer piggybacked from the SSS towfish (Table 22). Height above seabed during survey operations is determined by the height-to-range ratio required by the SSS.

Table 22. Geomatrix G-882 Magnetometer Specifications.

Characteristic	Geomatrix G-88s
Operating principle	Self-Oscillating split beam Optically pumped Caesium Vapour cell
Typical sensitivity (nT)	0.02 (at 0.1 samples/second)
Heading error (nT)	< 1
Absolute accuracy (nT)	< 3
Power supply (VDC)	24 - 32
Max depth (m)	2,600
Operating zones	The earth's field vector should be at an angle of greater than 6° away from the sensor's equator and greater than 6° away from the sensor's long axis.

Surface positioning

The Roman Rebel uses two GNSS systems to ensure redundancy and enable cross-checking and validation of positioning data (Table 23). The primary system is provided by Oceaneering International Services Limited and consists of a C-Nav 3050 receiver using C-NavC2 corrections. The C-Nav 3050 receiver offers global decimetre-level accuracy. The secondary system consists of a Hemisphere R330 receiver using Atlas corrections.

Table 23. GNSS Specifications

Receiver	Corrections	XY accuracy (m)	Z accuracy (m)
C-Nav 3050	SBAS, PPP, RTK	0.08	0.15
Hemisphere R330	L1/L2, RTK, SBAS	0.30	0.30

Underwater Positioning

Towed sensors will be tracked with a Kongsberg μ PAP 201-H USBL system. This system can track multiple targets at ranges of up to 4,000 m. The expected accuracy is 0.45%, range: $\pm$ 0.02 m (Table 24).

Table 24. USBL Specifications.

Characteristic	Specification
Model	μ PAP 201-H
Operational models	SSBL, LBL, and data telemetry

Inbuilt motion sensor	Seatex MRU-
Motion sensor accuracy	0.05°
Operating range	1 – 4,000 m
Angular accuracy	0.25°
Position accuracy	0.45% (1 Sigma, SNR > 20dB rel. 1μPa in bandwidth)
Transducer beam width	± 80°
Data telemetry	up to 2.5 kBit/s

Roman Rebel Geotechnical Survey Equipment

The geotechnical investigation aims to collect high-quality data using various methods including vibrocores, CPTs and grab samples. These data will be collected after the geophysical dataset, which will help inform sampling locations, and will be used to determine the geotechnical properties of the seabed along the three proposed cable routes. The information gathered will enable assessments of cable burial and help ensure a successful cable installation. Details of the proposed equipment are provided in the sections below.

Vibrocorer

The proposed FT0551 Vibrocorer has a high-power electric motor providing 75 kN total force and an increased vibratory amplitude due to improved power to weight ratio. A modular frame structure reduces the mobilisation time for cores of 1-9 m long. For the collection of samples across the cable routes, the vibrocorer will be configured for 3 m cores. Cores will be recovered in 1-m sections.

Cone-Penetration test (CPT)

The Geomil Manta 100DW allows in situ sediment property measurements to be conducted in a wide range of water depths, up to 1,500 m. The Manta-100 is also by far the most compact system in its class when transported. Umbilical and umbilical winch are also included to ensure power and communication with the vessel. Penetration speed is variable from 0 -80 mm/s and the Thrust capacity of 0 -100 kN help ensure appropriate penetration.

Seabed Sampling

A 1 x 0.1 m² Van Veen grab is proposed as the primary grab sampler for seabed sample collection. The Van Veen is ideal for taking samples in shallow to medium water depths, for biological, hydrological and environmental studies. The lead-weighted jaws close positively,

capturing the sample for secure recovery to the surface. The weights also ensure reliable operation in strong currents.

All sampling is logged during operations both on deck and independently in the laboratory. This allows quality control and cross-checking of operations on completion of the project. All sample containers are labelled with a clear pre-printed label describing the Client, location, replicate, sample type, operator, sample number code (the latter can be cross-referenced with log sheets to provide additional information on description, time, easting, northing, water depth etc.).

Lady Kathleen Equipment Overview

Hydrographic Equipment

The Lady Kathleen uses a single-head Teledyne T50-R MBES system (Table 25). An integrated Applanix OceanMaster Inertial Navigation System (INS) pairs positional data to the MBES data (and other geophysical data).

Table 25. Seabat T50-R MBES specifications

Characteristic	Teledyne T50 (EM7218)
Low frequency (kHz)	190
High frequency (kHz)	420
Frequency adjustability	10 kHz steps
Swath coverage (°)	170
Beam width (° at 400 kHz)	0.5
Shortest pulse (µs)	15
Max depth at low frequency (m)	575
Max ping rate (pings/s, i.e. Hz)	66
Beams/swath	1,024 (per head, 2,048 per swath)

Sub-Bottom Profiler (SBP)

A pole-mounted Innomar Standard parametric SBP system is used from the Lady Kathleen (Table 26). This parametric system generates two simultaneous sound signals that create a controlled, subsequent signal (secondary frequency) that yields better penetration than comparable SBPs. Data products can reach 40 m of penetration with vertical resolutions better than 5 cm.

Table 26. Innomar Medium-100 SBP specifications

Characteristic		Innomar Medium - 100
Primary frequencies	Low frequency (kHz)	85
	High frequency (kHz)	100
Secondary frequencies	Low frequency (kHz)	2
	High frequency (kHz)	22
Source level (dB// μ Pa re 1 m)		247
Maximum depth (m)		2,000
Penetration in mud (m)		70
Vertical resolution (cm)		Better than 5

Side-Scan Sonar (SSS)

Green Rebel proposes the use of a motion tolerant, multipulse EdgeTech 4205 SSS system capable of simultaneous dual-frequency operation (Table 27). Variable signal frequencies allow range to be balanced with resolution to fit local conditions and survey needs while motion tolerance and multi-pulse capabilities ensure quality in demanding conditions. This unit is depth rated for use in up to 2,000 meters of water.

Table 27. EdgeTech 4205 SSS specifications.

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Best resolution across track (cm)	1
Worst resolution across track (cm)	8
Vertical beam width (°)	50
Towfish weight (kg in air)	52
Max depth (m)	2,000
Piggyback capabilities	Magnetometer or Gradiometer

Magnetometer

The Roman Rebel and Lady Kathleen will tow a single Geomatrix G-882 magnetometer piggybacked from the SSS towfish (Table 28). Height above seabed during survey operations is determined by the height-to-range ratio required by the SSS.

Table 28. Geomatrix G-882 magnetometer specifications.

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Operating principle	Self-Oscillating split beam Optically pumped Caesium Vapour cell
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Heading error (nT)	< 1
Absolute accuracy (nT)	< 3
Power supply (VDC)	24 - 32
Max depth (m)	2,600
Operating zones	The earth's field vector should be at an angle of greater than 6° away from the sensor's equator and greater than 6° away from the sensor's long axis.

Surface Positioning

GNSS corrections for the Lady Kathleen are provided by an Applanix OceanMaster system, which also incorporates an Inertial Measurement Unit (IMU). Corrections are made at 1 Hz intervals and achieve positional accuracies of <0.1 m (XY) and <0.2 m (Z). Real-time correction services are acquired through Marinestar satellite service or Trimble VRS Now RTK corrections.

Underwater Positioning

Towed sensors will be tracked with a Kongsberg µPAP 201-H USBL system. This system can track multiple targets at ranges of up to 4,000 m. The expected accuracy is 0.45%, range: ± 0.02 m. Specifications are provided in Table 24.