Offshore Petroleum Regulator
for Environment
& Decommissioning

RECORD OF THE HABITATS REGULATIONS ASSESSMENT UNDERTAKEN UNDER REGULATION 5 OF THE OFFSHORE PETROLEUM ACTIVITIES (CONSERVATION of HABITATS) REGULATIONS 2001

HyNet Carbon Dioxide Transportation and Storage Project

Issued 03 February 2025
Rev 5.0

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ABBREVIATIONS

Abbreviation	Description
%	Percent
<	Less than
>	More than
µPa	Micropascal
AA	Appropriate Assessment
ADD	Acoustic Deterrent Device
AEoI	Adverse Effects on Integrity
ANSI	American National Standards Institute
BP	Biosecurity Plan
CBRA	Cable Burial Risk Assessment
CCS	Carbon Capture and Storage
CCUS	Carbon Capture, Utilisation, and Storage
cm	Centimetre
CIS	Celtic and Irish Seas
CMS	Construction Method Statement
CO_2	Carbon Dioxide
CS	Celtic Sea
CSIP	Cable Specification and Installation Plan
DAERA	Department of Agriculture, Environment and Rural Affairs
dB	Decibel
DCO	Development Consent Order
DESNZ	Department for Energy Security and Net Zero
EC	European Commission
EIA	Environmental Impact Assessment
EMF	Electromagnetic Field

Abbreviation	Description
EPA	Environmental Protection Agency
ES	Environmental Statement
EU	European Union
FLCP	Fisheries Liaison and Coexistence Plan
FLO	Fisheries Liaison Officer
H_2	Hydrogen
ha	Hectare
HDD	Horizontal Directional Drilling
Hz	Hertz
HF	High Frequency
HRA	Habitats Regulations Assessment
IAMMWG	Inter-Agency Marine Mammal Working Group
ICES	International Council for the Exploration of the Sea
IEMA	Institute of Environmental Management and Assessment
INNS	Invasive Non-Native Species
IROPI	Imperative Reasons of Overriding Public Interest
IS	Irish Sea
JNCC	Joint Nature Conservation Committee
kg	Kilogram
kHz	Kilohertz
km	Kilometre
km^2	Square kilometre
kV	Kilovolt
LF	Low Frequency
LSE	Likely Significant Effect
m	Metre

Abbreviation	Description
MARPOL	International Convention for the Prevention of Pollution from Ships
MBES	Multibeam Echosounder
MCA	Maritime and Coastguard Agency
MDS	Maximum Design Scenario
mg/l	Milligram per litre
MHWS	Mean High Water Springs
mm	Millimetre
MMMP	Marine Mammal Mitigation Protocol
MMMU	Marine Mammal Management Unit
MMO	Marine Mammal Observer
MPCP	Marine Pollution Contingency Plan
MU	Management Unit
NIOSH	National Institute for Occupational Safety and Health
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NRW	Natural Resources Wales
NSTA	North Sea Transition Authority
NW	Northwest
OCA	Other Marine Carnivores in Air
OCW	Other Marine Carnivores in Water
OPRED	Offshore Petroleum Regulator for Environment & Decommissioning
OSPAR	Oslo and Paris Convention
PAM	Passive Acoustic Monitoring
PCA	Phocid Carnivores in Air
PCW	Phocid Carnivores in Water
PoA	Point of Ayr

Abbreviation	Description
PTS	Permanent Threshold Shift
rms	Root Mean Square
SAC	Special Area of Conservation
SBP	Sub-Bottom Profiler
SCANS	Small Cetacean Abundance in the North Sea
SEL	Sound Exposure Level
SNCB	Statutory Nature Conservation Bodies
SNH	Scottish Natural Heritage
SPA	Special Protection Area
SPL	Sound Pressure Level
SSC	Suspended Sediment Concentration
SW	Southwest
TCPA	Town and Country Planning Act
TTS	Temporary Threshold Shift
TW	Territorial Waters
UK	United Kingdom
UXO	Unexploded Ordinance
VHF	Very High Frequency
VSP	Vertical Seismic Profiler
WG	Working Group
WSDOT	Washington State Department of Transport

1 INTRODUCTION

Council Directive 92/43/EC (European Commission) on the conservation of natural habitats and of wild fauna and flora (the Habitats Directive) and Council Directive 2009/147/EC on the conservation of wild birds (the Birds Directive) aim to ensure the long-term survival of certain habitats and species in Europe, by protecting them from the adverse effects of plans and projects.

The Habitats Directive aims to restore and maintain Europe's biodiversity by protecting habitats and species of European importance. It achieves this through the designation of protected sites known as Special Areas of Conservation (SACs). The goal is to ensure that these species and habitats are maintained or restored to a Favourable Conservation Status.

The Birds Directive aims to protect all naturally occurring wild bird species and their most important habitats, including rare, vulnerable, and migratory bird species. Along with the Habitats Directive, the Birds Directive also contributes to the designation of protected sites, known as Special Protection Areas (SPAs).

SPAs and SACs collectively form the United Kingdom (UK)'s national site network.

In the UK, a Habitats Regulations Assessment (HRA) is triggered for oil and gas activities (including Carbon Capture, Utilisation, and Storage (CCUS) projects) based on specific legislation:

- The Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 (as amended); and
- The Conservation of Habitats and Species Regulations 2017 (known as the Habitats Regulations).

The Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 (as amended) transpose the Habitats and Birds Directives into UK law for oil and gas activities carried out wholly or partly in the UK continental shelf. These regulations also apply to CCUS activities under Article 3 of the Energy Act 2008 (Consequential Modifications) (Offshore Environmental Protection) Order 2010. The regulations set down obligations for assessing the impact of offshore oil and gas activities (including gas and carbon dioxide (CO_2) unloading and storage) on habitats and species protected under the Habitats Directive and Birds Directive.

The Conservation of Habitats and Species Regulations 2017 (known as the Habitats Regulations), which apply to broader marine activities (not just oil and gas or CCUS), work alongside the Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 to protect European sites. These regulations serve as the governing legislation for implementing several other requirements contained in the Directives. Whilst the 2001 Regulations focuses on assessing impacts of oil and gas activities (including CCUS), the Habitats Regulations provide a broader framework for conservation in offshore marine environments. While the specific mention of CCUS projects isn't explicit, the Habitats Regulations apply broadly to any activity that could impact European sites.

Since the departure of the UK from the European Union (EU), the Conservation of Habitats and Species Amendment (EU Exit) Regulations 2019 ensure that the requirements under the Habitats Regulations remain largely unchanged. In the UK, the Habitats Regulations created a new national site network that replaced the EU's Natura 2000 ecological network. European sites, formerly Natura 2000 network, are now part of the UK's National Site Network. The term "European site" has been retained in accordance with guidance issued by the UK Government on the 2019 (EU Exit) Regulations (Department for Environment, Food and Rural Affairs (Defra), 2021).

The following European sites are protected by the Habitats Regulations and any proposals that could affect them will require a HRA:

- SACs, including possible SACs (pSAC), and
- SPAs, including potential SPAs.

Under the Habitats Regulations, all competent authorities must consider whether any plan or project could affect a European site before authorising or carrying it out. This includes assessing whether it will have a "Likely Significant Effect" (LSE) on a European site, either alone or in-combination with other plans or projects. If such an effect is anticipated, they must conduct an "Appropriate Assessment" (AA) to determine the implications for a site's integrity and conservation objectives. Such a plan or project may only be agreed after ascertaining that it will not adversely affect the integrity of a European Site unless there are imperative reasons of overriding public interest (IROPI) for carrying out the plan or project.

Regulation 5(1) of the 2001 Regulations provides that: *The Secretary of State shall, before granting any Petroleum Act licence, any consent, any authorisation, or any approval, where he considers that anything that might be done or any activity which might be carried on pursuant to such a licence, consent, authorisation or approval is likely to have a significant effect on a relevant site, whether individually or in-combination with any other plan or project, including but not limited to any other relevant project, make an appropriate assessment of the implications for the site in view of the site's conservation objectives.*

An application for Storage Permits (CS004A (Hamilton CS), CS004B (Hamilton North), and CS004C (Lennox CS)) under the Storage of Carbon Dioxide (Licensing etc.) Regulations 2010 has been received by the North Sea Transition Authority (NSTA) from Liverpool Bay CCS Ltd (hereafter 'the Developer') for the HyNet Carbon Dioxide Transportation and Storage Project (hereafter 'the Development').

An Environmental Statement (ES) documenting the assessment of environmental impacts of the Development has been submitted to the Offshore Petroleum Regulator for Environment and Decommissioning (OPRED) under the Offshore Oil and Gas Exploration, Production, Unloading and Storage (Environmental Impact Assessment (EIA)) Regulations 2020.

This is a record of the HRA undertaken by the Secretary of State for for Energy Security and Net Zero (DESNZ) in respect of the Development.

The Development is not directly connected with, or necessary to, the management of any National sites but it may affect them. The purpose of this HRA is to determine whether the Development will adversely affect the integrity of any UK National Site Network designated site.

Defra (2021) guidance outlines that the HRA process can have up the three stages, as defined below, where the outcome of each successive stage determines whether a further stage in the process is required:

1. Screening - to check if the proposal is likely to have a significant effect on the site's conservation objectives.
2. Appropriate Assessment - to assess the LSEs of the proposal on the integrity of the site and its conservation objectives and to consider ways to avoid or minimise any effects.
3. Derogation - to consider if proposals that would have an adverse effect on a European site qualify for an exemption, subject to three legal tests being satisfied (i.e. alternative solutions, IROPI and compensatory measures).

2 DEVELOPMENT DESCRIPTION

Hynet is a regional scale plan designed to reduce CO_2 emissions from industry, homes, and transport and support economic growth in the Northwest of England and North Wales. Aspects of the project include gathering CO_2 from large industrial emitters (including infrastructure to produce low carbon hydrogen using natural gas), transportation via pipe network and storing it within a geological store offshore. The Development being assessed within this Habitats Regulations Assessment is the construction and operation of an offshore geological store for CO_2 including the associated marine infrastructure. Other aspects of the Hynet plan, such as the onshore pipeline have been assessed under different applications.

The Development is described in detail within Chapter 3 of the Developer's ES (Liverpool Bay CCS Ltd, 2024) and includes details of the installation, testing, commissioning, operation, maintenance, monitoring and decommissioning of equipment and infrastructure required to meet this purpose.

An overview of the Development is provided here. Further particulars necessary for assessing specific impacts are described in subsequent sections of the HRA.

The Development is in the CS004 CO_2 Appraisal and Storage Licence area (NSTA, 2020), located approximately 12 kilometres (km) to the north of the Welsh coastline and 2 km west of the English coastline. The licence area covers approximately 576.82 kilometres squared (km^2) and encompasses the depleted hydrocarbon reservoirs of the Hamilton, Hamilton North, and Lennox fields. The Development infrastructure will be located within the 'Eni Development Area' defined by both the Licence area (CS004), and the pipeline and cable corridor connecting the Point of Ayr (PoA) Terminal to the Douglas Offshore Platform (up to Mean High Water Springs (MHWS)).

The Development involves the repurposing of the existing offshore natural gas import pipeline from PoA Gas Terminal to become an export pipeline to transport CO_2 to the newly constructed Douglas Carbon Capture and Storage (CCS) platform, and onwards to the Hamilton Main, Hamilton North, and Lennox platforms for injection into the depleted oil and gas reservoirs. The Development infrastructure is located within the 12 nautical miles (nm) limit of both Welsh and English territorial waters (TW) some associated activities and impacts extend beyond the TW's into offshore waters. The proposed Development includes:

- Installation of a new Douglas CCS platform to replace the existing Douglas Process platform to receive CO_2 from the onshore PoA Terminal and distribute CO_2 to the existing Hamilton Main, Hamilton North, and Lennox wellhead platforms and when necessary, provide heating to the CO_2 stream. Installation of the new Douglas CCS platform will include up to eight driven piles to secure the platform to the seabed.
- Installation of new sections of pipeline to connect the new Douglas CCS platform and the existing subsea natural gas pipelines.

- Installation of new topsides on the Hamilton Main, Hamilton North, and Lennox wellhead platforms to receive and inject CO_2 into the depleted hydrocarbon reservoirs.
- Repurposing of the existing subsea natural gas pipelines for their change of use from hydrocarbon to CO_2 service.
- Development of the Hamilton Main, Hamilton North, and Lennox reservoirs for CO_2 storage through the drilling and recompletion of injection wells by side tracking existing production wells. This includes drilling and recompletion operations, all of which will be within the existing footprint (template) of each platform.
- Implementation of a programme of Monitoring, Measurement and Verification activities. This includes the drilling of two new monitoring wells, one at Hamilton North and one at Hamilton Main. Additional monitoring wells will be created from the recompletion of existing wells within the existing footprint (template) of each platform: one monitoring well created by side tracking an existing well in Lennox; and two sentinel wells, one in Hamilton North and one in Lennox.
- Installation of two submarine 33 kilovolt (kV) power cables, with integrated fibre-optic cable connections (35 km from PoA Terminal onshore to the modified Douglas platform, including within the intertidal/foreshore area up to MHWS, within Welsh waters only).
- Installation of new submarine 33 kV power cables with integrated fibre optic connecting the modified Douglas platform with the Hamilton Main (12 km), Hamilton North (15 km) and Lennox (35 km) platforms.
- Installation of concrete mattresses and external cable protection, at crossings of existing cables, and in areas where cable burial is not deemed feasible, or as a remedial secondary protection measure if the target cable depth of lowering cannot be achieved.

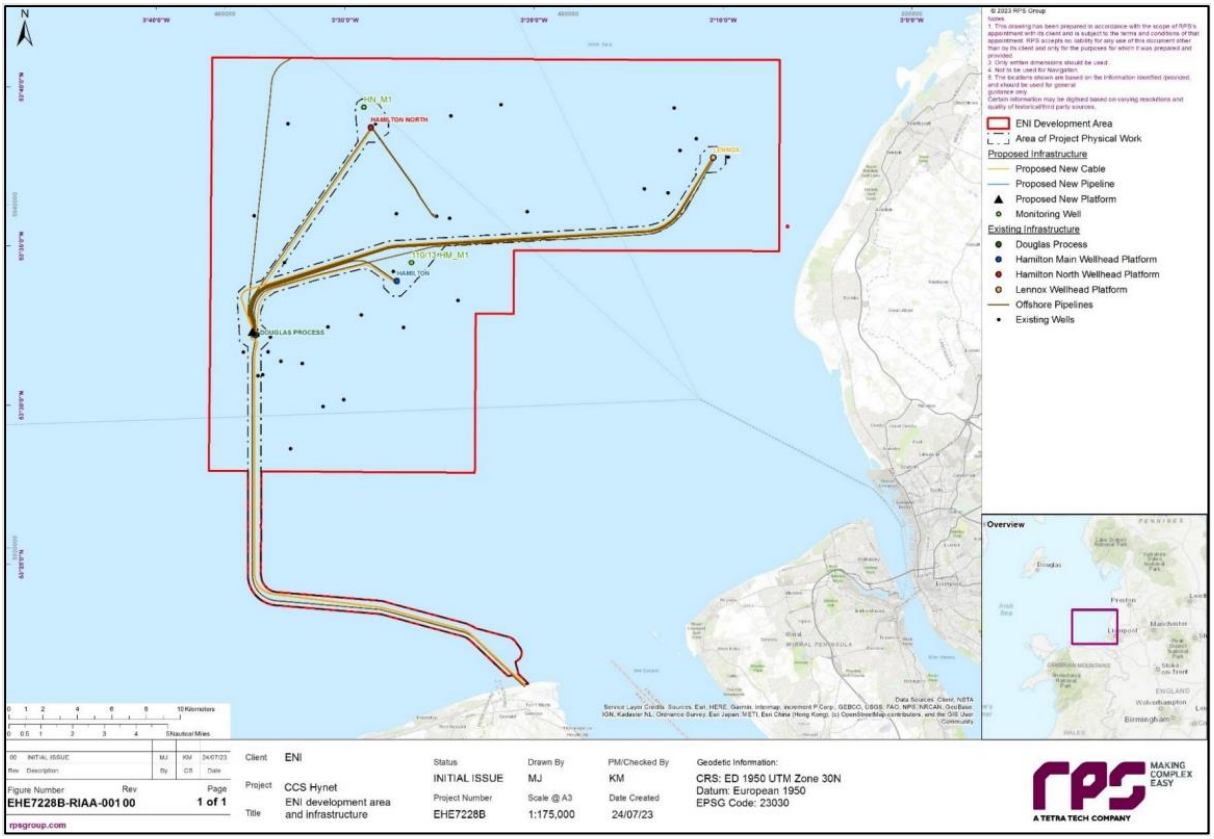


Figure 2-1: Proposed Development

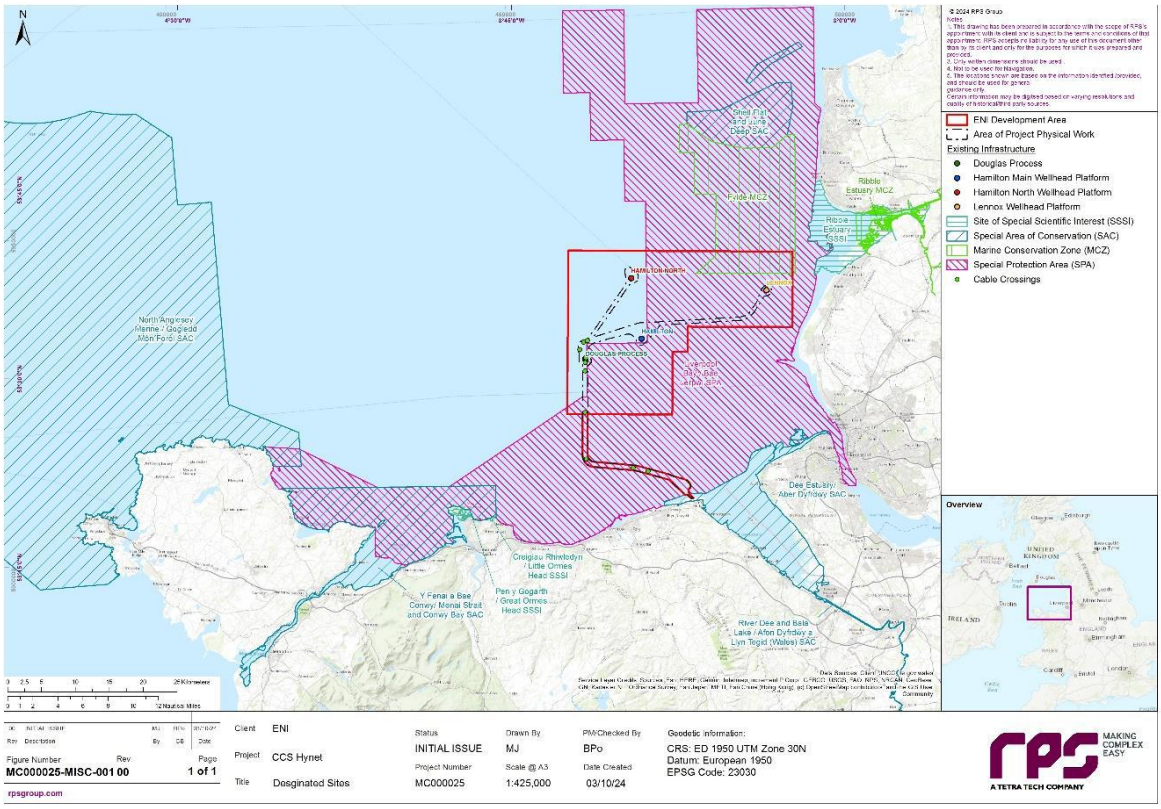


Figure 2-2: European sites in the immediate vicinity of the proposed Development.

2.1 HRA Scope

This HRA will cover the impacts of activities within English inshore TW and UK offshore waters. TW describes waters within the 12 nm limit and offshore describes waters out with the 12 nm limit, see Figure 2-3. UK offshore waters include both English and Welsh offshore regions. A separate HRA will address the impacts of activities within Welsh inshore TW. This is because OPRED has jurisdiction of English TW and UK offshore waters, and NRW has jurisdiction of Welsh TW. NRW and OPRED will undertake separate HRAs which will cover the portion of project within each regulatory jurisdiction.

In Figure 2-3, the 12 nm limit represents the boundary of the inshore and offshore Marine Plan Regions. The boundary between the England and Wales Marine Plan Regions represents the territorial boundary of the two nations.

