Vermilion Exploration & Production Ireland Limited

Corrib Field P6 Flexible Flowline Installation

EIA screening and environmental risk assessment

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1 INTRODUCTION

1.1 Background

Vermilion Exploration & Production Ireland (Vermilion) plan to replace the flexible flowline connecting the P6 subsea wellhead with the Corrib central manifold (see Figure 1-1). The new flowline will be shorter in length (158 m) than the existing flowline (1560 m)[1] and will significantly reduce unnecessary flow restrictions between the wellhead and the manifold.

The work scope is proposed to take place between the months of May and October 2021, or during the same period in 2022, and includes the mobilisation of an ROV construction support vessel (*Siem Spearfish*) and two remotely operated vehicles (ROVs) from a UK port to the Corrib Field and the P6 wellhead location and Corrib Central Manifold. Prior to arrival at the Corrib Field area, verification of the DP (dynamic positioning) system and USBL (ultra-short baseline) systems will be undertaken. Prior to removal of the existing P6 flowline an As-Found Survey will be undertaken. This will include underwater video / stills and geophysical survey using multibeam echo sounder (MBES) equipment deployed from an ROV. The flowline replacement will be carried out by ROV, with the existing flowline decoupled from the central manifold and P6 wellhead and left in situ on the seabed. Following the works there will be reinstatement of the worksite and an As-Left survey will be undertaken. The vessel will then return to the UK port for demobilisation.

Figure 1-1 shows the location of the proposed Corrib Field Central Manifold – P6 wellhead flexible flowline replacement works.

[1] The existing flexible flowline was installed in 2014 and had an increased length to mitigate extreme low temperature gas from reaching the central manifold. As the reservoir pressure has dropped, the longer 'warm up' flowline is no longer required.

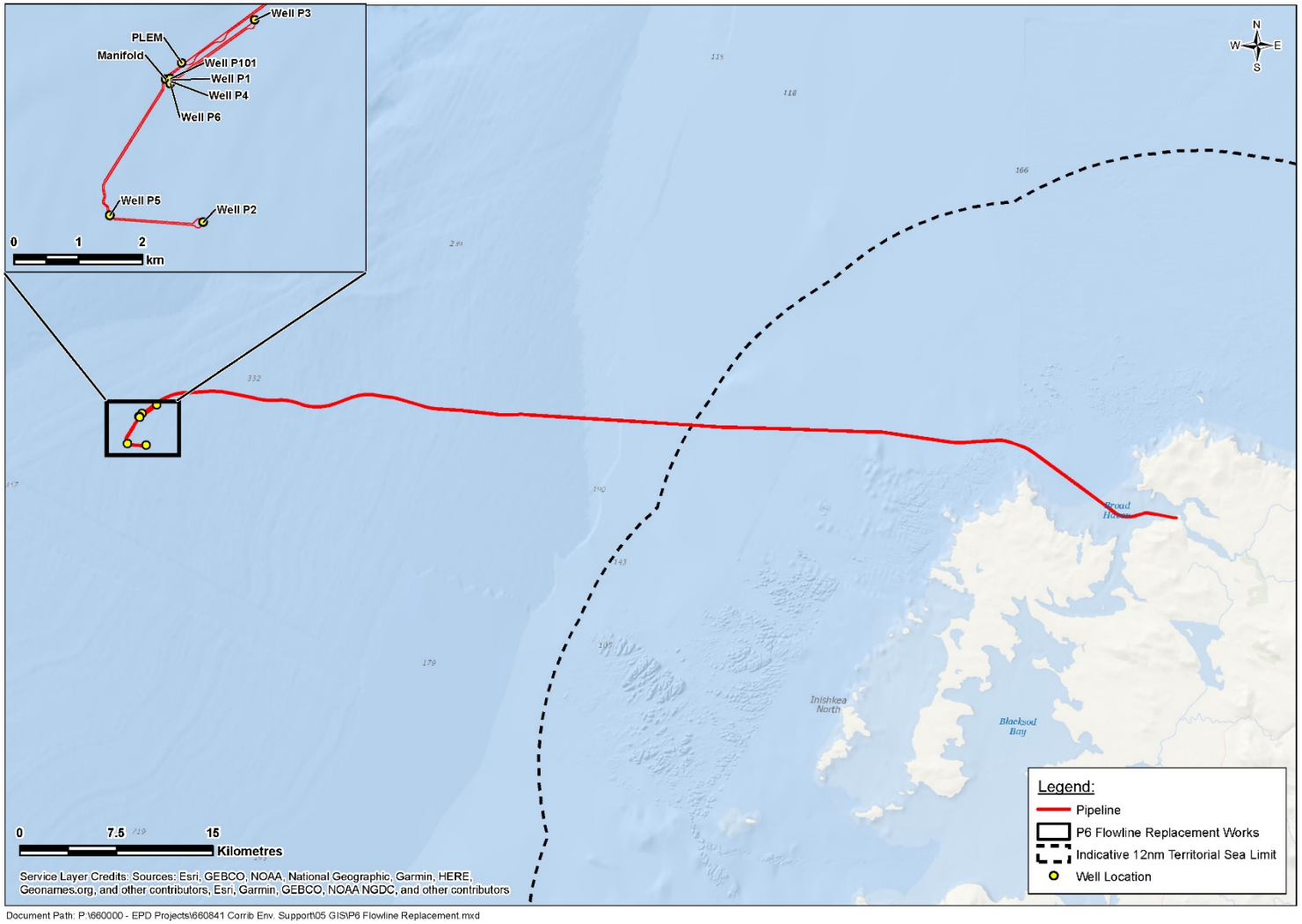

Figure 1-1: Approximate location of the proposed P6 Flexible Flowline replacement works at the Corrib Field

1.2 EIA screening for oil and gas exploration activities

Council Directive 85/337/EEC of 27th June 1985 on the assessment of the effects of certain public and private projects on the environment ('EIA Directive') put in place a system whereby certain projects by reason of their type, size, location, etc. must be assessed as to their likely effects on the environment through the process of Environmental Impact Assessment. Projects listed under Annex I must be subject to the EIA process in all cases (with the exception of national defence projects), while for those listed under Annex II EIA is at the discretion of the member states. Annex II projects will be subject to EIA based on predetermined thresholds or assessed on a case-by-case basis, as set out in national legislation. Where thresholds are set, some sub-threshold projects may be subject to EIA due to the likelihood of significant effects on the environment due to factors such as their nature, size, location, etc.