The activities which are within the region of this HRA include three satellite platforms (Hamilton Main, Hamilton North and Lennox) and the cable to them from Douglas, as well as the drilling of the CCS wells, some of the seismic surveys and likely unexploded ordnance (UXO) clearance during cable laying. Figure 2-3 shows that the Douglas platform (and pipeline corridor) is within Welsh TW and so activities associated with laying the cable to shore and installation of the new Douglas CCS platform (including pipeline spool) are outside the scope of this HRA.

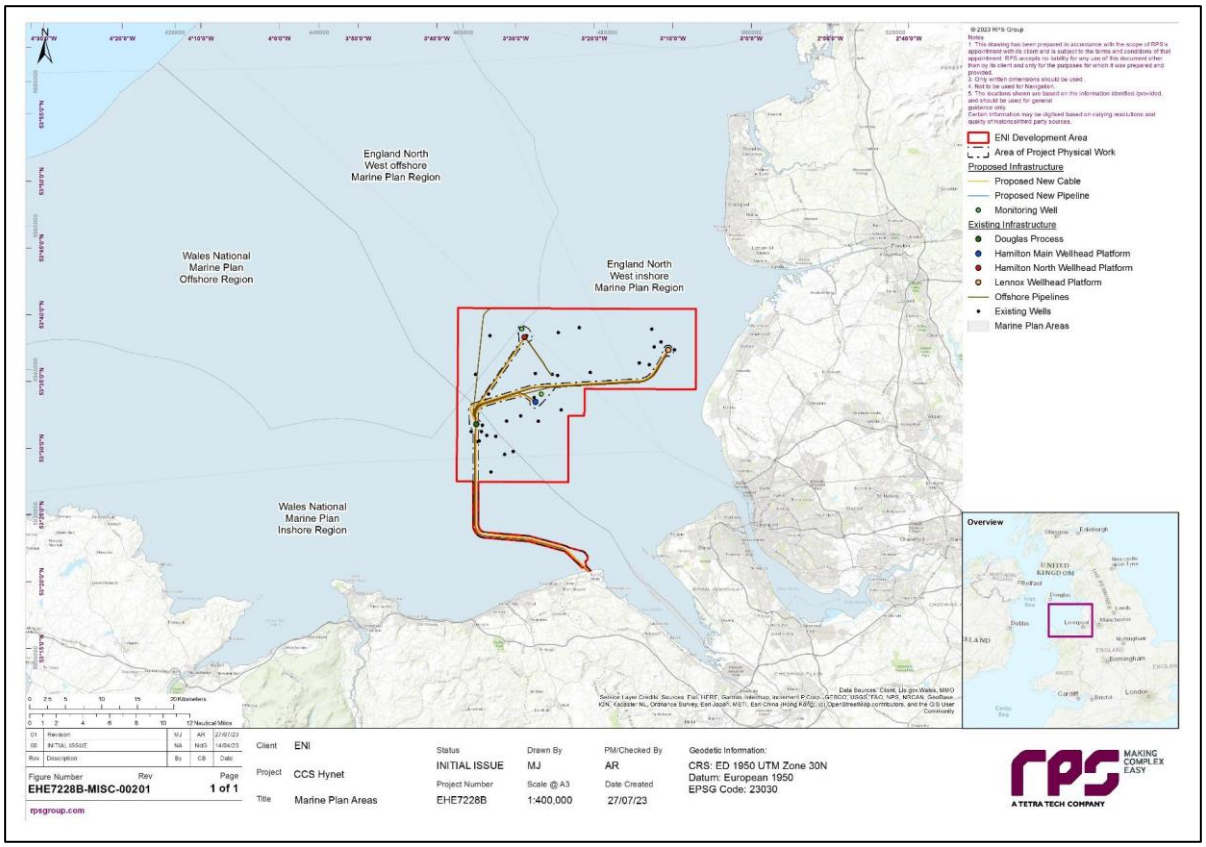


Figure 2-3 The Development in relation to the Marine Plan Regions.

Redefining the list in Section 2, the activities which are within the scope of this HRA include:

- Installation of new topsides on the Hamilton Main, Hamilton North, and Lennox wellhead platforms.
- Repurposing of the existing subsea natural gas pipelines for their change of use from hydrocarbon to CO_2 service.
- Development of the Hamilton Main, Hamilton North, and Lennox reservoirs for CO_2 storage.
- The drilling and recompletion of Hamilton Main, Hamilton North, and Lennox injection wells by side tracking existing production wells, all within the existing footprint of each platform.
- Drilling of two new monitoring wells, one at Hamilton North and one at Hamilton Main.
- Creation of additional monitoring wells from existing wells within the footprint of each platform: one monitoring well created by side tracking an existing well in Lennox; and two sentinel wells, one in Hamilton North and one in Lennox.
- Installation of new power cables connecting the modified Douglas platform with the Hamilton Main, Hamilton North and Lennox platforms.
- Installation of concrete mattresses and external cable protection at pipeline transition to platform and in areas where cable burial is not deemed feasible.

Therefore, these activities have the potential to have the following impacts within the scope of this HRA:

- Underwater noise pollution from percussive sources (UXO detonation, and seismic surveys) resulting in injury and disturbance.
- Dredging of the seabed for cable laying resulting in increased suspended sediment concentration (SSC) and release of sediment bound benthic contaminants.
- Disturbance of the seabed and resulting impact to the functioning of seabed habitats.
- Alteration of seabed habitats by resettlement of suspended sediments.
- Permanent change of habitat from soft sediment to hard substrate where rock or concrete mattresses are deposited at Lennox platform or along the cable from Douglas to Lennox within the SPA.
- Temperature variance across existing pipelines impacting benthic and marine communities.
- Disruption resulting in changes in prey availability.
- Presence of vessels and infrastructure resulting in collision, disturbance and displacement of protected features.

These impacts have the potential to cause effect so are included in the assessment of LSE in Section 3.

3 HRA STAGE 1: LIKELY SIGNIFICANT EFFECTS TEST

The purpose of this section is to identify any LSEs on relevant European sites and to record the conclusions on the need for an AA and the reasons for including activities, sites or plans and projects for further consideration in the AA.

There are no recognised criteria as to what can be considered to be trivial or inconsequential impacts. Where predicted impacts are relatively very small compared to either the population of the management unit or the area of the site or the duration of the impact, it was determined that the impact would not cause a LSE.

The Developer has presented a comprehensive evaluation of the potential effects on features of European sites. For Stage 1 of the HRA OPRED has reviewed the information provided to identify which mechanisms for potential effects are relevant to activities taking place within the English TW and offshore waters. The remainder of this section will explain why some pressures and effects have been screened out of an appropriate assessment.

On the basis of information provided by the Developer, OPRED is satisfied that it is appropriate to rule out the potential for LSE on certain features of relevant sites from activities for which the Developer flagged as having the potential to cause a likely significant effect i.e. the Developer recommended some pressures be considered within an appropriate assessment which OPRED felt were unnecessary. The justification for OPRED's conclusions is provided below.

OPRED concludes that there is no LSE to Atlantic salmon (*Salmo salar*) of any SAC due to injury or mortality caused by underwater noise generated from activities, including UXO clearance and seismic surveys, undertaken outside of Welsh TW. In reaching this conclusion OPRED has taken into consideration that:

- Noise will not be generated within the boundaries of any SAC.
- Relevant activities will take place more than 30 km from any SAC for which Atlantic salmon is a designated feature, with the closest site being the River Dee and Bala Lake SAC.
- Based on a substantial number of precedents for noise modelling that has been undertaken by developers and offshore operators to inform HRA for activities similar to those proposed for the Development, injury to fish is restricted to the immediate locality of the noise source.
- Following migration from their rivers of origin into the open seas, Atlantic salmon associated with multiple SACs may potentially come within close proximity to UXO at the time of its detonation and may consequently suffer permanent injury or be killed. Given the anticipated injury range in the context of the extent of the Atlantic available, any mortality is statistically likely only at an extremely low density of salmon which would not have a significant effect at a population level.

OPRED concludes that there is no LSE to Atlantic salmon of the Afon Gwyrfai a Llyn Cwellyn SAC, the Afon Eden – Cors Goch Trawsfynydd SAC or the Afon Teifi/River Teifi SAC due to disturbance by

underwater noise generated from activities, including UXO clearance and seismic surveys, undertaken outside of Welsh TW. In reaching this conclusion OPRED has taken into consideration that:

- Relevant activities will take place more than 60 km from any of these sites.
- Noise propagating across the boundaries of these SACs will not be of a magnitude or frequency range that would cause significant disturbance to Atlantic salmon.
- Following the migration routes of fish from their rivers of origin into the open seas, it cannot be ruled out that individual Atlantic salmon associated with multiple SACs may potentially come within close proximity to a UXO at the time of its detonation and may consequently suffer permanent injury or be killed. However, the anticipated injury range is an extremely small proportion of the sea area available to Salmon and there are likely to be a very small number of detonations (If any). Therefore the small number of individual fish affected are unlikely represent a significant proportion of the total number of salmon in the region and it is unlikely that UXO detonation could have a significant effect at a population level of any SAC.

OPRED concludes that there will be no LSE to the freshwater pearl mussel (*Margaritifera margaritifera*) feature of the Afon Eden – Cors Goch Trawsfynydd SAC. In reaching this conclusion OPRED has taken into consideration that:

- Freshwater pearl mussels spend a part of their lifecycle within the gills of Atlantic salmon. The only potential mechanism for effects from the Development on freshwater pearl mussels would be through indirect effects on the salmon host.
- Since no LSE to Atlantic salmon of the Afon Eden – Cors Goch Trawsfynydd SAC is concluded, there will be no LSE to freshwater pearl mussels.

OPRED concludes that there will be no LSE to sea lamprey (*Petromyzon marinus*) and river lamprey (*Lampetra fluviatilis*) features of the Afon Teifi SAC due to underwater noise generated from activities, including UXO clearance and seismic surveys, undertaken outside of Welsh TW. In reaching this conclusion OPRED has taken into consideration that:

- Noise will not be generated within the Afon Teifi SAC.
- The mouth of the Avon Teifi is significantly more than 100 km from the Development.
- Noise propagating across the boundaries of the Afon Teifi SAC will not be of a magnitude or frequency range that would cause injury to either lamprey species.
- Noise propagating across the boundaries of the Afon Teifi SAC will not be of a magnitude or frequency range that would cause significant disturbance to lamprey species.
- Following migration from their rivers of origin into the open seas, sea lamprey and river lamprey may potentially come within close proximity to UXO at the time of its detonation and may consequently suffer permanent injury or be killed. Given the anticipated injury range in the context of the extent of the Atlantic available any mortality is statistically likely only at an extremely low density of lamprey which would not have a significant effect at a population level.

OPRED concurs with the Developer that the potential for underwater noise to deter Atlantic salmon, sea lamprey and/or river lamprey of either the Dee Estuary SAC or the River Dee and Bala Lake SAC from attempting to migrate out of the Dee Estuary would need to be considered through noise modelling. OPRED agrees with the Developer that LSE cannot be ruled out for this mechanism of impact.

There are no other mechanisms for potential LSE to Atlantic salmon, sea lamprey or river lamprey for activities due to take place outside of Welsh TW.

OPRED concludes that there will be no LSE to harbour porpoise (*Phocoena phocoena*), bottlenose dolphin (*Tursiops truncates*), grey seal (*Halichoerus grypus*) or harbour seal (*Phoca vitulina*) features of any SAC due to disturbance from vessel activity and other noise producing activities other than potentially from underwater noise generated by the use of explosives, piling or certain forms of seismic surveys. This is aligned with JNCC guidance for mitigation of impacts from underwater noise and applies to all stages of the Development.

OPRED concludes that there will be no LSE to harbour porpoise, bottlenose dolphin, grey seal or harbour seal features of any SAC due to changes in prey availability. This conclusion applies to all stages of the Development. In reaching this conclusion OPRED has taken into consideration that:

- Each of these species range widely across large areas of UK waters. The UK has identified a network of sites for each of these species which are of particular importance to their conservation.
- Distinct changes to prey availability may be considered as having potential for LSE if they were to occur within an SAC for which any of these species is a feature, however, no Development activities will take place within an SAC.
- Changes to prey species populations would need to be significant at a regional scale to be considered for LSE to these species when outside of the SACs for which they are features.
- Activities of the Development are not of a type or scale that could result in changes to fish populations at the regional scale.

OPRED concludes that there will be no LSE to any ornithological feature of any SPA due to changes in prey availability in the operation stage of the Development. In reaching this conclusion OPRED has taken into consideration that:

- CO_2 transported along the pipelines will be of elevated temperature following its compression at the PoA facility.
- Heat egress from the pipeline may result in the surface of the seabed around the pipeline becoming warmer and thereby causing a change to the benthic species present.
- The existing pipelines are buried below the seabed.
- The pipelines have formerly been used for transporting hydrocarbons to shore and the temperature of the hydrocarbons was higher than that intended for the CO_2.

- If benthic communities along the pipelines have been affected by temperature changes in the past, they are likely to be more representative of the unaltered seabed state during operation of the Development than the current status for hydrocarbon extraction.
- The scale of maintenance activities and the consequently very low potential for associated mechanisms of impact, such as sediment disturbance or rock protection placement, to cause significant changes to prey availability across the ranges of any ornithological feature.
- Vessel activity to support operations is not considered to be significantly different to those currently required to support oil and gas extraction operations at these offshore facilities.

OPRED concludes that there will be no LSE to the lesser black-backed gull (*Larus fuscus*) feature of the Ribble and Alt Estuaries SPA nor of the Morecambe Bay and Duddon Estuary SPA due to changes in prey availability from any Development activities. In reaching this conclusion OPRED has taken into consideration that:

- The mean maximum foraging range of the lesser black-backed gull is quoted by Woodward *et al.* (2019) as 127 km, with a standard deviation of 109 km.
- Foraging by lesser black-backed gulls of the Ribble and Alt Estuaries SPA and of the Morecambe Bay and Duddon Estuary SPA may therefore be anticipated throughout the Irish Sea, from the Mull of Kintyre to St Davis's Head.
- Any potential disturbance to the foraging of lesser black-backed gulls in the Development area would be over an insignificant extent of the available foraging grounds.

The foraging ranges of the gannet (*Morus bassanus*), manx shearwater (*Puffinus puffinus*), the storm petrel (*hydrobates pelagicus*) and the northern fulmar (*Fulmarus glacialis*) quoted by Woodward *et al.* (2019) exceed those of the lesser black-backed gull and OPRED concludes that there will be no LSE to any of these features of any SPAs due to disturbance.

OPRED concludes that there will be no LSE to lesser black-backed gull, northern fulmar, Manx shearwater, storm petrel of any SPA from the potential for collision of these species with Development infrastructure during the operating stage. In reaching this conclusion OPRED has taken into consideration that the Development will not result in an increase in the number of offshore installations and that any changes to the sizing and lighting of the installations will not significantly increase the potential for collision above the present level.

The HRA does not assess impacts from accidental events as these are considered to be unplanned, unlikely and, in the case of a pollution event, are illegal and would be enforced accordingly.

These conclusions are aligned with other HRAs undertaken by OPRED for offshore developments under its jurisdiction.

OPRED concludes that there is a requirement to give further consideration to the potential LSEs listed in Table 3-1 and undertake an AA.

Table 3-1: European sites for which a likely significant effect on the conservation objectives (LSEs) are considered possible when the Development is considered alone or in combination with other plans or projects.

European Site	Qualifying Features	Potential Impact	Stage
• Dee Estuary SAC	• Sea lamprey (*Petromyzon marinus*) • River lamprey (*Lampetra fluviatilis*)	• Underwater noise causing migration barrier into or out of the Dee Estuary	• Construction • Decommissioning
• River Dee and Bala Lake SAC	• Sea lamprey (*Petromyzon marinus*) • River lamprey (*Lampetra fluviatilis*) • Atlantic salmon (*Salmo salar*)	• Underwater noise causing migration barrier into or out of the Dee Estuary	• Construction • Decommissioning
• North Anglesey Marine SAC • North Channel SAC • West Wales Marine SAC • Bristol Channel Approaches SAC • Rockabill to Dalkey Island SAC • Roaringwater Bay and Islands SAC	• Harbour porpoise (*Phocoena phocoena*)	• Injury or disturbance from underwater noise generated during UXO detonation • Injury or disturbance from underwater noise generated during geophysical and seismic surveys	• Construction • Construction • Operation • Decommissioning
• Lleyn Peninsula and the Sarnau SAC	• Bottlenose dolphin (*Tursiops truncatus*) • Grey seal (*Halichoerus grypus*)	• Injury or disturbance from underwater noise generated during UXO detonation	• Construction
• Maidens SAC • Pembrokeshire Marine SAC • Lundy SAC • Saltee Islands SAC	• Grey seal (*Halichoerus grypus*)	• Injury or disturbance from underwater noise generated during UXO detonation	• Construction
• Cardigan Bay SAC	• Bottlenose dolphin (*Tursiops truncatus*)	• Injury or disturbance from underwater noise generated during UXO detonation	• Construction
• Strangford Lough SAC • Murlough SAC	• Harbour seal (*Phoca vitulina*)	• Injury or disturbance from underwater noise generated during UXO detonation • Injury or disturbance from underwater noise generated during geophysical and seismic surveys	• Construction • Construction • Operation • Decommissioning

European Site	Qualifying Features	Potential Impact	Stage
• Liverpool Bay SPA	• Red-throated diver (*Gavia stellata*) • Little gull (*Hydrocoloeus minutus*) • Common scoter (*Melanitta nigra*) • Waterbirds assemblages	• Disturbance and displacement from airborne sound, visual and physical presence of vessels and infrastructure • Temporary habitat loss due to seabed disturbance on the seabed and above the seabed leading to displacement/ disturbance of birds • Impacts from changes in prey availability	• Construction

4 HRA STAGE 2: APPROPRIATE ASSESSMENT

The purpose of this AA is to determine whether or not an adverse effect on the integrity of the features of the sites identified can be ruled out as a result of the Development, alone or in combination with other plans and projects, in view of the site's conservation objectives and using the best scientific evidence available.

Whereas the LSE screening process establishes that a link exists between a source of impact and the conservation features of interest, and that this has the potential to result in significant impact, the AA considers whether the scale of impact is such that the integrity of the site would be adversely affected. The AA also takes account of measures, secured as commitments through the Storage Permit Consent, that will either remove the pathway for impact or minimise the likelihood or extent of impact.

5 APPROPRIATE ASSESSMENT FOR LIVERPOOL BAY / BAE LERPWL SPA

5.1 Information on the SPA

The SPA covers an area of 2,528 km^2 and extends out from Morecambe Bay beyond 12 nm at the north-west point and offshore of the mouth of the Dee Estuary. The western boundary extends into Welsh seas to Point Lynas on Anglesey. The landward boundary follows the mean low water mark or the boundary of other SPAs. The seaward boundary of the SPA is mostly within the 20-25 m depth contour (JNCC, 2010).

The site encompasses marine areas supporting large aggregations of wintering red-throated diver and common scoter as well as important marine foraging areas of little terns breeding within The Dee Estuary SPA, and foraging areas of common terns breeding at the Mersey Narrows & North Wirral Foreshore SPA.

In October 2017 the original site was reclassified with the addition of new protected features and associated boundary amendments. At the time of the SPA extension, it protected the largest aggregation of common scoters, the largest marine aggregation of little gull, and the third largest aggregation of red-throated diver in the UK.

As previously concluded, the Development works and activities covered by this part of the HRA are beyond the foraging ranges of little tern and common tern from their respective breeding colonies.

The AA therefore focuses on the non-breeding features of the SPA: red-throated diver, common scoter, little gull and the waterbird assemblage.

The conservation objectives for the Liverpool Bay SPA are to ensure that, subject to natural change, the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive:

- Conservation Objective 1 – The extent and distribution of the habitats of the qualifying features.
- Conservation Objective 2 – The structure and function of the habitats of the qualifying features.
- Conservation Objective 3 – The supporting processes on which the habitats of the qualifying features rely.
- Conservation Objective 4 – The population of each of the qualifying features; and
- Conservation Objective 5 – The distribution of the qualifying features within the site.

Targets are set for achieving the objectives for each feature and these are referred to where relevant in the AA.

5.2 Feature Accounts

5.2.1 Red-throated diver

Although not regarded as threatened within the EU, the conservation status of this species is regarded as unfavourable because of declines in the European breeding population between 1970 and 1990. The population is now considered stable though depleted.

The non-breeding population of red-throated divers in Great Britain is estimated to be 17,166 individuals (O'Brien *et al*., 2008), representing between 10% and 19% (depending on the areas included) of the northwest (NW) Europe biogeographical non-breeding population.

Wintering red-throated divers occur throughout Liverpool Bay SPA with highest recorded densities off the Ribble Estuary, North Wales and the North Wirral Foreshore (Webb *et al.*, 2006). The Liverpool Bay SPA records indicate 1,171 individuals are supported, representing 6.89% of the UK red-throated diver population.

The conservation target for the abundance of red-throated diver of the SPA is to maintain the non-breeding population at a level which is at or above 1,800 individuals.

Wintering red-throated divers are associated with shallow inshore waters, typically between 0 – 20 m deep and less frequently in depths of around 30 m.

Red-throated diver are opportunistic feeders, diving below the surface to catch small fish at shallow depths and forage on the seabed in some environments (Duckworth *et al*., 2021) and are particularly sensitive to elevated levels of turbidity which may reduce their foraging success (JNCC, 2022).

Red-throated divers are especially sensitive to disturbance at sea (Garthe & Huppop, 2004) and usually avoid boats and established shipping channels (JNCC, 2022). They often flush from large distances, relocating even further away from the source of disturbance (Goodship & Furness, 2022).

Supporting habitats may have a functional role in supporting their prey species, for example as nursery, spawning or feeding grounds or in providing shelter. Loss or damage to supporting habitats may cause a loss of foraging sites and therefore lead to a reduction in food resources.

When Liverpool Bay SPA was first classified in 2010, red-throated divers had an estimated area of 1702.93 km^2. This baseline area included windfarms that were present at the time of classification. As a result of further wind farm development, red-throated divers in Liverpool Bay SPA have experienced a reduction in available supporting habitat. Post construction monitoring between 2017 and 2020 has indicated that there are detectable displacement effects from the Burbo Bank extension windfarm in Liverpool Bay SPA (HiDef, 2020). Although the physical supporting habitat may still be present, disturbance and displacement from wind farms has meant that some areas are no longer accessible for red-throated divers (JNCC, 2022).

For this reason, the conservation objective for distribution of red-throated diver within the SPA is to aim to restore the extent of their previous coverage.

The level of displacement as seen for permanent offshore windfarm structures is not anticipated for the Development, which will introduce no new structures above the sea surface in English TW. Those offshore installations of the Development located within English TW are existing infrastructure and considered to form part of the site's baseline footprint at the time of designation.

Displacement due to disturbance by the physical presence of vessels will be likely during all phases of the Development.

Burt *et al.* (2022) processed shipping and other anthropogenic activity data and combined it with aerial survey data to model the distribution of wintering red-throated diver in Liverpool Bay SPA. Amongst other findings, the model results suggest that a displacement buffer of 2 km for shipping may be appropriate.

The Developer has adopted a 2 km buffer to determine the potential area of displacement due to vessel activity during the construction phase of the Development.

5.2.2 Common scoter

The most recent four-year peak mean population estimate of common scoter in the Liverpool Bay SPA is 141,801 individuals (JNCC, 2022) and maintenance of this population level has been adopted as the conservation target for the abundance of common scoter of the SPA.

The Liverpool Bay SPA consists of 10.31% of the north-western European common scoter population (Natural England, 2009).

Common scoters have a more clustered distribution within Liverpool Bay than red-throated divers, with highest concentrations recorded from three broad areas (Webb *et al*., 2006):

- Red Wharf Bay (Anglesey) and Conwy Bay.
- Great Orme's Head to the North Wirral Foreshore.
- Formby Point to Shell Flat (off Blackpool).

Wintering common scoters are associated with shallow offshore areas with sandy seabed's (Lack, 1986), typically between 0 – 20 m deep and less frequently in depths of around 30 m. They feed by diving for cockles, clams, other bivalves, and a variety of other molluscs, crustaceans, and worms and the distribution of common scoter in Liverpool Bay SPA is strongly associated with the distribution of its benthic prey species and closely associated with the availability and condition of their shallow seabed habitat (JNCC, 2022).

Common scoters arrive in Liverpool Bay in large numbers from October onwards and start to depart for the breeding grounds in February. Some birds remain in Liverpool Bay over the summer period, but these tend to be immature or birds that are moulting.

The conservation advice from NRW and Natural England has attributed targets set as 'Maintain' for common scoter due to evidence that the feature is in favourable condition within the site (NRW&NE,2022).

As with red-throated diver, common scoter is highly susceptible to disturbance at sea often flushing from large distances and relocating even further away from the source of disturbance (Goodship & Furness, 2022).

Kaiser *et al.* (2006) noted that large flocks of the birds were observed being put to flight at a distance of 2 km from a 35 m vessel. Smaller flocks were less sensitive but conversely, larger vessels are expected to have an even greater disturbance distance (Kaiser *et al.*, 2006).

As with red-throated divers, common scoters are found in low numbers or are absent from areas of intense shipping activity such as existing shipping channels.

5.2.3 Little gull

The 2017 SPA site extension included an area to the north and west of the existing SPA, identified as supporting the second largest aggregation of little gulls in the UK.

A mean peak of 319 individuals was established for the Liverpool Bay SPA (Lawson *et al*., 2015) and maintenance of this population level has been adopted as the conservation target for the abundance of little gull of the SPA.

Little gulls are observed in clearly defined hotspots within the SPA (Natural England, NRW and JNCC, 2016), with highest densities consistently found to be offshore of Blackpool and the Ribble Estuary, close to the 12 nm line.

Little gull feed at or immediately below the water surface.

Conservation status is currently considered to be in favourable condition (Natural England, 2010).

5.2.4 Assemblage of non-breeding waterbirds

The mean peak number of non-breeding waterbirds in the SPA is determined as 157,952 individuals (JNCC, 2022) and maintenance of this population level has been adopted as the conservation target for the abundance of the non-breeding waterbird assemblage of the SPA.

Named components of the assemblage include the three non-breeding qualifying features (see above) plus red-breasted merganser (*Mergus serrator*) and great cormorant (*Phalacrocorax carbo*).

Wintering red-breasted merganser tend to be concentrated around estuarine environments (Kirby *et al*., 1993; Musgrove *et al*., 2013). They dive and swim to forage on fish and aquatic invertebrates in the water column. Feeding, roosting, loafing and moulting occur at sea within the site boundary.

During the period 2001/02 – 2006/07, Liverpool Bay SPA supported at least 55,597 individual waterfowl in the non-breeding season. This assemblage is of European importance and includes the populations

of both species of waterfowl regularly occurring in Liverpool Bay SPA that are migratory or listed in Annex I to the Birds Directive and which constitute qualifying ornithological interest features in their own right (Natural England, 2009).

Aside from common scoter and red-throated diver, no such species have been identified as particularly important components of the assemblage of waterfowl that uses Liverpool Bay in the non-breeding season. Aerial survey data analysed by Webb *et al.* (2006) and shore-based observations presented in county and regional bird reports suggest that eider, red-breasted merganser, great crested grebe, cormorant and little gull (for which there is no Great Britain population estimate) may all occur within the SPA in numbers of national importance. However, on the basis of current information it is not possible to be certain that all of the individuals concerned are using the SPA (as opposed to areas immediately adjacent to it) or that important numbers occur regularly (Natural England, 2010).

Conservation status is currently considered to be in favourable condition (Natural England, 2010).

5.3 Impact Mechanisms

Three mechanisms of impact due to Development activities within English TW and or UK offshore water have been identified for AA. These are:

- Displacement due to disturbance by the physical presence of vessels;
- Temporary loss of supporting habitats; and
- Changes to prey availability.

Whereas the assessment relates to the Development activities within English TW and UK offshore waters, the assessment of each impact mechanism has been undertaken in the context of the cumulative impact from Development activities in all parts of the Development area.

5.4 Appropriate Assessment for Disturbance by Vessels

5.4.1 Mechanism of impact – vessel disturbance

Construction of the Development will result in increased vessel activity within the SPA for cable laying, topsides installation for satellite platforms, drilling of wells and installation of the new Douglas platform and pipeline tie-in spool.

Description of Vessel Movements relative to the existing baseline

The Development area has a high level of existing vessel traffic with, on average, 54 commercial vessels passing through the Development area each day. The construction phase of the Development will require a total of around 240 construction vessels round tips over the whole construction period. This will, on average, add an additional two vessels per day to this daily baseline although this will be considerably lower during the winter months as the majority of construction vessel activity will occur in the summer. Furthermore, the geographical layout of the Liverpool Bay development means that a large proportion of this vessel activity is likely to occur outside of the SPA boundary. Specifically, the Hamilton

and Hamilton North platforms are not within the SPA boundary and Hamilton East and Douglas are located on the SPA boundary meaning vessels approaching from northerly or westerly directions will avoid the SPA.

Vessel movements in the development area, over a 12-month period, have been compiled and aggregated and visually represented in Figures 5-1 and 5-2. These maps display the spatial location and intensity of vessel movements (of all ship types) over time, showing that most vessel movements follow established routes or shipping lanes (indicated by red colouring in fig 5-1) approaching Liverpool. These shipping lanes and routes traverse through the Development area and are close to many of the installations. As displayed in Fig 5-1 and 5-2 the Hamilton and Douglas installations are adjacent to heavily used shipping routes thus whilst it is not possible at this stage to know precisely what routes vessels will follow in order to access these installations, there is confidence that vessels will use established routes with only short deviations from general shipping routes to access the installations. Vessel movements within these shipping channels are not considered to cause an increase in disturbance over the existing baseline. Lennox is the only installation in the English portion of the project which is fully within the SPA and is located away from shipping channels, it will be vessels attending this installation which are likely to result in the greatest disturbance.

The Liverpool Bay hydrocarbon operations required the frequent use of supply and support vessels throughout its production life and the intensity of this vessel activity will have changed from year to year depending on what operations were ongoing at the time. The spatial area of this existing support vessel activity is shown by the orange tracks (oil and gas) in figure 5-1. In addition to supply vessels and support vessels these tracks show the emergency rescue and recovery support vessel (ERRV) which was on station at the Liverpool Bay complex throughout the hydrocarbon production operation. An ERRV will likely remain on station throughout the construction phase. This vessel in the past has covered all the installations in Liverpool Bay and does not move significant distances spending most its time close to the main cluster of installations which are outside of the SPA There is no reason to assume the spatial footprint or location of this vessel activity will change significantly as a result of the transfer of the Liverpool Bay assets from Hydrocarbon exploitation to CCS.

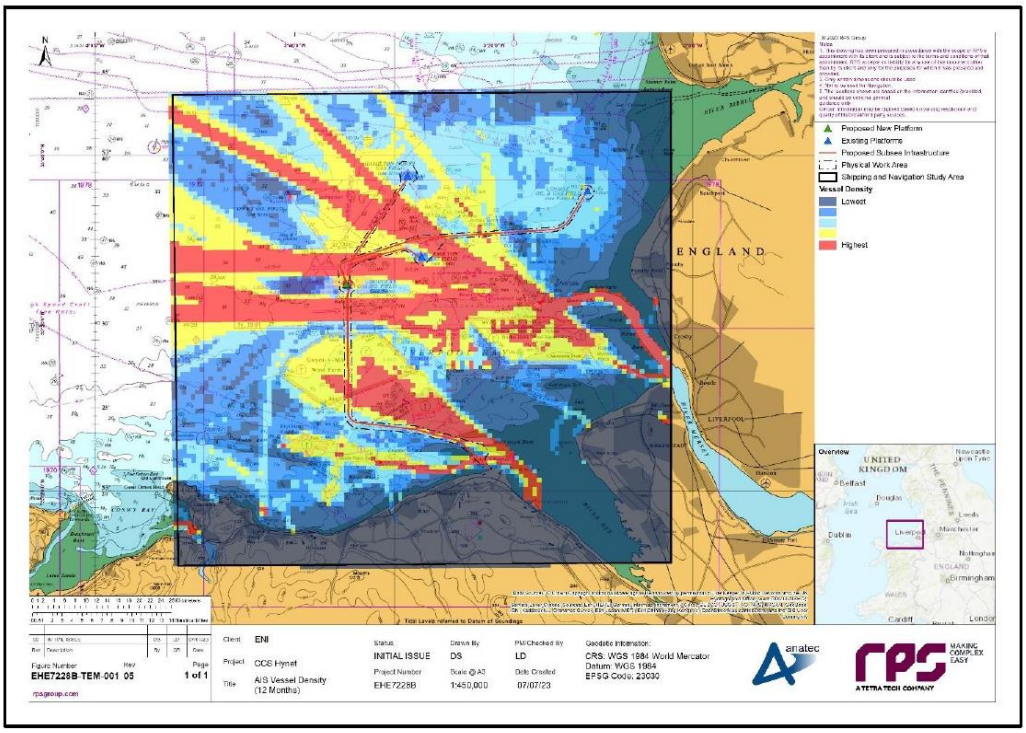


Fig 5-1: AIS Tracks showing shipping movements in the Development Area over 12 months.

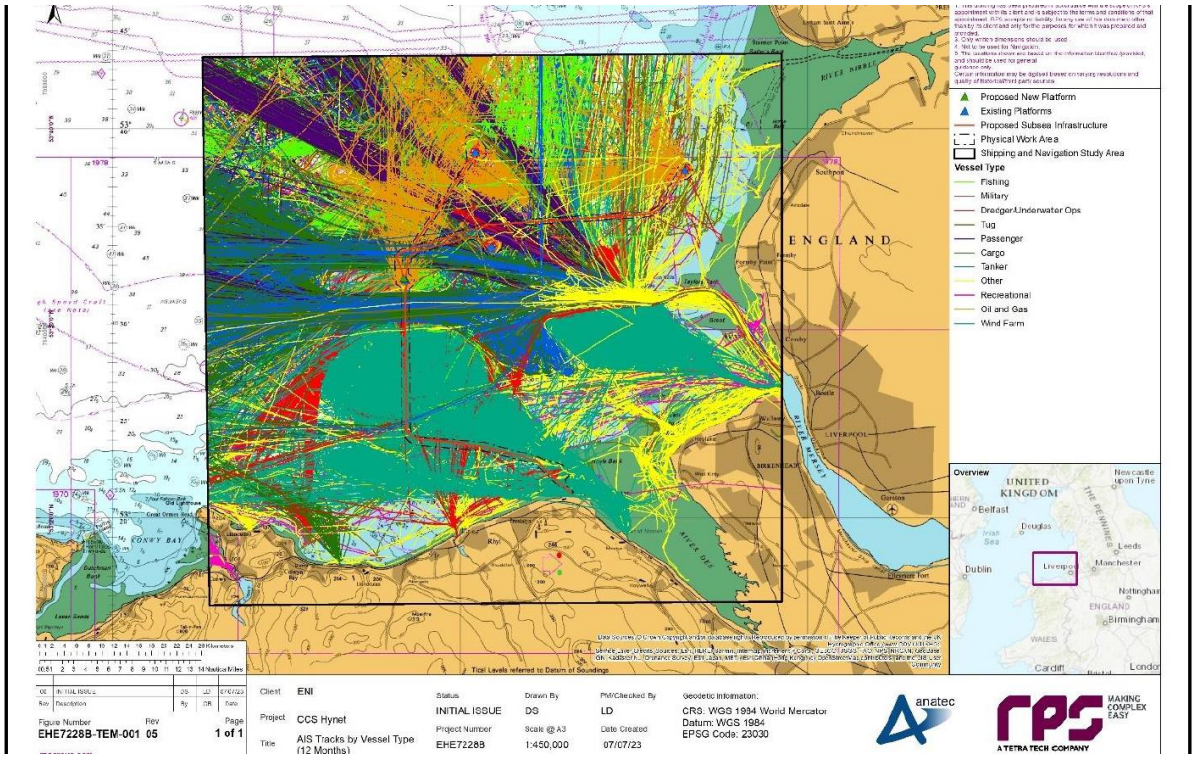


Fig 5-2: AIS Tracks showing shipping movements in the Development Area over 12 months

The Developer indicates that a maximum of two vessels associated the construction could operate at any point within the SPA during the winter period.

Furthermore, with the exception of cable laying, which would take 3-5 days per cable, the Developer already carries out many of the proposed Development activities on its existing assets, using for example jack-up vessels next to its platforms.

The presence and operation of vessels within the SPA can result in disturbance of seabirds, causing them to relocate.

For the duration of displacement, displaced birds may move to areas already occupied by other birds and thus face higher intra/inter-specific competition due to a higher density of individuals competing for the same resource. Alternatively, displaced birds may be forced to move into areas of lower quality (e.g. areas of lower food resources). The displacement could ultimately affect their demographic fitness (i.e. survival rates and breeding productivity) as well as potentially impacting on other birds in areas that displaced birds move to. Such impacts have the potential to lead to a change in the size or extent of distribution of the biogeographic population.

Red-throated diver and common scoter are considered to be particularly susceptible to disturbance by marine vessels. Little gulls are also sensitive to disturbance, though a little less so.

The principal conservation attribute that could be affected by the temporary increase in vessel activity is the disturbance caused by human activity.

For each feature, the target set in relation to this attribute is to minimise the frequency, duration and/or intensity of disturbance affecting the feature so that the population, its distribution within the site, or its use of the habitat is not significantly affected.

5.4.2 Assessment approach

The assessment is based on identifying the increased mortality of birds due to disturbance by the presence of construction vessels within the Liverpool Bay SPA. These estimates are compared to the respective species baseline mortalities, with increases of less than 1% considered not to cause an adverse impact to the integrity of a feature of the SPA.

The Developer anticipates that there could be two vessels operating independently as part of the construction programme during the non-breeding season (though not undertaking heavy lift activities in the non-breeding season).

The schedule also suggests that drilling may continue through the non-breeding season at one or other of the platforms at any one time. However, as vessel activity at each platform is assumed in the assessment, the presence of a drill rig will not significantly increase the overall area of disturbance.

5.4.3 Area of disturbance

Studies undertaken indicate that common scoter may be displaced by vessel traffic at distances from between 40 m and 3,200 m and red-throated diver at distances between 250 m and 1,700 m (Fliessbach *et al*., 2019).

JNCC has indicated to the Developer that a buffer of 2.5 km and 2 km around any vessel is appropriate for assessing disturbance to common scoter and red-throated diver respectively.

Once a vessel moves on, birds return to the previously impacted area. Consequently, the maximum impacted area has been assumed to be the buffer areas multiplied by the number of vessels active during the non-breeding season.

The same buffers are adopted for works around platforms, all of which are assumed to have active works throughout the non-breeding season.

Within the Liverpool Bay SPA the potential maximum disturbance area for winter vessel is 79.45 km^2 for common scoter and to 49.93 km^2 for red-throated diver. These disturbance figures are based on the following scenarios:

Common Scoter:

- Platform disturbance (Douglas, Hamilton, Hamilton N, Lennox) - 40.18 km^2
- Vessel disturbance (2 vessels) - 39.27 km^2
- Total 79.45 km^2.

Red-throated diver:

- Platform disturbance (Douglas, Hamilton, Hamilton N, Lennox) - 24.80 km^2
- Vessel disturbance (2 vessels) - 25.13 km^2
- Total 49.93 km^2.

Note: Disturbance from the platforms already exists due to the presence of the existing platform structures and the displacement effect around these structure is part of the baseline condition of the SPA. Vessel operations are therefore the main contributor of disturbance.

There is little evidence that little gull is sensitive to disturbance and displacement from airborne sound and presence of vessels and infrastructure (Goodship & Furness, 2022). Reviews of the sensitivity of different seabird species to disturbance from vessels and helicopter traffic have not assessed little gull, although generally gulls are considered not to be sensitive to disturbance or displacement by the physical presence of vessels and that is predicted to be the case for little gull (Furness *et al*., 2013). Studies on gull species indicate that gulls may be displaced by vessel traffic at distance from between 250 m to 500 m (Fliessbach *et al*., 2019).

An area of impact for little gull has been estimated as 4.7 km^2, based on a disturbance zone of 500 m applied to two vessels that may be present along the cable corridors and activities at four platforms.

The small scale of displacement around the vessels is not likely to impact any of the assemblage features to a greater extent than the highly sensitive common scoter and red-throated diver and therefore the conclusion for these features is relevant to the assemblage also.

5.4.4 Species densities within the area of impact

Mean species densities have been established for the areas of the Liverpool Bay SPA that could be subject to disturbance during construction of the Development.

For common scoter and red-throated diver the densities were based on data from HiDef Aerial Surveying Limited (2023) applicable to the cable corridors plus a 4 km buffer.

Mean densities for the non-breeding period were estimated to be 83.53 birds per km^2 for common scoter and 1.06 birds per km^2 for red-throated diver.

A peak density of 0.328 birds per km^2 was estimated for little gull in the non-breeding period from Bradbury *et al.* (2014) and Waggitt *et al.* (2020) applicable to the cable corridors plus a 2 km corridor.

5.4.5 Number of birds at risk of disturbance

The abundances of each species in the area of disturbance (Section 5.4.3) were calculated from the respective densities and are presented, along with other assessment metrics, in Table 5-1.

5.4.6 Regional population and baseline mortality

A regional non-breeding population estimate of 141,801 for common scoter within the Liverpool Bay SPA has been derived from a four-year peak population estimate in HiDef Aerial Surveying Limited (2023).

Equivalent populations for red-throated diver have been derived from 'UK Western Waters' populations defined by Furness (2015) as 1,800 in the non-breeding period.

Lawson *et al.* (2016) provides a non-breeding population estimate of 319 for non-breeding little gull within Liverpool Bay.

Baseline mortality rates were established from data in Horswill & Robinson (2015) as 0.238 for common scoter, 0.233 for red-throated diver and 0.157 for little gull. Baseline mortalities are presented in Table 5-1 for each species, derived from these rates and the regional population.

5.4.7 Displacement mortality

Displacement due to the presence of construction vessels is temporary and reversible. An upper range value for the displacement mortality rate has been taken as 1% of the affected birds and this is applied to the respective peak abundance values. These numbers are shown in Table 5-1 and also expressed as a % increase to the baseline mortality rate.

Table 5-1 Metrics for the assessment of increased mortality due to vessel disturbance.

Species	Abundance in Zone of Impact	Regional Population	Baseline Mortality	Upper Mortality Rate (%)	Number of individuals subject to mortality	Increase in baseline mortality (%)
Common scoter	6,637	141,801	33,749	1.0	66.37	0.20
Red-throated diver	52.9	1,800	419	1.0	0.53	0.13
Little gull	1.55	319	50	1.0	0.016	0.03

5.4.8 Consequence in relation to Conservation Objectives

The increases in excess mortality for common scoter, red-throated diver and little gull are all less than 1% of the respective baseline values and this is considered to be insufficient to significantly impact population viability.

Displacement during the construction phase is short term and reversible. Changes to the extent of supporting habitats has been assessed to have an insignificant effect on population viability.

The structure, function and supporting processes of the habitats (*e.g.* in providing for prey species of the qualifying features) will be largely unaffected. The relatively small area of seabed habitats that will be disturbed is expected to recover and be recolonised in the short term.

Disturbance by up to two construction vessels will not significantly affect the population of each qualifying feature within the SPA nor compromise the potential for achieving the conservation targets on abundance for each of the features. The short-term presence of two vessels will not reduce the long-term distribution of features within the SPA.

As such there would be no adverse effects to the integrity of the Liverpool Bay SPA due to disturbance from the physical presence, light and sound associated with construction vessels.

The non-breeding assemblage feature of the Liverpool Bay SPA is made up largely from the populations of common scoter and red-throated diver features, with smaller numbers of other species also contributing, including red-breasted merganser and great cormorant. The small scale of displacement around the vessels is not likely to impact any of the assemblage features to a greater extent than the highly sensitive common scoter and red-throated diver and therefore the conclusion for these features is relevant to the assemblage also.

The effects on the waterbird assemblage are not quantified, however as the common scoter is the dominant species within the Liverpool Bay SPA (Lawson, *et. al.*, 2016) the effects upon the assemblage will most closely mirror those of the scoter.

5.5 Appropriate Assessment for Loss of Habitat

5.5.1 Mechanism of impact – loss of habitat

Seabed habitat will be impacted by direct mechanical disturbance and in areas where resettlement of sediments causes deep burial of the existing seabed.

Direct disturbance of the seabed within English TW will be a result of laying cables between the new Douglas platform and the three satellite platforms.

Direct disturbance of seabed in Welsh TW will be from the sandwave removal south of the Douglas platform, dredging of a channel through the West Hoyle Spit, laying of parallel cables from Port of Ayr to the new Douglas platform, and installation of a pipeline connection spool at the new Douglas platform.

Assessment of impacts to SPA features is on the basis of the cumulative affects since both sets of activities are within the Liverpool Bay SPA.

Direct disturbance of the seabed would impact common scoter and red-throated diver by removing benthic prey and would last until the altered seabed is recolonised. Little gull, being surface feeders, are not anticipated to be directly affected.

Beyond areas that have been directly disturbed, burial of seabed habitat by the resettlement of sediments or by settlement of discharged drill cuttings may temporarily impact the diversity of benthic prey species of common scoter and red-throated diver within the altered habitat. This may cause birds to avoid the affected area and effectively give rise to a temporary loss of supporting habitat.

The seabed in the Liverpool Bay SPA is subject to natural suspension, dispersion and resettlement of sediments and it is understood that the benthic organisms are resilient to a degree of burial. Impacts are therefore likely to be restricted to areas suffering deep sedimentation.

Where high SSC are caused by the suspension of sediments in the water column, as a result of direct seabed disturbance or from discharge of drill cuttings, this has the potential to inhibit the foraging success of SPA features that dive for prey by reducing visibility or other prey-detection mechanisms.

In areas of the Liverpool Bay SPA where increases in SSC are considered to impact foraging success it may be possible that the water column and seabed habitat becomes temporarily unavailable to birds.

High SSC in the water column is short lived and loss of water column habitat will likely last for no more than a few days beyond cessation of activities. Little gull, being surface feeders, are not anticipated to be directly affected by increased suspended sediments in the water column.

For the duration of displacement from the affected habitats, displaced birds may move to areas already occupied by other birds and thus face higher intra/inter-specific competition due to a higher density of individuals competing for the same resource. Alternatively, displaced birds may be forced to move into areas of lower quality (e.g. areas of lower food resources). The displacement could ultimately affect their demographic fitness (i.e. survival rates and breeding productivity) as well as potentially impacting on

other birds in areas that displaced birds move to. Such impacts have the potential to lead to a change in the size or extent of distribution of the biogeographic population.

5.5.2 Assessment approach

A conservative area of short-term habitat loss has been estimated and comparison made with the evaluation and conclusions from disturbance from vessels.

5.5.3 Area of impact

The Developer has identified an area of physical works, within which all activities for the Development will occur. The area is based on applying a buffer of approximately 200 m either side the centre line of the cables, expanding in places to accommodate other works, such as for the installation of the new Douglas Platform and to give flexibility in the final cable route approach to PoA.

A total of 37.02 km^2 of the area of physical works sits within the Liverpool Bay SPA which itself is 2,521.77 km^2 in extent.

5.5.3.1 Area of direct seabed disturbance

Within the area of physical works, there are sources of direct impact to seabed from seabed preparation, such as sand wave clearance, and cable laying, including deposition of protection at transition points and crossings.

Areas of directly affected seabed are provided for each activity, from which total areas of seabed disturbance have been estimated as 1.95 km^2 for cable laying and 0.022 km^2 for seabed preparation.

5.5.3.2 Area of impact from increased SSC

Direct seabed disturbance and the discharge of drill cuttings will give rise to increased sediments in the water column.

For each activity the Developer has undertaken sediment dispersion modelling to determine where plumes of sediment would increase suspended solid concentrations in the water column and where sediments are expected to settle.

Some conclusions of the modelling are presented in the application, indicating that very high SSC of up to 3,000 mg/l, 1,000 mg/l and 360 mg/l would be expected from seabed preparation, cable laying and drilling respectively, but that these levels would be very localised to the point of disturbance or discharge.

Impacts to common scoter and red-throated diver from increased SSC have been conservatively taken to cover all of the area of physical works within the SPA.

The area of physical works covers 37.02 km^2 within the SPA and, assuming that all of the SPA represents foraging for its various features, this equates to 1.47% of the Liverpool Bay SPA that will be temporarily affected by proposed works. Noting this small area is a considerable over estimation of what could potentially occur.

5.5.3.3 Area of impact from sediment deposition

Modelling undertaken by the Developer also anticipates that resettlement of suspended sediments would be most intense in close proximity to the activity, giving rise to maximum depths of coverage of 3,000 mm, 160 mm and 100 mm from dredging at the West Hoyle Spit, cable laying and drilling respectively.

Depth of burial is understood to decrease rapidly with distance from the point of disturbance with, for example, depths of <1 mm coverage outside of the area of physical works for sand wave clearance south of the Douglas platform and of <3 mm from cable laying.

Assuming that all of the SPA represents foraging for its various features, this equates to 1.47% of the Liverpool Bay SPA that will be temporarily affected by proposed works.

5.5.4 Number of birds affected

From the time when seabed and water-column habitats are impacted until they are again able to perform their natural supporting functions for common scoter and red-throated diver, these birds may in effect by disturbed from using the impacted areas.

Suspended sediment concentrations will return to background levels very quickly after the cessation of activities, meaning any impact will be temporary and of a very short duration.

Following completion of the seabed disturbance activities and the subsequent resettlement of suspended sediments, mobile fish and mobile benthic species are expected to move freely back to the affected areas. Less mobile benthic organisms are expected to recolonise the disturbed habitat over time.

The duration of displacement of common scoter and red-throated diver from the area, either due to reduced visibility or lack of prey, is consequently expected to be of short duration.

The number of birds affected have not been estimated by the Developer. However, an indication of numbers affected can be obtained by comparison of the area of temporary habitat loss with the area of disturbance due to vessel activity noted in Section 5.4.3.

The total area of temporary lost habitat (37.02 km^2) is 47% of the area from which common scoter may be displaced due to vessel activity (79.45 km^2) and is 74% of the area from which red-throated diver may be displaced (49.93 km^2).

The potential impact on common scoter and red-throated diver due to temporary habitat loss is therefore considered to be no more than the impact estimated from disturbance by vessels. It is also of note that the areas from which birds may be excluded by each source of disturbance would largely overlap.

5.5.5 Consequence in relation to Conservation Objectives

The Liverpool Bay SPA conservation targets for the supporting habitat of common scoter and little gull are to maintain the extent, distribution and availability of suitable habitat which supports the feature; the quality and extent should not deteriorate due to anthropogenic factors (including water quality).

The equivalent target for red-throated diver is to restore the extent, distribution and availability of suitable habitat which supports the feature; preventing further deterioration, and where possible, reduce any existing anthropogenic influences impacting the extent and quality (including water quality).

There will be no long-term impact from the Development on sustaining or achieving these targets. The construction phase of the Development will result in a short-term restriction of the extent and availability of supporting habitats of common scoter and red-throated diver, but the level of impact is not considered to cause an adverse impact on the integrity of the site.

5.6 Appropriate Assessment for Changes in Prey Availability

5.6.1 Mechanism of impact – prey availability

There is the potential for changes in bird prey abundance and distribution to arise as a result of construction activities that disturb the seabed and that cause increased SSCs. Reduction or disruption to prey availability to birds may cause displacement from foraging grounds in the area, or result in reduced energy intake, affecting survival rates or productivity in the population.

The principal conservation attribute that could be affected by the temporary changes to prey availability is the food availability and quality of prey.

For each feature the target set for this attribute is to maintain the distribution, abundance and availability of key food and prey items to maintain the population. Generally, prey items are taken to mean finfish, though for common scoter the prey items include molluscs and bivalves reflecting the main diet of this feature (Kaiser, 2002).

5.6.2 Assessment approach

A conservative area of short-term changes to prey availability has been estimated and is considered in relation to the conservation target for prey availability.

5.6.3 Area of impact

Reduced availability of prey was the cause of the temporary loss of seabed habitat assessed in Section 5.5.

Many shellfish species are reported to be insensitive to increases in turbidity (Wilber & Clarke, 2001). This includes shellfish such as brown crab which has been assessed in the Marine Evidence based Sensitivity Assessment as being tolerant to increase in SSCs, smothering, and increase in turbidity, with very low, low, and no sensitivity to each of these impacts respectively (Neal & Wilson, 2008). This is due

to their mobility, allowing brown crab to escape from sediment deposition and avoid areas of increased SSCs, as they rely on good visibility to forage (Neal & Wilson, 2008).

Furthermore, some non-mobile shellfish, such as common cockle, have also been assessed as being tolerant and not sensitive to increased SSCs and turbidity (Tyler-Walters, 2007). This is because this species naturally inhabits sedimentary and turbid environments and is therefore considered to be tolerant to these impacts (Navarro & Widdows, 1997; Tyler-Walters, 2007).

The common cockle also has intermediate tolerance to smothering of up to 5 cm of deposited sediment, with a high recovery rate, and an overall low sensitivity to smothering (Tyler-Walters, 2007; Jackson & James, 1979; Richardson *et al*., 1993).

The area of impact previously identified for direct seabed disturbance and for subsequent burial by resettlement of suspended sediments is also valid for changes to prey availability due to impacts on the seabed.

For prey species displaced due to SSC, a conservative area of impact is considered to be the area of physical works, which was also assumed previously to be the area of displacement of birds as a response to SSC.

Development construction activities that generate underwater noise may cause some mortality to some life stages of some fish species over short distances from the noise source. Long term changes to fish populations due to mortality during construction of the Development are considered to be insignificant given the very large areas over which fish spawn. Underwater noise is not expected to impair achievement of conservation targets relating to prey availability.

5.6.4 Number of birds affected

Indirect effects to prey availability are predicted to be short term and reversible, lasting only for the duration of construction. Mobile prey species disturbed from the construction areas during cable laying would move to alternative equivalent unimpacted nearby habitat and would remain available to birds.

For the AA, common scoter and red-throated diver are assumed to be temporarily displaced from the area of physical works due to habitat loss (see Section 5.5). Short term changes to prey availability in areas from which these birds are assumed to be absent will cause no additional impact to common scoter and red-throated diver.

For little gull, the short-term changes to prey availability may result in this feature also being displaced from the area of physical works. This is equivalent to almost eight times the area of impact to little gull assumed by the Developer for vessel disturbance.

Vessel disturbance was conservatively estimated to result in a 0.03% increase to baseline mortality of little gull. By extrapolation, displacement of little gull due to the short-term change to prey availability may result in an increase in baseline mortality of 0.24%.

The area of displacement of little gull by vessels overlaps significantly with the area of physical works. The cumulative effect of disturbance from vessels and from changes to prey availability may therefore lie between 0.24% and 0.27% increase to baseline mortality.

This is below the 1% threshold and is concluded not to give rise to an adverse effect on the integrity of little gull in the Liverpool Bay SPA.

5.6.5 Consequence in relation to Conservation Objectives

For common scoter, red-throated diver and little gull features of the Liverpool Bay SPA, the conservation target is to maintain the distribution, abundance and availability of key food and prey items to maintain the populations of the features.

There will be no long term impact from the Development on sustaining or achieving the targets. The construction phase of the Development may result in a short-term change to the availability of prey within areas from which common scoter and red-throated diver are displaced due to habitat loss. This will cause no additional impact to common scoter and red-throated diver.

The abundance and availability of prey for little gull will be temporarily reduced but the level of impact is not considered to cause an adverse impact on the integrity of the site.

5.7 Conclusion of Impacts from the Development Alone

Based on the assessment provided, the Secretary of State is satisfied that impacts from the construction of the Development alone are insufficient to have an adverse impact on the integrity of the common scoter, red-throated diver and little gull features of the Liverpool Bay SPA.

5.8 In-Combination Effects

Consideration has been given to whether the effects of the Development construction phase may, in combination with effects caused by other planned developments, lead to adverse effects on the integrity of the site for common scoter, red-throated diver and little gull features.

5.8.1 In-combination projects included

An application has been submitted for the Awel y Môr offshore wind farm project which will, at its closest, come within 1.1 km of the Development area. There is potential for the Development construction to overlap with construction of the Awel y Môr project.

A further five projects have been identified which are at the pre-application stage that could result in in-combination effects with the Development. These are listed below, with minimum distances from the Development area shown in brackets:

- Morgan offshore wind farm generation assets (7.5 km);

- Morecambe offshore wind farm generation assets (30 km).
- Combined Morgan and Morecambe offshore wind farm transmission assets (3 km).
- Mona offshore wind farm (no data available); and
- Mostyn Energy Park extension (4 km).

Given that a construction schedule of 3.5 years is considered typical for an offshore wind farm, and a planned construction finish data of 2026 for the Development, there is potential overlap with the construction phases of the pre-application offshore wind farm projects.

5.8.2 Data from projects

5.8.2.1 Awel y Môr project

A spatial extent of 41.11 km^2 has been assumed for the Awel y Môr offshore wind farm and export cable within Liverpool Bay SPA.

The maximum design scenario (MDS) for potential changes to SSC and deposition at Awel y Môr offshore wind farm provides for:

- pre-lay cable trenching and sand wave clearance using a mass flow excavator.
- cable installation through jetting.
- dredge spoil disposal at surface; and
- drill cuttings produced by foundation installation.

These activities will result in increased SSC and, given the close proximity of works to the Development, sediment plumes from both projects could have in-combination effects if works are undertaken at the same time.

Modelling indicates that plumes produced during drilling for foundation installation or produced during sand wave clearance activities within the Awel y Môr Array Area may reach the Development's area of project physical work at up to 50 mg/l on flood tides, with greater interaction at spring tides.

Likewise, plumes produced through pre-lay cable trenching within the Awel y Môr export cable corridor may overlap directly with the Development's area of project physical work though do so at lower values of *c.* 5 mg/l and are only likely to occur if trenching activities occur simultaneously.

The Awel y Môr offshore wind farm, also involves the installation of an interlink cable with the Gywnt y Môr offshore wind farm, with the magnitude of suspended sediments likely being of a similar magnitude to export cable installation.

Cumulative deposition may occur between the PoA to Douglas cable trenching and the foundation drilling with the Awel y Môr Array Area, however, interaction is expected to occur at *c.* <1 mm.

Increases to the baseline mortality rates due to disturbance by vessels during construction of the Awel y Môr project have been estimated as 0.007% for common scoter and 0.582% for red-throated diver. No data is available for little gull.

5.8.2.2 Projects at the pre-application stage

There is very little quantitative data available to date for any of these projects due to the early stage of their design.

Spatial data was not available for Morgan and Morecambe Offshore Wind Farms, however as works are expected to be broadly similar to Mona and Awel Y Mor (i.e. and export cable route) the mean of those two schemes was taken. The area of proposed works for Mona within the Liverpool Bay SPA is expected to cover 28.53 km^2, and 41.11 km^2 for Awel y Môr. Therefore Morgan/Morecambe was estimated at 34.82 km^2. This combines to 104.46 km^2 and the Liverpool Bay SPA is 2,521 km^2.

Assuming that all works were to take place at once, this would equate to an additional temporary loss of habitats of 4.14% of the Liverpool Bay SPA that will be affected by proposed works.

The Developer has derived estimates for increases to baseline mortality rates from vessels used for the construction of the Morgan/Morecambe shared transmission asset of 0.98% for common scoter and 0.35% for red-throated diver. No data is available for little gull.

No other data has been derived.

5.8.3 In-combination consequences in relation to Conservation Objectives

Disturbance due to construction vessel activity of the Development in-combination with construction of the Awel y Môr project could result in an increase to the baseline mortality rates of 0.21% for common scoter and of 0.71% for red-throated diver.

Both in-combination values are below the 1% threshold and so considered not to cause a significant effect on either feature.

There is a possibility that the combined effects of the Development and Awel y Môr in combination with other projects that are as yet in the pre-application phase could lead to estimates of increased mortality rates that are greater than 1% of the baseline values. However, there is as yet insufficient data for these projects to be able to make a quantitative assessment with any degree of certainty.

When these projects make licence applications the respective developers will provide quantitative assessment of impacts to the features of the Liverpool Bay SPA, including impacts in-combination with the Development.

5.9 Conclusion of Impacts from the Development Alone and In-Combination

There is some uncertainty regarding when the construction of the Development will commence which subsequently means there is some uncertainty regarding what other projects or activities may also be underway at the same time. This level of uncertainty is considered acceptable because prior to the commencement of construction activities further consents e.g. a consent to locate, will be required from the Department. These consents will be considered closer to the commencement date and will also be subject to a HRA which will provide further opportunity to undertake a more up to date and comprehensive in-combination assessment of overall disturbance in the SPA.

Based on the assessment provided, the Secretary of State is satisfied that impacts from the construction of the Development in combination with other projects for which sufficient data is available will not have an adverse impact on the integrity of the common scoter, red-throated diver and little gull features of the Liverpool Bay SPA.

When applications are presented for other projects the Secretary of State will review the potential for those projects to impact features of the Liverpool Bay SPA in combination with the Development and update his assessment at such time.

5.10 Mitigation and Avoidance Measures

The assessment regarding Liverpool Bay SPA has been undertaken using a worst-case scenario where no mitigation or avoidance measures have been considered, and it is clear the spatial scale and short duration nature of the impacts (in English waters) would not be of a magnitude which could adversely affect the site's integrity. This conclusion however does not imply that the Department is satisfied that the assessed scenario represents the best possible option for the Liverpool Bay SPA conservation objectives. This is because there are measures which could be employed to further avoid and reduce the disturbance of construction works on common scoter and red throated diver. The primary and most effective of these would be a seasonal restriction, limiting vessel and construction activities to the period outside of the 'wintering season' wherein common scoter and red throated diver are most abundant in the SPA. The Department will therefore require that the cable installation between the new Douglas platform and the satellite platforms be undertaken outside of the 'over wintering period' when common scoter and red throated diver are most abundant (this period will be November to March inclusive).

The decision to employ a seasonal restriction is guided by the SNCBs' advice on conservation objectives document which stipulates targets for those attributes which underpin the integrity of the SPA features. For the Red Throated Diver attributes 'population – distribution' and 'supporting habitat – extent and distribution' a target of 'restore to favourable condition' has been proposed. A target of restore in this context means that measures should be taken to prevent further deterioration. Therefore, while the effects of the Development (in English waters) are too small and short in duration to have a material or

significant impact on the site's integrity or condition it is important to minimise any impacts on distribution and supporting habitat as much as is reasonably feasible.

The seasonal restriction on cable laying activities will be implemented as a requirement on the individual enabling/operational consents which are managed by OPRED. The NRW part of the HRA outlines that a similar seasonal restriction will be conditioned as part of the marine licence for those aspects of the project in Welsh waters.

There are significant differences in the consenting process between the Welsh part of the 'Hynet Project' and the English portion which influence how the seasonal restriction will be implemented. Within Wales the HRA is informing the Marine licensing process which will be used to directly manage the disturbing activities. In England the HRA is informing the 'Storage permit' managed by the NSTA, consequently before the works commence there will be a further requirement for operational permits/approvals to be granted by OPRED, specifically these will include marine licences, consents to locate (for the positioning of structures such as rigs at sea) and screening directions (The Offshore Oil and Gas Exploration, Production, Unloading and Storage - Environmental Impact Assessment - Regulations 2020). These operational approvals will be applied for closer to the time of undertaking and will be subject to further HRAs by OPRED. It is within these approvals that OPRED will administer the seasonal restriction and any other mitigation or avoidance measures OPRED deems appropriate to minimise impacts to the SPA.

The seasonal restriction will only apply to the cable laying operations. Any works at the installations, for example drilling, well interventions or maintenance which utilise mobile units such as jack ups will not be subject to seasonal restrictions. The reason for not restricting these operations is that the installations (Hamilton, Douglas and Lennox) and their associated support vessels have been a continual presence in the SPA and were part of the baseline condition at the time of designation. There is an expectation that red throated diver and common scoter will already show avoidance of the area around these installations and the area around the installations will thus not represent supporting habitat to either species. Further operations at these installations will therefore not result in a significant change in distribution of the species or reduction in supporting habitat. This approach aligns with OPRED's existing management and assessment process for operations at the Liverpool Bay assets.

Further to the seasonal restriction the Developer will be required to present vessel management plans within their applications to OPRED. These plans will describe the number of vessel movements required for each activity and the ways in which this vessel activity will be managed to minimise disturbance e.g. defining likely access routes to the installation and best practice vessel operations. This information will be submitted as part of the individual applications required to enable the construction activity e.g. Consents to locate or Screening Directions, which are regulated by OPRED. This vessel management information will be used to inform the decision process to approve an application by the Department before construction operations begin.

In summary the implementation of the seasonal restriction on cable laying activities will further reduce impacts to the Liverpool Bay SPA and provide greater confidence in the Secretary of State's conclusion that the Development will not cause an adverse effect on the site's integrity.

6 ACOUSTIC ASSESSMENT CRITERIA

The HRA Stage 1 was unable to conclude there would be no LSE for several features of SACs due to impacts from underwater noise sources.

The AA is based on approaches that have become widely accepted as being most appropriate to scientific understanding of the effects of underwater noise on marine animals.

The approaches rely on modelling of the sources and propagation of noise in the Development's marine environment and determining whether relevant features may be exposed to levels of noise above thresholds that would have an effect.

An overview of the widely accepted thresholds and methods for using them in the assessment is presented in this Section.

6.1 Introduction

Underwater noise has the potential to affect marine life in different ways depending on the noise level and characteristics. Richardson *et al.* (1995) defined zones of noise influence which vary with distance from the source and level. For this study, it is the zones of injury and responsiveness (i.e., disturbance) that are of concern:

- The zone of injury/hearing loss: this is the area where the sound level is high enough to cause tissue damage in the ear. This can be classified as either temporary threshold shift (TTS) or permanent threshold shift (PTS). At even closer ranges, and for very high intensity sound sources (e.g., underwater explosions), physical trauma or even death are possible.
- The zone of responsiveness: this is defined as the area within which the animal responds either behaviourally or physiologically. The zone of responsiveness is usually smaller than the zone of audibility because not all audible sounds evoke a reaction.

To determine the potential spatial range of injury and disturbance, a review has been undertaken of available evidence, including international guidance and scientific literature. The following sections summarise the relevant thresholds for onset of effects and describe the evidence base used to derive them.

6.2 Injury to Marine Mammals

The injury criteria proposed by Southall *et al.* (2019) are based on a combination of linear (i.e. unweighted) peak pressure levels and mammal hearing weighted sound exposure levels (SEL). The hearing weighting function is designed to represent the bandwidth for each group within which acoustic exposures can have auditory effects. The categories include:

- Low Frequency (LF) cetaceans: marine mammal species such as baleen whales.
- High Frequency (HF) cetaceans: marine mammal species such as dolphins, toothed whales, beaked whales and bottlenose whales.

- Very High Frequency (VHF) cetaceans: marine mammal species such as true porpoises, river dolphins and pygmy/dwarf sperm whales and some oceanic dolphins, generally with auditory centre frequencies above 100 kHz).
- Phocid Carnivores in Water (PCW): true seals; hearing in air is considered separately in the group Phocid Carnivores in Air (PCA); and
- Other Marine Carnivores in Water (OCW): including otariid pinnipeds (e.g. sea lions and fur seals), sea otters and polar bears; air hearing considered separately in the group Other Marine Carnivores in Air (OCA).

Injury criteria are proposed in Southall *et al.* (2019) are for two different types of sound as follows:

- Impulsive sounds which are typically transient, brief (<1 second), broadband, and consist of high peak sound pressure with rapid rise time and rapid decay (ANSI, 1986; NIOSH, 1998; ANSI, 2005). This category includes sound sources such as seismic surveys underwater explosions.
- Non-impulsive sounds which can be broadband, narrowband or tonal, brief or prolonged, continuous or intermittent and typically do not have a high peak sound pressure with rapid rise/decay time that impulsive sounds do (ANSI, 1995; NIOSH, 1998). This category includes sound sources such as continuous running machinery, drilling, sonar and vessels.

The criteria for impulsive and non-impulsive sound have been adopted for this study given the nature of the sound source used during construction activities. The relevant criteria proposed by Southall *et al.* (2019) are as summarised in Table 6-1 and Table 6-2.

Table 6-1: Summary of PTS onset acoustic thresholds (Southall *et al*., 2019).

Hearing Group	Parameter	Impulsive	Non-impulsive
Low-frequency (LF) cetaceans	Peak, unweighted	219	-
	SEL, LF weighted	183	199
High-frequency (HF) cetaceans	Peak, unweighted	230	-
	SEL, HF weighted	185	198
Very High-frequency (VHF) cetaceans	Peak, unweighted	202	-
	SEL, VHF weighted	155	173
Phocid Carnivores in Water (PCW)	Peak, unweighted	218	-
	SEL, PCW weighted	185	201
Other Marine Carnivores in Water (OCW)	Peak, unweighted	232	-
	SEL, OCW weighted	203	219

Table 6-2: Summary of TTS onset acoustic thresholds (Southall *et al*., 2019).

Hearing Group	Parameter	Impulsive	Non-impulsive
Low-frequency (LF) cetaceans	Peak, unweighted	213	-
	SEL, LF weighted	168	179
High-frequency (HF) cetaceans	Peak, unweighted	224	-
	SEL, HF weighted	170	178
Very High-frequency (VHF) cetaceans	Peak, unweighted	196	-
	SEL, VHF weighted	140	153
Phocid Carnivores in Water (PCW)	Peak, unweighted	212	-
	SEL, PCW weighted	170	181
Other Marine Carnivores in Water (OCW)	Peak, unweighted	226	-
	SEL, OCW weighted	188	199

6.2.1 Disturbance to marine mammals

Beyond the area in which injury may occur, the effect on marine mammal behaviour is the most important measure of impact. Significant (i.e. non-trivial) disturbance may occur when there is a risk of animals incurring sustained or chronic disruption of behaviour or when animals are displaced from an area, with subsequent redistribution being significantly different from that occurring due to natural variation.

Southall *et al.* (2007) recommended that the only currently feasible way to assess whether a specific sound could cause disturbance is to compare the circumstances of the situation with empirical studies, which the paper groups by severity in a scale from zero to nine. The Joint Nature Conservation Committee (JNCC) guidance in the UK (JNCC, 2010a) indicates that a score of five or more on the Southall *et al.* (2007) behavioural response severity scale could be significant. The more severe the response on the scale, the lower the amount of time that the animals will tolerate it before there could be significant negative effects on life functions, which would constitute a disturbance.

Southall *et al.* (2007) present a summary of observed behavioural responses for various mammal groups exposed to different types of noise: continuous (non-pulsed) or impulsive (single or multiple pulsed).

6.2.1.1 Continuous (non-pulsed, non-impulsive) sound

For non-pulsed sound (e.g. vessels etc.), studies for minke whales (*Balaenoptera acutorostrata*) and Atlantic white-beaked dolphin (*Lagenorhynchus albirostris*) showed response scores of three at a received level of 100 dB to 110 dB re 1 µPa (rms) and 110 to 120 dB re 1 µPa (rms) respectively. No higher severity scores were encountered for these species. For HF cetaceans such as bottlenose dolphins, response scores of six are noted from 80 dB re 1 µPa (rms) upwards. There is a significant increase in the number of mammals responding at a response score of six once the received sound pressure level (SPL) is greater than 140 dB re 1 µPa (rms) (Southall *et al*., 2007).

6.2.1.2 Impulsive (pulsed) sound

Southall *et al.* (2007) presents a summary of observed behavioural responses due to multiple pulsed sound, although the data are primarily based on responses to seismic exploration activities. Although

these datasets contain much relevant data for LF cetaceans, there are no strong data for MF or HF cetaceans.

LF cetaceans were typically observed to respond significantly at a received level of 140 dB to 160 dB re 1 µPa (rms). Behavioural changes at these levels may have included a visible startle response, extended cessation or modification of vocal behaviour, brief cessation of reproductive behaviour or brief/minor separation of females and dependent offspring. The data available for MF cetaceans indicate that some significant response was observed at a SPL of 120 dB to 130 dB re 1 µPa (rms), although the majority of cetaceans in this category did not display behaviours of this severity until exposed to a level of 170 dB to 180 dB re 1µPa (rms).

According to Southall *et al.* (2007) there is a general paucity of data relating to the effects of sound on pinnipeds in particular. One study using ringed seals (*Pusa hispida)*, bearded seals (*Erignathus barbatus)* and spotted seals (*Phoca largha)* (Harris *et al*., 2001) found that it is only at higher SPLs in the range of 190 dB to 200 dB re 1 µPa (rms) that considerable numbers of seals were found to exhibit a significant response.

Southall *et al.* (2007) noted that due to paucity of data, it was not possible to present any data on responses of HF cetaceans. However, Lucke *et al.* (2009) showed a single harbour porpoise consistently showed aversive behavioural reactions to pulsed sound at received SPL above 174 dB re 1 µPa (peak-to-peak) or a SEL of 145 dB re 1 µPas, equivalent to an estimated rms SPL of 166 dB re 1 µPa.

This AA adopts a conservative approach and uses the NMFS Level B harassment threshold of 160 dB re 1 µPa (rms) for impulsive sound (Table 6-3) (NMFS, 2005). Level B Harassment is defined by NMFS (NMFS, 2005) as having the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioural patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering but which does not have the potential to injure a marine mammal or marine mammal stock in the wild. This is similar to the JNCC (2010a) description of non-trivial disturbance and has therefore been used as the basis for onset of behavioural change in this AA.

Exposure to sound levels exceeding the behavioural change threshold stated above does not necessarily imply that the sound will result in significant disturbance as this will also depend on the likelihood that the sensitive receptors will be exposed to that sound and whether the numbers exposed are likely to be significant at the population level.

Table 6-3 : Disturbance criteria for marine mammals used in this study (NMFS, 2005).

Effect	Non-Impulsive Threshold	Impulsive Threshold (Other than Piling)
Mild disturbance (all marine mammals)	-	140 dB re 1µ Pa (rms)
Strong disturbance (all marine mammals)	120 dB re 1µ Pa (rms)	160 dB re 1µ Pa (rms)

6.2.2 Fish and Sea Turtles

Adult fish not in the immediate vicinity of a noise source are generally able to vacate the area and avoid physical injury. However, larvae and eggs either lack or have limited flight response and are therefore more likely to incur injuries from the sound energy in the immediate vicinity of the sound source, including damage to their hearing, kidneys, hearts, and swim bladders.

For fish, the most relevant criteria for injury are considered to be those contained in the Sound Exposure Guidelines for Fishes and Sea Turtles (Popper *et al*., 2014). These guidelines broadly group fish into the following categories based on their anatomy and the available information on hearing of other fish species with comparable anatomies:

- Group 1 fish: fishes with no swim bladder or other gas chamber (e.g. elasmobranchs, flatfishes and lampreys). These species are less susceptible to barotrauma and are only sensitive to particle motion, not sound pressure. Basking shark, which does not have a swim bladder, falls into this hearing group.
- Group 2 fish: fishes with swim bladders but for which the swim bladder does not play a role in hearing (e.g. salmonids). These species are susceptible to barotrauma, although hearing only involves particle motion, not sound pressure.
- Group 3 fish: Fishes with swim bladders that are close, but not connected, to the ear (e.g. gadoids and eels). These fishes are sensitive to both particle motion and sound pressure and show a more extended frequency range than groups 1 and 2, extending to about 500 Hz.
- Group 4 fish: Fishes that have special structures mechanically linking the swim bladder to the ear (e.g. clupeids such as herring (*Culpea harengus*), sprat (*Sprattus sprattus*) and shads). These fishes are sensitive primarily to sound pressure, although they also detect particle motion. These species have a wider frequency range, extending to several kHz and generally show higher sensitivity to sound pressure than fishes in Groups 1, 2 and 3.
- Sea Turtles: There is limited information on auditory criteria for sea turtles and the effect of impulsive noise is therefore inferred from documented effects to other vertebrates. Bone conducted hearing is the most likely mechanism for auditory reception in sea turtles and, since high frequencies are attenuated by bone, the range of hearing are limited to low frequencies only (Tonndorf, 1972). For leatherback turtle (*Dermochelys coracea*) the hearing range has been recorded as between 50 and 1,200 Hz with maximum sensitivity between 100 and 400 Hz (Piniak *et al*., 2012).
- Fish eggs and larvae: separated due to greater vulnerability and reduced mobility. Very few peer-reviewed studies report on the response of eggs and larvae to anthropogenic sound.

The guidelines of Popper *et al*. (2014) set out criteria for injury due to different sources of noise. Those relevant to the Development are considered to be those for injury due to impulsive piling (criteria for

which were used to assess impacts from geophysical surveys), seismic surveys, non-impulsive sources and explosives.

Where insufficient data exist to make a recommendation for guidelines Popper *et al.* (2014) adopted a subjective approach in which the relative risk of an effect was placed in order of rank at three distances from the source – near (N), intermediate (I), and far (F). While it was not appropriate to ascribe particular distances to effects because of the many variables in making such decisions, "near" might be considered to be in the tens of meters from the source, "intermediate" in the hundreds of meters, and "far" in the thousands of meters.

The *relative risk* of an effect was then rated as being "high," "moderate," and "low" with respect to source distance and animal type. No assumptions were made about source or received levels because there were insufficient data to quantify what these distances might be. However, in general the nearer the animal is to the source the higher the likelihood of high energy and a resultant effect. The rating for effects in these tables is highly subjective and represents general consensus within the National Oceanic and Atmospheric Administration (NOAA) panel Working Group (WG).

The criteria presented in the Washington State Department of Transport Biological Assessment Preparation for Transport Projects Advanced Training Manual (WSDOT, 2011) are also used in this AA for predicting the extent of behavioural effects due to impulsive piling. The manual suggests an un-weighted SPL of 150 dB re 1 µPa (rms) as the criterion for onset of behavioural effects, based on work by (Hastings, 2002). Temporary behavioural changes, such as elicitation of a startle response, disruption of feeding, or avoidance of an area are expected when this level is exceeded.

It is noted that the threshold is for onset of potential effects and not necessarily an 'adverse effect' threshold.

The criteria used in this noise assessment for impulsive piling are given in Table 6-4. Physiological effects relating to injury criteria are described below (Popper *et al*., 2014; Popper & Hawkins, 2016).

- Mortality and potential mortal injury: either immediate mortality or tissue and/or physiological damage that is sufficiently severe (e.g. a barotrauma) that death occurs sometime later due to decreased fitness. Mortality has a direct effect upon animal populations, especially if it affects individuals close to maturity.
- Recoverable injury: Tissue and other physical damage or physiological effects, that are recoverable, but which may place animals at lower levels of fitness, may render them more open to predation, impaired feeding and growth, or lack of breeding success, until recovery takes place.
- TTS: Short term changes in hearing sensitivity may, or may not, reduce fitness and survival. Impairment of hearing may affect the ability of animals to capture prey and avoid predators, and also cause deterioration in communication between individuals, affecting growth, survival, and

reproductive success. After termination of a sound that causes TTS, normal hearing ability returns over a period that is variable, depending on many factors, including the intensity and duration of sound exposure.

Table 6-4: Criteria for onset of injury to fish and sea turtles due to impulsive piling (Popper *et al*., 2014).

Type of Animal	Parameter	Mortality and Potential Mortal Injury	Recoverable Injury	TTS
Group 1 Fish: no swim bladder (particle motion detection)	SEL, dB re 1 μPa^2s	>219	>216	>>186
	Peak, dB re 1 µPa	>213	>213	-
Group 2 Fish: where swim bladder is not involved in hearing (particle motion detection)	SEL, dB re 1 μPa^2s	210	203	>186
	Peak, dB re 1 µPa	>207	>207	-
Groups 3 and 4 Fish: where swim bladder is involved in hearing (primarily pressure detection)	SEL, dB re 1 μPa^2s	207	203	186
	Peak, dB re 1 µPa	>207	>207	-
Sea turtles	SEL, dB re 1 μPa^2s	210	(Near) High (Intermediate) Low (Far) Low	(Near) High (Intermediate) Low (Far) Low
	Peak, dB re 1 µPa	>207		
Eggs and larvae	SEL, dB re 1 μPa^2s	>210	(Near) Moderate (Intermediate) Low (Far) Low	(Near) Moderate (Intermediate) Low (Far) Low
	Peak, dB re 1 µPa	>207		

The criteria used in this noise assessment for non-impulsive piling and other continuous noise sources are presented in Table 6-5. The only numerical criteria for these sources are for recoverable injury and TTS for Group 3 and Group 4 fish.

Table 6-5: Criteria for onset of injury to fish and sea turtles due to non-impulsive sound (Popper *et al*., 2014).

Type of animal	Mortality and potential mortal injury	Recoverable injury	TTS
Group 1 Fish: no swim bladder (particle motion detection)	(Near) Low (Intermediate) Low (Far) Lo w	(Near) Low (Intermediate) Low (Far) Low	(Near) Moderate (Intermediate) Low (Far) Low
Group 2 Fish: where swim bladder is not involved in hearing (particle motion detection)	(Near) Low (Intermediate) Low (Far) Low	(Near) Low (Intermediate) Low (Far) Low	(Near) Moderate (Intermediate) Low (Far) Low
Groups 3 and 4 Fish: where swim bladder is involved in hearing (primarily pressure detection)	(Near) Low (Intermediate) Low (Far) Low	170 dB re 1 µPa (rms) for 48 hours	158 dB re 1 µPa (rms) for 12 hours
Sea turtles	(Near) Low (Intermediate) Low (Far) Low	(Near) Low (Intermediate) Low (Far) Low	(Near) Moderate (Intermediate) Low (Far) Low
Eggs and larvae	(Near) Low (Intermediate) Low (Far) Low	(Near) Low (Intermediate) Low (Far) Low	(Near) Low (Intermediate) Low (Far) Low

The criteria used in this noise assessment for UXO clearance activities are given in Table 6-6. Although there is a numerical threshold defined for eggs and larvae, this is in terms of particle motion and therefore has not been assessed as part of this report as not suitably tested and reviewed propagation exists at this time.

Table 6-6: Criteria for injury to fish due to explosives (Popper *et al*., 2014).

Type of Animal	Parameter	Mortality and Potential Mortal Injury	Recoverable Injury	TTS
Group 1 Fish: no swim bladder (particle motion detection)	Peak, dB re 1 µPa	229 - 234	(Near) High (Intermediate) Low (Far) Low	(Near) High (Intermediate) Moderate (Far) Low
Group 2 Fish: where swim bladder is not involved in hearing (particle motion detection)	Peak, dB re 1 µPa	229 - 234	(Near) High (Intermediate) High (Far) Low	(Near) High (Intermediate) Moderate (Far) Low
Group 3 and 4 Fish: where swim bladder is involved in hearing (primarily pressure detection)	Peak, dB re 1 µPa	229 – 234	(Near) High (Intermediate) High (Far) Low	(Near) High (Intermediate) High (Far) Low
Sea turtles	Peak, dB re 1 µPa	229 – 234	(Near) High (Intermediate) High (Far) Low	(Near) High (Intermediate) High (Far) Low
Eggs and larvae	Peak velocity, mm s^{-1}	> 13	(Near) High (Intermediate) Low (Far) Low	(Near) High (Intermediate) Low (Far) Low

It should be noted that there are no thresholds in Popper *et al.* (2014) in relation to noise from high frequency sonar (>10 kHz). This is because the hearing range of fish species falls well below the

frequency range of high frequency sonar systems. Consequently, the effects of noise from high frequency sonar surveys on fish has not been conducted as part of this study, due to the frequency of the source being beyond the range of hearing and due to the lack of any suitable thresholds.

6.2.3 Source sound levels

6.2.3.1 Overview of modelling scenarios

The following modelling scenarios have been determined based on the project description and an identification of potential sources of noise:

- Geophysical site investigations.
- Vertical Seismic Profiler (VSP); and
- Clearance of UXO.

Noise from piling is not part of the assessment as there will be no piling activities within English TW or UK offshore waters. The Secretary of State has assessed the impacts from piling within Welsh TW within a separate HRA.

7 APPROPRIATE ASSESSMENT FOR DIADROMOUS FISH FEATURES OF THE DEE ESTUARY SAC AND OF THE RIVER DEE AND BALA LAKE SAC

The Dee Estuary SAC is designated for sea lamprey (*P. marinus)* and river lamprey (*L. fluviatilis)*.

The River Dee and Bala Lake SAC is designated for sea lamprey, river lamprey, and Atlantic salmon (*S. salar*).

The mechanism of impact requiring AA is the same for each of these features.

LSE could not be ruled out in Stage 1 of the HRA for the propagation of underwater noise from Development activities within English TW and UK offshore waters to the mouth of the Dee Estuary at levels that could cause disturbance to diadromous fish features and thereby have an adverse effect on their migration from the SAC into open waters or their return.

The assessment considers noise generated by UXO clearance and by survey equipment.

UXO clearance is restricted to the construction phase whereas surveys may be undertaken for construction, operation and/or decommissioning phases.

7.1 Dee Estuary SAC

The Dee Estuary SAC is located within the Dee Estuary, which is one of the largest estuaries in the UK, with an intertidal area primarily comprising extensive mudflat and sandflat areas and some saltmarsh habitat. It overlaps with the Development where the offshore cable connects to the shore. The estuary is hypertidal giving rise to a mean tidal range of 7.7 m. The intertidal mud flats of the sheltered inner estuary in particular support populations of marine worms, molluscs, and other invertebrates, which often occur at high densities and with high biomass.

The Dee Estuary is also used as a migratory passage for migratory fish species including river lamprey, sea lamprey, Atlantic salmon, sea trout (*Salmo trutta)*, twaite shad (*Alosa fallax)*, smelt (*Osmerus eperlanus)*, and European eel (*Anguilla anguilla)* to and from their spawning and nursery grounds in the River Dee (Natural England and NRW, 2010).

7.1.1 Conservation Objectives

The conservation objective for the sea lamprey and river lamprey features of the site is to maintain the features in a favourable condition through ensuring the following (Natural England, 2018):

- The migratory passage of both adult and juvenile sea lamprey and river lamprey through the Dee Estuary between Liverpool Bay and the River Dee is unobstructed by physical barriers and/or poor water quality.

- The five year mean counts recorded by the Chester Weir fish trap is no less than 18 sea lampreys and no less than 55 river lampreys under the monitoring regime in use prior to notification.
- The abundance of prey species forming the sea lamprey's and river lamprey's food resource within the estuary is maintained.

Of relevance to this assessment is the condition of migratory access, in this case the potential physical barrier being underwater noise.

7.2 River Dee and Bala Lake SAC

The River Dee and Bala Lake SAC encompasses the Bala Lake and its banks and outfalls into the River Dee and, at its closest, is located 22.5 km from the Development.

The SAC extends downstream to where it joins the Dee Estuary SAC. Several Dee tributaries are also included within the site, specifically the Ceiriog, Meloch, Tryweryn, and Mynach.

Atlantic salmon is a primary reason for the selection of the River Dee and Bala Lake SAC, with the Mynach, Meloch and Ceiriog tributaries being the most prevalent salmon spawning tributaries in the Dee catchment.

Other diadromous fish species include river lamprey and sea lamprey which are present as qualifying features but are not a primary reason for site selection.

7.2.1 Conservation Objectives

The vision for all three features of the site is for them each to be in a favourable conservation status, where all of the following conditions are satisfied:

- The parameters defined in the vision for the watercourse must be met;
- The SAC feature populations will be stable or increasing over the long term;
- The natural range of the features in the SAC is neither being reduced nor is likely to be reduced for the foreseeable future.
- There will be no reduction in the area or quality of habitat for the feature populations in the SAC on a long term basis; and
- All known, controllable factors, affecting the achievement of these conditions are under control (many factors may be unknown or beyond human control).

Of relevance to this assessment is control of factors affecting the migration of the features from the SAC, via the Dee Estuary, into open waters such that this does not impact the stability of the features' populations within the site.

7.3 Feature Accounts – Dee Estuary SAC & River Dee and Bala Lake SAC

7.3.1 Atlantic salmon

Atlantic salmon spawn in freshwater but complete their life cycle in the sea. They spend two to three years in freshwater, with downstream migration to open sea occurring between April and May. Atlantic salmon remain at sea for one to three years. Upstream migration into freshwater occurs year round, with a peak in late summer/early autumn (NRW, 2022a).

7.3.2 Sea lamprey

The sea lamprey is the largest and least common of the three lamprey species found in the UK. It occurs in estuaries and easily accessible rivers (JNCC, 2023a).

Sea lamprey larvae spend several years in silt beds of rivers before metamorphosing and migrating downstream to the sea. They grow to maturity in the sea and then migrate into fresh water to spawn (Natural England and Countryside Council for Wales, 2010).

As adults, sea lamprey parasitises other fish by sucking their blood and other body fluids.

Relatively little is known about the precise habitats occupied by adult sea lamprey, but it is thought to occur over much of the North Atlantic, both in shallow coastal waters and deep offshore.

Sea lampreys are present in the River Dee and thus the Dee Estuary forms an essential part of their migratory route. Records of sea lamprey caught at the fish trap at Chester Weir indicate that mature adults migrate upstream almost exclusively during the months of May and June (Potter & Hatton-Ellis, 2003).

7.3.3 River lamprey

The river lamprey is found in coastal waters, estuaries and accessible rivers. The species is normally anadromous although some populations are permanent freshwater residents (JNCC, 2023b).

As adults, river lamprey are parasitic, feeding by attaching to the sides of other fish. They live on hard bottoms or attached to larger fish such as cod (*Gadus morhua*) and herring due to their parasitic feeding behaviour.

On reaching sexual maturity, the adult lamprey stops feeding and migrate up stream to their spawning grounds. After spawning it is thought that they die.

After hatching, the young, elongate larvae swim or are carried downstream by the flow to areas of depositional sediments in slow flowing water. Where the gradient of a river is low there may be little downstream movement, in such circumstances the larvae burrow within the river sediment where they spend the next few years feeding and growing larger. They migrate downstream, away from the nursery areas and into the estuary where they may remain for some time to allow their osmoregulatory mechanisms to acclimatise to increased salinity before moving offshore to feeding grounds.

River lamprey from the site use the Dee Estuary as part of their migratory route.

Although considerable information is available on the biology of the river lamprey in freshwater, much less is known about its habits in estuaries and the sea (Maitland, 1997).

Records of river lamprey caught at the fish trap at Chester weir indicate that mature adults undertake their upstream migration at two different periods of the year, either early spring (March to April) or late summer/autumn (August to November) (Natural England and Countryside Council for Wales, 2010).

7.4 Assessment of Noise Effects on Migration

Lampreys are known to have relatively simple ear structures (Popper and Hoxter, 1987). They have been recorded to demonstrate very few responses to auditory stimuli overall (Popper, 2005), except a slight increase in swim speed and decrease in resting behaviour when exposed to continuous low frequency sound of 50 to 200 Hz (Mickle *et al*., 2018). This suggests that they have a low vulnerability to underwater noise impacts overall and is in keeping with the classification of both species of lampreys as Group 1 fish (Popper *et al*., 2014), which lack swim bladders, are not sensitive to sound pressure and show sensitivity to only a narrow band of frequencies.

Salmonids are categorised as Group 2 fish, as they have a swim bladder which does not play a role in hearing. These species are considered more sensitive to particle motion than sound pressure and show sensitivity to only a narrow band of frequencies. Physiological or behavioural responses were not observed in Atlantic salmon when subjected to noise from a source similar to that of piling, although at reduced noise levels estimated to be <160 dB re 1 µPa rms (Harding *et al*., 2016).

7.4.1 UXO clearance

The Developer has undertaken noise modelling to assess impacts to fish and marine mammals from UXO clearance. The precise details and locations of potential UXOs is unknown at this time and will only be required if pre-construction surveys identify UXO that cannot be avoided.

Where UXO are identified the Developer has stated that it will follow the provisions of the interim joint position statement on UXO clearance (UK Government, 2022), which includes the requirement to prioritise the use of low noise alternatives to high order detonation. The UXO joint position statement has recently been published (UK Government, 2025). However, as it is acknowledged that high order detonation may be necessary in some limited instances, the Developer has assessed worst case scenarios including high order detonation.

In their assessment, the Developer considered a MDS to be clearance of 907 kg UXO size, cleared by either low order or high order techniques. The MDS accounts for up to one UXO clearance within 24 hours, and a total duration of clearance activities of 12 days.

During the worst-case scenario of high order clearance of 907 kg UXO size, the modelling concluded that, utilising the thresholds highlighted in Table 6-6 (229 – 234 dB re 1 µPa), injury may be experienced up to 985 m from the source for all fish groups.

UXO clearance in the Development area of physical works lying within English TW are at least 20 km from the mouth of the Dee Estuary and therefore noise, even from the worst case UXO clearance, would not deter Atlantic salmon sea lamprey or river Lamprey from migrating into or out of the Dee Estuary.

7.4.2 Geophysical surveys

Geophysical surveys may be required throughout the project lifetime, although individual survey campaigns are likely to be short term and spatially limited at any one time.

Surveys may make use of various types of equipment that give rise to different noise source types and levels.

The Developer has identified VSP surveys as having the potential to cause effects on diadromous fish over the widest area.

Noise modelling indicates that VSP may result in mortality/recoverable injury at ranges of up to 26 m for Group 1 fish (based on 213 dB re 1 µPa threshold stated in Table 6-4) and 54 m Groups 2, 3 and 4 fish (based on 207 dB re 1 µPa threshold stated in Table 6-4). The modelling further concluded that there is potential for TTS up to 2,653 m for all fish Groups when utilising the 150 dB re 1 µPa threshold stated in Section 6.2.2.

7.5 Conclusion

Noise modelling was undertaken to determine the range of potential effects on fish species due to noise associated with the Development. The modelling demonstrated that the greatest TTS identified was 2,653 m in response to VSP, for all fish Groups, and both SACs are over 20 km from the Development. Sources of underwater noise associated with the Development within English TW or UK offshore waters are therefore not predicted to cause disturbance to designated lamprey (Group 1 fish) or Atlantic salmon (Group 2 fish) species of the Dee Estuary SAC and the River Dee and Bala Lake SAC.

8 MARINE MAMMAL ASSESSMENT CRITERIA AGAINST IAMMWG MMMU'S

The HRA Stage 1 (LSE) concluded that there is a potential LSE to four species of marine mammals, including harbour porpoise, bottlenose dolphin, grey seal, and harbour seal (Table 3-1).

Given the transient nature of marine mammals their presence is not limited to designated areas within which they are protected. It is reasonable, therefore, to assume that should an activity occur outside a site, marine mammal features of the sites (several of them rather than just the occasional individual) could travel to and thus be impacted by that activity.

NRW's position on the use of Marine Mammal Management Units (MMMUs) for screening and assessment in HRAs for SACs with marine mammal features has been adopted in this AA.

It is generally considered that there is the potential for MMMU to be 'functionally linked' to SACs given, in most cases, the evidence demonstrating the degree of connectiveness and the fact that SACs are dependent on the wider population within the MMMU and represent special areas of sea within it (Chapman & Tyldesley, 2016; NRW, 2022b). When considering LSEs on site features from offsite impacts, it must be considered whether the marine mammal qualifying feature can reach the impact and in doing so whether it would be adversely affected in relation to the conservation objectives of the site and not just whether the impact occurs inside or overlaps with the site.

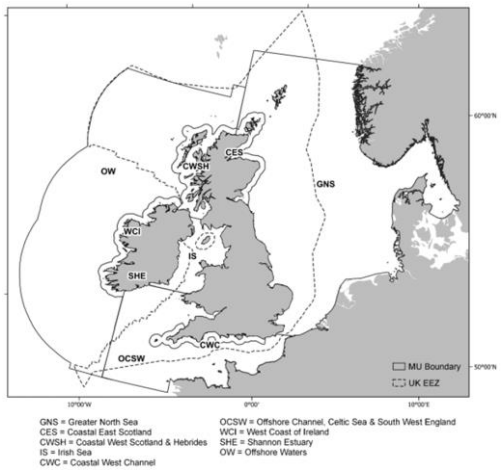
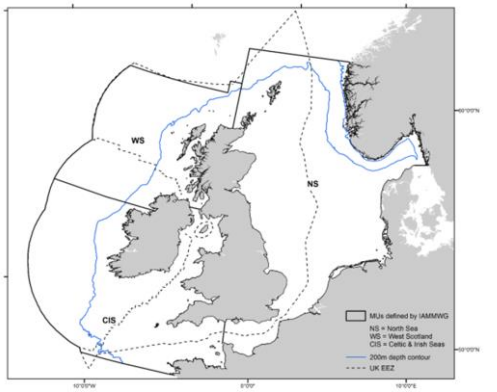
In addition, JNCC advise that it is not appropriate to use the designated site population estimates in any assessments of effects of plans or projects (i.e. HRAs), as it is necessary to take into consideration population estimates at the MMMU level to account for daily and seasonal movements of the animals (JNCC 2017c; JNCC and NE 2019).

Since 2012, the Inter-Agency Marine Mammal Working Group (IAMMWG), comprising representatives of the UK's Statutory Nature Conservation Bodies (SNCBs) - Natural England, Scottish Natural Heritage (SNH), NRW, Department of Agriculture, Environment and Rural Affairs (DAERA) and JNCC – have developed and proposed MMMUs for the seven most common cetacean species around the UK (Table 8-1). These were approved by the SNCBs' Chief Scientist Group and published in 2015 (IAMMWG, 2015) and have been adopted by SNCBs as the relevant spatial scales for conservation advice on key cetacean species in UK waters.

There are no formal thresholds at which impacts on site integrity are considered to be adverse. However, a threshold of 1.7 % mortality of the relevant harbour porpoise population above which a population decline is inevitable has been agreed with Parties to the Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas (ASCOBANS), with an intermediate precautionary objective of reducing the impact to less than 1 % of the population (Defra 2003; ASCOBANS, 2015). This threshold relates to impacts from fisheries by-catch on harbour porpoise where the impact on the harbour porpoise is permanent, i.e. up to 1.7 % of the population may be caught as by-catch before a population decline

is inevitable. An equivalent level of impact from disturbance, which is temporary and non-lethal, on a population will have a lower level of impact on the population compared to that from a fisheries by-catch.

Table 8-1: Marine mammal management units.

Species	MMMU	Map
Bottlenose dolphin	Irish Sea (IS; International Council for the Exploration of the Sea (ICES) Division 7a)	
Harbour porpoise	Celtic and Irish Seas (CIS; comprising ICES Subareas 6, excluding 6a and 6b, and 7, except 7d)	

Seal MMMUs were also developed by the IAMMWG at the same time but due to differences in how seals were managed in some parts of the UK (e.g., licensing in Scotland), seal MMMUs were not officially published, and further work is required to develop these. Although draft IAMMWG grey seal management units have been used in previous applications and NRW advice, IAMMWG do not currently advocate their use. Until these are better defined by the IAMMWG, NRW suggest the use of the Oslo and Paris Convention (OSPAR) Region III: Celtic Seas area as the appropriate interim management unit (Figure 8-1). Based on the best available evidence, this area reflects the most appropriate spatial scale of seal movements in the region, and currently the most plausible option among various management unit possibilities.

Figure 8-1: Example grey seal management units: OSPAR Region III: Celtic Seas (left); Draft IAMMWG management unit (right) (NRW, 2022b).

Given that the AA is at MMMU level (rather than by individual European site), the following four sections consider each marine mammal species in turn. The conclusion for each species is applicable to all sites within the respective MMMU.

9 APPROPRIATE ASSESSMENT FOR BOTTLENOSE DOLPHIN

9.1 Feature Account

The Annex II species bottlenose dolphin is a qualifying feature for two of the European sites for which LSEs were considered, Lleyn Peninsula and the Sarnau SAC and the Cardigan Bay SAC (Table 3-1).

Two distinct ecotypes of bottlenose dolphin are recognised in UK waters – a wide-ranging offshore type, and a more philopatric inshore type (Louis *et al*., 2014). A number of inshore groups (considered inshore populations) have been identified in UK and Irish waters and there is limited interchange between them (Robinson *et al*., 2012; Cheney *et al*., 2013; ICES, 2014; IAMMWG, 2015; Lohrengel *et al*., 2018). Seven MMMUs in UK waters are currently recognised for bottlenose dolphin. The bottlenose dolphin MMMU relevant to this HRA is the Irish Sea (IS; ICES Division 7a) MMMU (Table 8-1).

Lleyn Peninsula and the Sarnau SAC is the closest protected site designated for bottlenose dolphin to the proposed activities. Bottlenose dolphins do not form a discrete site-based population within the Lleyn Peninsula and the Sarnau SAC but are seen as part of a wider population that ranges across waters of south-west UK, Ireland and particularly the Cardigan Bay (NRW, 2018). The number of individuals increases during the summer months, as does group size reaching a peak in late September and October when quite large aggregations of more than 60 individuals may be seen (NRW, 2018). Calving has been documented within Cardigan Bay and newborn and very young calves have been reported in the bay from April to September, suggesting a seasonal pattern to calving (NRW, 2018).

The proposed activities fall within the Small Cetacean Abundance in the North Sea (SCANS) SCANS-IV block CS-E for which the bottlenose dolphin population is shown in

Table 9-1. The size and boundaries of survey blocks were determined partly by logistics but also to encompass designated/proposed protected areas or other areas of high probability of species occurrence in some cases. SCANS-IV surveys in 2022 estimated that CS-E supports *c*. 127 individuals for at least part of the year and represents *c*. 43% of the population within CIS MMMU (Gilles *et al*., 2023).

The abundance estimates of bottlenose dolphins in the IS MMMU are listed in

Table 9-1.

Table 9-1: Abundance estimates of bottlenose dolphins in the IS MMMU (IAMMWG, 2023).

MMMU	Abundance of animals in MMMU	95% Confidence interval for MMMU	Abundance of animals in the UK portion of MMMU	95% Confidence interval for UK portion of MMMU	Source
IS	293	108 – 793	186[a&b]	70 – 492	Rogan *et al.*, 2018; Hammond *et al.*, 2021.
Note: Estimates of inshore populations from regional line-transect (identified with [a]) and photo-identification (identified with [b]) studies.					

9.2 Conservation Objectives

The vision for bottlenose dolphins within both Lleyn Peninsula and the Sarnau SAC and the Cardigan Bay SACs is for them to be in a favourable conservation status, where all of the following conditions are satisfied (NRW, 2018c; NRW, 2018a):

- Populations - The population is maintaining itself on a long-term basis as a viable component of its natural habitat.
- Range - 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.
- Supporting habitats and species - 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.
- Restoration and recovery - As part of this objective, it should be noted that for the bottlenose dolphin populations should be increasing.

Bottlenose dolphin has been given an indicative conservation assessment of favourable status within both the Lleyn Peninsula and the Sarnau SAC (NRW, 2018d) and the Cardigan Bay SACs (NRW, 2018b).

9.3 Potential Noise Impact

Noise modelling presented by the Developer (Liverpool Bay CCS Ltd, 2024) revealed that bottlenose dolphin was unlikely to be affected by the noise generated by the Development.

The maximum distance over which noise from disposal of the largest ordnance assessed (907 kg) would cause injury to bottlenose dolphin was determined to be 890 m. Disturbance of bottlenose dolphin may extend to 1,635 m from the point of detonation.

Neither the area of potential injury nor of disturbance overlaps with either the Lleyn Peninsula and the Sarnau SAC or the Cardigan Bay SAC, which are 115 km and 122 km respectively from the Development area of physical works.

Based on the modelled range of potential disturbance, and a density of bottlenose dolphin in the East Irish Sea established from either SCANS-III or SCANS-IV data, less than one individual might be expected to be disturbed (see APPENDIX A, Table A-2; Table A-4) while ranging freely within the Irish Sea, beyond either SAC.

If a single animal were to be disturbed this would equate to 0.34% of the MMMU population.

Potential impacts on bottlenose dolphin, with respect to the relevant conservation objectives, as result of UXO clearance include:

- Prolonged behavioural disturbance as a result of underwater noise may have an effect on reproductive success of some individuals.
- Though bottlenose dolphin range within the site will not be constrained, the accessibility to other areas within the Irish sea may be hindered during the UXO clearance due to barrier effects.

Given the short-term duration of impact (elevated sound) for each UXO detonation is very short (seconds), and the reversibility of the disturbance effect, it can be anticipated that bottlenose dolphin would be able to tolerate the effect without any impact on reproduction or survival rates, and with the ability to return to previous behavioural states or activities once the impacts had ceased. Underwater noise associated with UXO clearance is not predicted to occur at levels that could adversely affect the restoration and recovery of bottlenose dolphin population.

9.4 Conclusion of Assessment for Bottlenose Dolphin

OPRED has concluded that the disturbance effects on bottlenose dolphin from underwater noise generated by Development activities outside of Welsh TW will not lead to an adverse effect on the integrity of Lleyn Peninsula and the Sarnau SAC or of Cardigan Bay SAC.

However, depending on the number and size of UXO clearances to be performed, there is potential for underwater noise to cause injury to a significant proportion of the population of bottlenose dolphin during the years of construction if no mitigation was employed. Were this to happen it would compromise achievement of conservation objectives of maintaining the abundance of the species within a site.

Whereas a single event may be consistent with maintaining the viability of the population, multiple high order clearances could result in a decline.

Whereas the population may recover from any effects in subsequent years, the potential for adverse effect on the integrity of the sites designated for bottlenose dolphin cannot be ruled out.

The likelihood of any injury to marine mammals is however extremely small as the Developer will be required to employ standard marine mammal mitigation measures which will ensure any marine mammal is not within the zone of potential injury during any detonation.

It must be incumbent on the Developer to assess every UXO that it identifies on a case-by-case basis to establish the least impactful solution for each. Opportunities to avoid the need for clearance should be seen as optimal. Where avoidance is not feasible, and clearance is essential, methods that minimise noise generation shall be prioritised and methods to suppress the propagation of noise shall be implemented. In addition, the Developer will be required to employ mitigation measures which avoid the risk of injury to marine mammals

Further assessment of impacts to bottlenose dolphin will be required to enable OPRED to evaluate each application for a marine licence to undertake UXO clearance.

10 APPROPRIATE ASSESSMENT OF HARBOUR PORPOISE

10.1 Feature Account

Harbour porpoise is a qualifying feature for six of the European sites for which LSEs were considered, specifically North Anglesey Marine SAC, North Channel SAC, West Wales Marine SAC, Bristol Channel Approaches SAC, Rockabill to Dalkey Island SAC, Roaringwater Bay and Islands SAC (Table 3-1).

The harbour porpoise MMMU relevant to this HRA is the Celtic and Irish Sea (CIS) (comprising ICES Subareas 6, excluding 6a and 6b, and 7, except 7d) MMMU (Table 8-1).

The North Anglesey Marine SAC is the closest protected site (40 km), to the proposed activities, for which harbour porpoise are a qualifying feature. Harbour porpoise is the most common and widespread cetacean in Welsh waters with hot spots identified off the Pembrokeshire coast, the Lleyn Peninsula (to a lesser extent), in southern Cardigan Bay and in the Bristol Channel off the south coast of Wales (around the Gower Peninsula and in Newport Bay) (Baines & Evans, 2012). The North Anglesey Marine site was identified as being within the top 10% of persistently high-density areas for harbour porpoise in UK waters during the summer season (Heinänen & Skov, 2015). There is an indication that the harbour porpoises within the CIS MU prefer water depths shallower than 40 m (NRW & JNCC, 2016). The SCANS-IV surveys in 2022 estimated that the site supports *c.* 6,325 individuals for at least part of the year and represents *c*. 10% of the population within CIS MMMU (Gilles *et al*., 2023).

The abundance estimates of harbour porpoise in the CIS MMMU are listed in Table 10-1.

Table 10-1: Abundance estimates of harbour porpoise in the CIS MMMU (IAMMWG, 2023).

MMMU	Abundance of animals in MMMU	95% Confidence interval for MMMU	Abundance of animals in the UK portion of MMMU	95% Confidence interval for UK portion of MMMU	Source
CIS	62,517	48,324 – 80,877	16,777	11,216 – 25,096	Rogan *et al*., 2018; Hammond *et al*., 2021.

10.2 Conservation Objectives

The vision for harbour porpoise within North Anglesey Marine SAC (JNCC et al., 2019c), North Channel SAC (JNCC and DAERA, 2019), West Wales Marine SAC (NRW and JNCC, 2019), and Bristol Channel Approaches SAC, is for them to be in a favourable conservation status, where all of the following conditions are satisfied:

- Harbour porpoise is a viable component of the site;

- There is no significant disturbance of the species. For example, noise disturbance within a SAC from a plan/project individually or in-combination is significant if it excludes harbour porpoises from more than:
  - 20% of the relevant area of the site in any given day; and
  - an average of 10% of the relevant area of the site over a season.
- The condition of supporting habitats and processes, and the availability of prey is maintained.

The harbour porpoise conservation objectives for Rockabill to Dalkey Island SAC, and Roaringwater Bay and Islands SAC, are:

- Access to suitable habitat – The species range within the site should not be restricted by artificial barriers to site use.
- Disturbance - Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site.

10.3 Potential Noise Impacts

The Developer has presented modelling of noise impacts to harbour porpoise from UXO clearance and for a variety of equipment that may be utilised during seismic and geophysical surveys.

Based on thresholds suggested in Southall *et al.* (2019), clearance of the largest ordnance considered (907 kg) was predicted to have the potential to cause injury to harbour porpoise up to a distance of 15,370 m.

Based on the thresholds for mild disturbance proposed in NMFS (2005) clearance of the largest ordnance considered was predicted to have the potential to cause disturbance up to 28,320 m from the point of detonation.

Neither of these ranges overlap with any of the Irish Sea SACs for which harbour porpoise is a designated feature.

Applying the ranges for injury and disturbance to the density of harbour porpoise established from SCANS-IV (Giles *et al*, 2023) suggests that 383 animals could suffer injury and 1,299 animals show mild disturbance from noise generated by this size of UXO clearance (Table A-2; Table A-4). This represents 0.61% and 2.08% of the MMMU population respectively.

Based on the approach in NRW guidance (NRW, 2023), the disturbance range for clearance of a 907 kg UXO would be 8,925 m and have the potential to cause disturbance to 129 animals (Table A-5), or 0.21% of the MMMU population.

The Developer modelled the potential for injury and disturbance to harbour porpoise from survey equipment including multibeam echo sounder (MBES), sub-bottom profiler (SBP) and vertical seismic profiler (VSP). All of which may potentially be used prior to or during construction, during the Development operation phase and around the time of decommissioning.

The greatest distance over which injury to harbour porpoise could extend was predicted to be 345 m, from MBES. Given the density of harbour porpoise (0.515 animals per km^2), injury to less than one animal would be anticipated.

The greatest distance over which mild disturbance to harbour porpoise could extend was predicted to be 13 km, from VSP. On this basis, 274 animals (

Table A-8) may be expected to suffer mild disturbance during the operation of VSP. This equates to 0.44 % of the MMMU population.

Based on NRW guidance (2023), noise from VSP could cause disturbance to harbour porpoise within 7,500 m which could have an effect on 92 animals (

Table A-9), equating to 0.15% of the MMMU population.

Underwater noise from UXO clearance and survey equipment sources will not result in significant disturbance as it is defined in the SAC conservation objectives with respect to daily or seasonal proportions of an SAC affected.

Conservation objectives for Rockabill to Dalkey Island SAC and Roaringwater Bay and Islands SAC refer to disturbance within the sites and to maintaining access within the sites. As there is no overlap between areas of disturbance and the sites, these activities will not prevent achievement of the objectives.

Conservation objectives pertaining to the viability of the harbour porpoise population could in principle be compromised if there were:

- Injury to a significant proportion of the population.
- Prolonged behavioural disturbance such as to have an effect on the reproductive success of some individuals; or
- Disturbance to foraging, given that harbour porpoise needs to forage frequently.

The potential for UXO clearance to cause injury to up to 0.61% of the CIS population of harbour porpoise is, in isolation, below the ASCOBANS (2015) threshold of 1.7% mortality beyond which a population decline is deemed to be inevitable. Whereas a single event may therefore be consistent with achieving the conservation objectives for the respective SACs, multiple events of this scale could cause a decline in the CIS harbour porpoise population and, consequently, have an adverse effect on the integrity of this feature of the six sites within the CIS.

Conversely, the disturbance affects from UXO clearance are short lived and reversible. OPRED is satisfied that this would not cause significant disturbance to foraging of harbour porpoise within the CIS, nor be sufficiently prolonged to impair reproductive success.

There will be 2 to 5 surveys geophysical and seismic surveys during 25-year operational phase, with each survey up to six months in duration depending on weather downtime. The highest noise source from these surveys could cause mild disturbance to 274 animals using the most conservative estimation

method. Although harbour porpoises need to forage frequently and are vulnerable to disturbance if their foraging is interrupted, behavioural effects may take place only outside of the site boundary and are reversible. OPRED is satisfied that this would not compromise the viability of the harbour porpoise population.

10.4 Conclusion of Assessment for Harbour Porpoise

OPRED has concluded that the disturbance effects on harbour porpoise from underwater noise generated by Development activities outside of Welsh TW will not lead to an adverse effect on the integrity of North Anglesey Marine SAC, North Channel SAC, West Wales Marine SAC, Bristol Channel Approaches SAC, Rockabill to Dalkey Island SAC or Roaringwater Bay and Islands SAC.

However, depending on the number and size of UXO clearances to be performed, there is potential for underwater noise to cause injury to a significant proportion of the CIS population during the years of construction if no mitigation measures are employed.

Whereas a single event may be consistent with maintaining the viability of the population, multiple high order clearances could result in a decline.

Whereas the population may recover from any effects in subsequent years, the potential for adverse effect on the integrity of the CIS sites designated for harbour porpoise cannot be ruled out, if no mitigation measures are employed.

The likelihood of any injury to marine mammals is however extremely small as the Developer will be required to employ standard marine mammal mitigation measures which will ensure any marine mammal is not within the zone of potential injury during any detonation.

It must be incumbent on the Developer to assess every UXO that it identifies on a case-by-case basis to establish the least impactful solution for each. Opportunities to avoid the need for clearance should be seen as optimal. Where avoidance is not feasible, and clearance is essential, methods that minimise noise generation shall be prioritised and methods to suppress the propagation of noise shall be implemented. In addition, the Developer will be required to employ mitigation measures which avoid the risk of injury to marine mammals

Further assessment of impacts to harbour porpoise will be required to enable OPRED to evaluate each application for a marine licence to undertake UXO clearance.

11 APPROPRIATE ASSESSMENT OF GREY SEAL

11.1 Feature Account

Grey seal is a qualifying feature for five of the European sites for which LSEs were considered, specifically Lleyn Peninsula and the Sarnau SAC, Maidens SAC, Pembrokeshire Marine SAC, Lundy SAC, Saltee Islands SAC (Table 3-1).

The closest site to the Development area of physical works is the Lleyn Peninsula and the Sarnau SAC which is approximately 115 km distant at its closest point. Nevertheless, grey seals associated with each site are considered as part of the same population.

NRW suggest the use of the Oslo and Paris Convention (OSPAR) Region III: Celtic Seas area as the appropriate interim management unit for HRA. This is shown in Figure 8-1.

Grey seals associated with the Lleyn Peninsula and the Sarnau SAC range throughout the open coast areas of the SAC and beyond but are commonly observed within the SAC around the Llŷn, Bardsey Island and the islands along the south Llŷn coast (NRW, 2018c). Grey seals present within the SAC are thought to be a part of a wider north Wales population. The site contains several important pupping sites which are located around the north-west of the SAC including Bardsey Island, with the majority of pups born from September to October, but with some pupping activity occurring from early August to the end of November (NRW, 2018c). Haul out sites are distributed throughout the SAC and non-pupping seals are present year round at these haul out sites. Haul out sites are predominantly located on intertidal rocky outcrops, rock and boulder/cobble beaches, sea caves that are tidally exposed, and occasionally sandy beaches and tidally exposed sandflats (NRW, 2018c).

The abundance estimates of grey seals in regions of the UK and Ireland of relevance to the sites identified for AA are presented in Table 11-1.

Table 11-1: Abundance estimates of grey seal in relevant regions of the UK and Ireland.

MMMU	Density (animals per km²)	Abundance of animals in MMMU	Source
Wales	0.467 – 4.06[1]	3,766	Carter *et al.*, 2022
NW England		1,046	
Northern Ireland		2,113	
Southwest Scotland		2,163	
Isle of Man estimate		400	
East of Ireland		1,749	
Southeast of Ireland		2,326	
OSPAR Region III		60,780	

[1] Carter *et al* (2022) – average and maximum densities calculated to per km² using absolute mean values for cells overlapping with the Proposed Development marine mammal study area.

11.2 Conservation Objectives

For all five sites, the vision for grey seals is for them to be in a favourable conservation status, where all of the conservation objectives for each site are satisfied.

The conservation objectives for each site are worded differently to suit individual site conditions but can be summarised as being to maintain:

- Population numbers and distribution.
- Their range within the SAC and adjacent inter-connected areas without constraint or hinderance.
- Physical features, such as breeding sties, haul out sites for resting and moulting.
- Structure, function, extent and distribution of supporting habitats.
- Levels of human activity below that which could adversely affect the grey seal community.

11.3 Potential Noise Impacts

The Developer has presented modelling of noise impacts to grey seal from UXO clearance and for a variety of equipment that may be utilised during seismic and geophysical surveys.

Clearance of the largest ordnance considered (907 kg) was predicted to have the potential to cause injury to grey seal up to a distance of 3,015 m, and to have the potential to cause disturbance up to 6,470 m from the point of detonation.

Neither of these ranges overlap with any SAC for which grey seal is a designated feature.

Applying the ranges for injury and disturbance to the maximum density of grey seal in areas overlapping the Development area established from Carter *et al*, (2022) suggests that 115 animals could suffer injury and 534 animals show mild disturbance from noise generated by this size of UXO clearance (Table A-2; Table A-4). This represents 0.19% and 0.88% of the OSPAR Region III population respectively.

The Developer modelled the potential for injury and disturbance to grey seal from survey equipment including multibeam echo sounder (MBES), sub-bottom profiler (SBP) and vertical seismic profiler (VSP). All of which may potentially be used prior to or during construction, during the Development operation phase and around the time of decommissioning.

The greatest distance over which injury to grey seal could extend was predicted to be 40 m, from SBP. Given the upper range value or the density of grey seal in the Development area (4.06 animals per km^2), injury to less than one animal would be anticipated.

The greatest distance over which mild disturbance to grey seal could extend was predicted to be 13 km, from VSP. On this basis, 2,155 animals (

Table A-8) may be expected to suffer mild disturbance during the operation of VSP. This equates to 3.5% of the OSPAR Region III population. This is almost certainly an overestimate given that the population estimate for NW England is 1,046 (Table 11-1).

Areas of noise impact from Development activities outside of Welsh TW are a least 100 km from all sites for which grey seal is a qualifying feature. There is no risk of adverse impact on the condition of the species within the sites, this includes at supporting shoreline habitats necessary for breeding, moulting and resting.

Some grey seals may be present outside of the sites and could be injured due to noise from high order UXO clearance, by suffering a PTS to their hearing ability. For those individuals affected, PTS could impair their ability to communicate and to hunt, potentially reducing there likelihood of breeding and their life expectancy. The Developer's modelling suggests that a single event may cause PTS in up to 0.19% of the regional population of grey seal.

Whereas a single event may not compromise the achievement of the conservation objectives pertaining to population size and range of each site, multiple events of this scale could cause a decline in the OSPAR Region III population and, consequently, have an adverse effect on the integrity of this feature of the five sites.

Mild disturbance to grey seals may deter animals from utilising the full extent of the Irish Sea area outside of the sites and, if prolonged, behavioural disturbance as a result of underwater noise may have an effect on reproductive success of some individuals. Given the short duration of the impact and the reversibility of the effect, it is unlikely that mild disturbance from noise would compromise achievement of conservation goals for grey seal.

11.4 Conclusion of Assessment for Grey Seal

OPRED has concluded that the disturbance effects on grey seal from underwater noise generated by Development activities outside of Welsh TW will not lead to an adverse effect on the integrity of Lleyn Peninsula and the Sarnau SAC, Maidens SAC, Pembrokeshire Marine SAC, Lundy SAC or Saltee Islands SAC.

However, depending on the number and size of UXO clearances to be performed, there is potential for underwater noise to cause injury to a significant proportion of the OSPAR Region III grey seal population during the years of construction if no mitigation measures are employed.

Whereas a single event may be consistent with maintaining the viability of the population, multiple high order clearances could result in a decline.

Whereas the population may recover from any effects in subsequent years, the potential for adverse effect on the integrity of the sites designated for grey seal cannot be ruled out if no mitigation measures are employed.

It must be incumbent on the Developer to assess every UXO that it identifies on a case-by-case basis to establish the least impactful solution for each. Opportunities to avoid the need for clearance should be seen as optimal. Where avoidance is not feasible, and clearance is essential, methods that minimise noise generation shall be prioritised and methods to suppress the propagation of noise shall be implemented. In addition, the Developer will be required to employ mitigation measures which avoid the risk of injury to marine mammals

Further assessment of impacts to grey seal will be required to enable OPRED to evaluate each application for a marine licence to undertake UXO clearance.

12 APPROPRIATE ASSESSMENT FOR HARBOUR SEAL

12.1 Feature Account

Harbour seal is a qualifying feature for two of the European sites for which LSEs were considered, Strangford Lough SAC and Murlough SAC (Table 3-1).

Both sites are located on the Northern Ireland coast and, at their closest, are 115 km and 143 km from the Development area.

A review conducted by Culloch *et al.* (2018) reported that in Strangford Lough, there was a 2.01% and a 1.31% annual decrease in harbour seal adults and pups, respectively (using data from 1995 to 2014, inclusive). The Murlough SAC is recognised as an important haul out site for harbour seal with yearly maximum counts of 141 individuals. With a 25% maximum decline from the baseline values, a target to maintain a favourable condition of 106 individuals is set (DAERA, 2018).

The abundance estimates of harbour seals in regions of the UK and Ireland that are relevant to Strangford Lough SAC and Murlough SAC are presented in Table 12-1.

Table 12-1: Abundance estimates of harbour seal in relevant regions of the UK and Ireland

MMMU	Density (animals per km^2)	Abundance of animals in MMMU	Source
Wales	0.0049 – 0.593[1]	14	Carter *et al., 2022*
NW England		7	
Northern Ireland		1,406	
Isle of Man		No estimate	

[1] Carter *et al* (2022) – average and maximum densities calculated to per km^2 using absolute mean values for cells overlapping with the Proposed Development marine mammal study area.

The maximum mean density value for harbour seal in the Development area is unrealistic, based on the value for a single 5 km by 5 km cell. For context, if the density were valid, this cell alone would account for either the entire population for Wales, or twice the total abundance of the northwest England area. The Developer has presented assessments using a density value of 0.06 animals per km^2 as a more realistic conservative value.

12.2 Conservation Objectives

The conservation objectives for harbour seal within both Strangford Lough SAC and Murlough SAC are (DAERA, 2017b; DAERA, 2018):

- to maintain (or restore where appropriate) the harbour seal feature to favourable condition.
- maintain and enhance, as appropriate, the harbour seal population; and
- maintain and enhance, as appropriate, physical features used by harbour seal within the site.

12.3 Potential Noise Impacts

The Developer has presented modelling of noise impacts to harbour seal from UXO clearance and for a variety of equipment that may be utilised during seismic and geophysical surveys.

Clearance of the largest ordnance considered (907 kg) was predicted to have the potential to cause injury to harbour seal up to a distance of 3,015 m, and to have the potential to cause disturbance up to 6,470 m from the point of detonation.

Neither of these ranges overlap with either SAC for which harbour seal is a designated feature.

Applying the ranges for injury and disturbance to the density assumed for harbour seal in the Development area suggests that between 1 and 2 animals could suffer injury and up to eight animals show mild disturbance from noise generated by this size of UXO clearance.

The Developer modelled the potential for injury and disturbance to harbour seal from survey equipment including MBES, SBP and vertical seismic profiler VSP. All of which may potentially be used prior to or during construction, during the Development operation phase and around the time of decommissioning.

The greatest distance over which injury to harbour seal could extend was predicted to be 40 m, from SBP, which may cause injury to less than one animal.

The greatest distance over which mild disturbance to harbour seal could extend was predicted to be 13 km, from VSP. On this basis, 32 animals (

Table A-8) may be expected to suffer mild disturbance during the operation of VSP.

Areas of noise impact from Development activities outside of Welsh TW are a least 100 km from both sites for which harbour seal is a qualifying feature. There is no risk of adverse impact on the condition of the species within the sites, this includes at supporting shoreline habitats necessary for breeding, moulting and resting.

Some harbour seals from the Northern Ireland population may be present outside of the sites and could be injured due to noise from high order UXO clearance, by suffering a PTS to their hearing ability. For those individuals affected, PTS could impair their ability to communicate and to hunt, potentially reducing there likelihood of breeding and their life expectancy. Given the low abundance of harbour seals, injury to even 1 – 2 animals (as implied from the Developer's modelling) could represent up to 0.14% of the Northern Ireland population of harbour seal.

Whereas a single event may not compromise the achievement of the conservation objectives pertaining to population size and range of each site, multiple events of this scale could cause a decline in the population and, consequently, have an adverse effect on the integrity of this feature of the two sites.

Mild disturbance to harbour seals may deter animals from utilising the full extent of the Irish Sea area outside of the two sites and, if prolonged, behavioural disturbance as a result of underwater noise may have an effect on reproductive success of some individuals. Given the short duration of the impact and

the reversibility of the effect, it is unlikely that mild disturbance from noise would compromise achievement of conservation goals for harbour seal.

12.4 Conclusion of Assessment for Harbour Seal

OPRED has concluded that the disturbance effects on harbour seal from underwater noise generated by Development activities outside of Welsh TW will not lead to an adverse effect on the integrity of Strangford Lough SAC or Murlough SAC.

However, depending on the number and size of UXO clearances to be performed, there is potential for underwater noise to cause injury to a significant proportion of the Northern Ireland harbour seal population during the years of construction if no mitigation measures are employed.

Whereas a single event may be consistent with maintaining the viability of the population, multiple high order clearances could result in a decline.

Whereas the population may recover from any effects in subsequent years, if no mitigation measures are employed the potential for adverse effect on the integrity of the sites designated for harbour seal cannot be ruled out, particularly given the low abundance of harbour seals within the Irish Sea and that the population in Strangford Lough has undergone a decline.

The likelihood of any injury to marine mammals is however extremely small as the Developer will be required to employ standard marine mammal mitigation measures which will ensure any marine mammal is not within the zone of potential injury during any detonation.

It must be incumbent on the Developer to assess every UXO that it identifies on a case by case basis to establish the least impactful solution for each. Opportunities to avoid the need for clearance should be seen as optimal. Where avoidance is not feasible, and clearance is essential, methods that minimise noise generation shall be prioritised and methods to suppress the propagation of noise shall be implemented. In addition, the Developer will be required to employ mitigation measures which avoid the risk of injury to marine mammals

Further assessment of impacts to harbour seal will be required to enable OPRED to evaluate each application for a marine licence to undertake UXO clearance.

13 MITIGATION

To minimise the environmental impact of the Development throughout the construction, operation and maintenance, and decommissioning phases, various mitigation measures have been proposed, and the Developer has committed to putting these in place.

All mitigation techniques will be adopted in line with legislative requirements or adopted standard industry practice where relevant.

To minimise disturbance to birds vessel transits to Development activity sites will maximise use of established existing transit routes.

To minimise impacts from geophysical and seismic surveys, the Developer has committed to following the JNCC guidelines for minimising the risk of injury to marine mammals from geophysical surveys (JNCC 2017a).

To minimise the impacts from UXO clearance the operator will be required to adhere to the JNCC guidelines for minimising the risk of disturbance and injury to marine mammals whilst using explosives (JNCC 2010a).

14 IN-COMBINATION EFFECTS: HYNET DEVELOPMENT IN WELSH WATERS

A considerable proportion of the Hynet Development occurs within 12nm of the Welsh coast, this includes the installation of new cables and the new Douglas CCS platform. The installation and operation of assets in Welsh waters will be concurrent with those undertaken in English waters. These aspects of the project are managed by Natural Resources Wales (NRW) via the marine licensing regime under the Marine and Coastal Access Act 2009. A habitats regulations assessment has been undertaken by NRW for those elements in Welsh waters and that assessment is available to view via the following link Public register - Customer Portal.

The impacts of the Hynet Liverpool Bay project as a wholly are fully represented by the two NRW and OPRED assessments, with liaison between the government departments ensuring alignment between the two assessments.

The NRW Habitats Regulations assessment concludes there will be no aspect of the project which is likely to result in an adverse effect on the integrity of any European site either alone or in-combination with any other plan or project.

15 CONCLUSION

The Secretary of State has carefully considered all the information available in order to undertake a HRA of those elements of the Development that will take place in English territorial waters or in UK offshore waters.

The assessment was not able to conclude the absence of a likely significant effect on the qualifying non-breeding bird features of the Liverpool Bay SPA nor for the effects of underwater noise to disrupt migration of the diadromous fish features of the River Dee and Bala Lake SAC and the Dee Estuary SAC. Nor was the assessment able to conclude no likely significant effect from underwater noise to bottlenose dolphin, harbour porpoise, grey seal or harbour seal features of European sites within the Irish Sea.

The Secretary of State has consequently undertaken an AA in respect of each relevant site's Conservation Objectives to determine whether the Development, either alone or in-combination with other plans or projects, will result in an adverse effect on integrity of each site in respect to those features.

For the Liverpool Bay SPA, the Secretary of State concludes that:

- Impacts from the construction of the Development alone are insufficient to have an adverse impact on the integrity of the common scoter, red-throated diver and little gull features; and
- Impacts from the construction of the Development in combination with other projects for which sufficient data is available will not have an adverse impact on the integrity of the common scoter, red-throated diver and little gull features.

However, the Secretary of State considers there to be insufficient certainty as to what other developments will be taking place during the Development construction period and of the extent of impacts those other developments could have.

When applications are presented for other projects the Secretary of State will review the potential for those projects to impact features of the Liverpool Bay SPA in combination with the Development via the Habitats Regulations Assessment for those projects.

For the Dee Estuary SAC and River Dee and Bala Lake SAC, the Secretary of State concludes that:

- Migration of Atlantic salmon, river lamprey and sea lamprey into or away from the Dee Estuary will not be impeded by noise generated by Development construction activities taking place in English territorial waters, either alone or in combination with other developments.

For the bottlenose dolphin feature of the Lleyn Peninsula and the Sarnau SAC and the Cardigan Bay SAC, for the harbour porpoise feature of the North Anglesey Marine SAC, North Channel SAC, West Wales Marine SAC, Bristol Channel Approaches SAC, Rockabill to Dalkey Island SAC and the Roaringwater Bay and Islands SAC, for the grey seal feature of the Lleyn Peninsula and the Sarnau SAC, Maidens SAC, Pembrokeshire Marine SAC, Lundy SAC and the Saltee Islands SAC, and for the

harbour seal feature of the Strangford Lough SAC and Murlough SAC, the Secretary of State concludes that:

- There is no potential for noise to impact any marine mammal species within their respective SACs.
- Given that each species ranges widely outside the boundaries of sites for which they are qualifying features, there is the potential for individual animals to be affected by noise from the Development.
- Without mitigation measures, there is a potential for injury, in the form of PTS, to bottlenose dolphin, harbour porpoise, grey seal and harbour seal due to noise from UXO clearance and that, depending on the number of such events, this has the potential to reduce the overall regional abundance of a species. A reduction in species abundance could compromise the achievement of site conservation measures to maintain the population of the site. However, the likelihood of the Development causing any reduction in species abundance is extremely unlikely as the Developer will be required to adhere to standard marine mammal mitigations measures designed to avoid injury to marine mammals from noise.
- Whilst no marine mammal injury is expected (due to mitigation measures) any unexpected injuries sustained by clearance of a device of the largest ordnance considered by the Developer would not in isolation cause an adverse effect on the integrity of any site.

The Developer will be obliged under the marine licensing regime to assess the impacts of every UXO that it identifies for detonation on a case-by-case basis, including the requirement to establish the least impactful clearance solution for each and what marine mammal mitigation measures will be employed. Opportunities to avoid the need for clearance will be seen as optimal. Where avoidance is not feasible, and clearance is essential, methods that minimise noise generation will be prioritised and methods to suppress the propagation of noise shall be implemented.

Before clearing any UXO the Developer must apply for and be granted a marine licence from OPRED. As part of this application the Developer will demonstrate that the proposed clearance plan will cause no adverse effect on the integrity of sites for bottlenose dolphin, harbour porpoise, grey seal and harbour seal. Within the marine licence application,

- The Developer shall inform OPRED of all UXO it intends to clear, or may need to clear, and provide justification for the proposed clearance, including all mitigation measures that will be used (including mitigation measures to avoid injury to marine mammals); and
- The Developer shall provide a schedule for all clearance activities planned and shall demonstrate, to the satisfaction of OPRED, that the cumulative impacts of the full clearance plan will not cause adverse effects to bottlenose dolphin, harbour porpoise, grey seal and

harbour seal, including in-combination with impulsive noise sources from other developments that will take place at or around the same time.

Subject to the aforementioned conditions the Secretary of State concludes that Development activities within English territorial waters and within UK offshore waters will not have an adverse effect on the integrity of any European site.

16. CONSULTATION WITH STATUTORY NATURE CONSERVATION BODIES

Consultation Date	Key areas of advice	How has advice been taken into account?
V1: 08/11/24	**All SNCBs stated**: Accidental pollution events should be further assessed Without seasonal restrictions on construction works and the requirement for vessel management plans SNCBs cannot agree to conclusion of no AEOI on Liverpool Bay through bird disturbance Reference to the joint policy statement requiring low noise UXO disposal should be included **NRW further stated** Indirect effects on prey availability for Liverpool Bay SPA birds has not been considered Some migratory fish features from Welsh SACs not considered More information on seismic noise sources is required Assessment of how disturbance to marine mammals impacts SACs should be included	Clarified that accidental pollution events have not been considered further as any unplanned release of polluting substances would be an offence and there is high confidence in the mandatory measures which prevent pollution events Further reference to the requirement for low noise UXO disposal has been added Clarification provided as to how indirect impacts on prey availability have been considered Explanation provided for why the migratory fish features indicated by NRW have been screened out Explanation provided for why further details of seismic noise sources have not been included. Also included explanation for how disturbance has been considered Further text added to the HRA explaining that a seasonal restriction will be placed on cable laying activities precluding it from occurring in the wintering season when sensitive bird features are present in the Liverpool Bay SPA
V2: 06/12/24	**All SNCBs Stated**: The application needs to be accompanied by a vessel management plan outlining how vessel movements will be undertaken to best minimise disturbance to SPA birds Accidental pollution events should be further considered	No further action taken regarding accidental pollution as the Department's position is that this risk is adequately managed through existing controls and represents a minimal risk. Further text added outlining that the operator will be required to produce a vessel management plan as part of their future applications and the SNCBs will be consulted on these.

	JNCC and NE further stated Whilst the operations at the platforms i.e. via jack up alone will not cause significant further disturbance, supply vessel movements associated with these works could cause an adverse impact on the SPA. These vessel movements need further assessment.	To address the gap in the assessment of supply vessel movements to the platforms further information was added outlining the vessel routes and likely vessel activity
V3:13/12/24	**JNCC and NE** More information is required on how the vessel activity associated with the construction/preparation works at the platforms relates to the baseline/existing vessel operations in the SPA. More information required on exact numbers of vessels and their movements. Vessel management plans should be implemented/produced now and not as part of future applications. Recommended adverse impacts on the Liverpool SPA could best be avoided by construction/preparatory works at the platforms taking place outside of the wintering season for CS and RTD. **NRW** No further comment	Further information added to assessment on existing vessel routes and traffic in the SPA to contextualise and provide a baseline upon which to base the assessment Further information provided explaining that the operational permits are the best mechanism through which to condition and administer the seasonal restriction and vessel management plan. It was concluded that extra information requested from SNCBs on precise numbers and details regarding vessel movements was not available at this stage in the planning process. It was also deemed that such details were not deemed necessary to underpin the assessment at this stage and the risk is adequately informed by the available information. Further details and refinement of the assessment and vessel management plan will most usefully be undertaken at the operational permit/consent stage. The view was taken not to implement a seasonal restriction on all vessel movements as this would be unreasonably restrictive. There is sufficient confidence that vessel operations are adequately within the limits of existing shipping operations and of such a transient and short duration as to not cause an adverse impact on the site's integrity.

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APPENDIX A

A-1 Marine Mammals Underwater Noise Thresholds and Potential Impacts

A-1-1 UXO

Table A-1: Potential PTS ranges for high order clearance of UXOs.

Charge Size	PTS Range (m)			
	Threshold	Harbour Porpoise	Bottlenose Dolphin	Grey and Harbour Seal
1.5 kg donor	SPL_{pk}	1,690	98	331
	SEL	596	6	34
3.5 kg donor	SPL_{pk}	2,415	140	473
	SEL	885	10	57
25 kg UXO – high order explosion	SPL_{pk}	4,645	268	910
	SEL	1,645	27	147
130 kg UXO – high order explosion	SPL_{pk}	8,045	464	1,580
	SEL	2,520	61	323
907 kg UXO – high order explosion	SPL_{pk}	15,370	890	3,015
	SEL	3,820	151	800

SPL_{pk} = Sound Pressure Level maximum peak experience.
SEL = Sound Exposure Level.

Table A-2: Number of animals with the potential to experience PTS due to high order UXO clearance activities.

Threshold	Estimated Number of Animals with the Potential to be Affected			
	Harbour Porpoise	Bottlenose Dolphin	Grey Seal	Harbour Seal
1.5 kg donor				
SPL_{pk}	<1 – 5	<1	2	<1
SEL	<1	<1	<1	<1
3.5 kg donor				
SPL_{pk}	2 – 10	<1	3	<1
SEL	<1 – 2	<1	<1	<1
25 kg UXO – high order explosion				
SPL_{pk}	6 – 35	<1	<1	<1
SEL	<1 – 5	<1	<1	<1
130 kg UXO – high order explosion				
SPL_{pk}	18 – 105	<1	32	<1
SEL	2 – 11	<1	2	<1
907 kg UXO – high order explosion				
SPL_{pk}	64 – 383	<1	115	2
SEL	4 – 24	<1	9	<1
SPL_{pk} = Sound Pressure Level maximum peak experience. SEL = Sound Exposure Level				

Table A-3: Potential TTS ranges for high order clearance of UXOs.

Charge Size	TTS Range (m)			
	Threshold	Harbour Porpoise	Bottlenose Dolphin	Grey and Harbour Seal
1.5 kg donor	SPL_{pk}	3,110	180	610
	SEL	2,975	85	454
3.5 kg donor	SPL_{pk}	4,445	257	875
	SEL	3,715	141	745
25 kg UXO – high order explosion	SPL_{pk}	8,555	494	1,680
	SEL	5,290	343	1,760
130 kg UXO – high order explosion	SPL_{pk}	14,825	855	2,905
	SEL	6,830	680	3,360
907 kg UXO – high order explosion	SPL_{pk}	28,320	1,635	5,550
	SEL	8,925	1,380	6,470

SPL_{pk} = Sound Pressure Level maximum peak experience.
SEL = Sound Exposure Level

Table A-4: Number of animals with the potential to experience TTS due to high order UXO clearance activities.

Threshold	Estimated Number of Animals with the Potential to be Affected			
	Harbour Porpoise	Bottlenose Dolphin	Grey Seal	Harbour Seal
1.5 kg donor				
SPL_{pk}	3 – 16	<1	5	<1
SEL	3 – 15	<1	3	<1
3.5 kg donor				
SPL_{pk}	6 – 32	<1	10	<1
SEL	4 – 23	<1	7	<1
25 kg UXO – high order explosion				
SPL_{pk}	20 – 119	<1	36	<1
SEL	8 – 46	<1	40	<1
130 kg UXO – high order explosion				
SPL_{pk}	60 – 356	<1	107	<1
SEL	4 – 19	<1	145	<1
907 kg UXO – high order explosion				
SPL_{pk}	217 – 1,299	<1	393	<1
SEL	22 – 129	<1	534	<1
SPL_{pk} = Sound Pressure Level maximum peak experience. SEL = Sound Exposure Level				

Table A-5: Potential disturbance ranges to harbour porpoise based on NRW (2023) guidance and numbers of animals potentially affected.

Charge Weight	Distance (m)	Number of animals
Low order and low yield donor charge configurations		
0.08 kg	1,500	<1 – 4
0.5 kg	2,435	2 – 10
2 x 0.75 kg	3,120	3 – 16
4 x 0.75 kg	3,600	4 – 21
High order donor charge options		
1.2 kg	2,975	3 – 15
3.5 kg	3,715	4 – 23
Potential UXOs (high order disposal)		
25 kg	5,290	8 – 46
130 kg	6,830	13 – 76
907 kg	8,925	22 – 129

A-1-2 Geophysical and Seismic Surveys

Table A-6: PTS ranges for marine mammals during geophysical and seismic site investigation surveys.

Threshold	Range, SEL (m)	
	Harbour Porpoise	Grey and Harbour Seal
Geophysical		
MBES	345	5
SBP	335	40
Seismic - VSP		
SELcum	235	11
SEL_{pk}	124	16

Table A-7: Disturbance ranges for marine mammals during geophysical and seismic investigation.

Activity	Range, SEL (m)
Geophysical	
MBES	1,100
SBP	1,180
Seismic – VSP	
VSP	13 km (mild)
	0.8 km (strong)

Table A-8: Estimated number of animals with the potential to be disturbed from geophysical site investigation surveys (120 dB SPLrms) and seismic surveys (Mild Disturbance – 140 dB SPLrms; Strong Disturbance – 160 dB SPLrms).

Threshold	Estimated Number of Animals with the Potential to be Disturbed		
	Harbour Porpoise	Grey Seal	Harbour Seal
Geophysical			
MBES	<1 – 2	16	<1
SBP	<1 – 3	18	<1
Seismic			
VSP (mild)	46 – 274	2,155	32
VSP (strong)	<1 – 2	9	<1

Table A-9: Potential disturbance ranges to harbour porpoise based on NRW (2023) guidance and numbers of animals potentially affected.

Activity	Range, SEL (m)	Number of animals
Geophysical		
MBES	490	<1
SBP	430	<1
Seismic		
VSP	7,500	16 – 92