The EIA Directive has been amended three times. Directive 97/11/EC brought in the concept of transboundary effect; increased the number of projects covered by the Directive and also presented new screening criteria (Annex III) for assessing whether an Annex II project should be subject to EIA when considered on a case-by-case basis. Directive 2003/35/EC aimed to align public participation as set out in the Directive with the Aarhus Convention on public participation in decision-making and access to justice in environmental matters. Directive 2009/31/EC added projects to Annexes I and II that related to CO_2 transport, capture and storage.

The original 1985 Directive and its three amending directives were codified by Directive 2011/92/EU. In transposing the EIA Directive into Irish law (European Communities (Environmental Impact Assessment) Regulations 1989 – S.I. 349/1989 as amended), Ireland chose to set thresholds above which an EIA is required for projects listed under Annex II, while also allowing for sub-threshold projects to be subject to EIA where the Competent Authority considers the project is likely to have significant effects on the environment.

A further codification of the EIA Directive and its amendments by Directive 2014/52/EU has taken place and this amends Directive 2011/92/EU. This has now been transposed into Irish legislation (The European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 (S.I. No. 296 of 2018).

It is understood that the proposed scope of works for the flexible flowline replacement works would not fall under Annex I or II of the EIA Directive (or the First Schedule of the Irish 1989 regulations as amended, which transposes the Directive and its Annexes), and therefore does not require an EIA to be carried out on these grounds.

Other current relevant documentation in respect of EIA screening in Ireland include the following:

- *Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (Government of Ireland, August 2018);*
- *Guidelines on the Information to be Contained in the Environmental Impact Assessment Reports, Draft August 2017 (EPA, 2017).*

1.2.1 Previous assessments

The proposed P6 Flexible Flowline replacement works have also been considered under the European Union (Environmental Impact Assessment) (Petroleum Exploration)

Regulations 2013 (S.I. 134 of 2013) and (Amendment) Regulations 2019 (S.I. No. 124 of 2019), which gives the Minister the discretion to require an Environmental Impact Statement (EIS) to be prepared where a significant effect on the environment is likely. As such a high-level impact screening exercise has been carried out (Section 4).

A full EIS was submitted and approved for the offshore phases of the Corrib offshore gas field project in 2001 (RSK, 2001). The offshore EIS was updated in a Supplementary Update Report (RSK, 2010) to reflect changes to the project scope of works, as well as updates to the environmental baseline. The offshore EIS and update report included a project description, an environmental and social baseline for receptors such as commercial fisheries, the physical environment, marine archaeology and seascape/landscape, and assessed all potential impacts from the project. These potential impacts included subsea infrastructure installation, as well as operational impacts as a result of vessel operations, including subsea surveys.

The Consent to Operate the Corrib Gas Pipeline was issued pursuant to Section 40 of Gas Act, as amended. This consent was awarded in 2015 subject to a number of conditions, based on commitments made in the offshore EIS and its supplementary updates and the Consent to Operate application itself. Condition 20 of the Consent to Operate was as follows:

'Subsea facilities and flowlines will be subject to annual inspection to ensure that protection measures remain effective and any remedial measures necessary to provide additional protection will be undertaken as soon as practically possible. The first such inspection will be undertaken within the first month from the start of commercial gas production, when the flowlines are at maximum operating pressure and temperature'.

In 2019, a necessary programme of subsea inspection, maintenance and infrastructure renewal surveys was proposed at the Corrib Field in accordance with Condition 20 of the Consent to Operate. RSK completed an EIA Screening and Environmental Risk Assessment for Annex IV species and a Natura Impact Statement for the proposed survey activities (RSK, 2019 a and b respectively). On the 26th November 2019, it was concluded through Appropriate Assessment by the Department of Communications, Climate Action and Environment (DCCAE)[2] (the competent authority) that the proposed surveys would not adversely impact the integrity of any relevant European sites, considering the sites' conservation objectives and the mitigation methods proposed. It was also concluded through the EIA Screening and Environmental Risk Assessment that the proposed surveys would not significantly impact any relevant Annex IV species. The survey programme has since taken place in the summer of 2020. A similar programme of inspection surveys is likely to be proposed to take place during the summer months of 2021 and 2022.

This EIA Screening and Risk Assessment document focuses on those impacts associated with underwater noise generated by the geophysical survey equipment during the As-Found and As-Left Surveys at the beginning and completion of the proposed P6 Flexible Flowline replacement work scope (as required under Condition 20 of the Consent to Operate). Other potential impacts associated with vessel operations and subsea infrastructure installation were summarised and relevant sections referenced from the EIS and Supplementary Update Report in the Roadmap for EIS Documentation (RSK

[2] Formally the Department of Communications, Energy and Natural Resources (DCENR).

2015), which was submitted as Appendix A to the Cover Letter in the Application for Consent to Operate the Corrib Pipeline under Section 40 of the Gas Act. This roadmap document signposts to the relevant sections of the Offshore EIS and Supplementary Update where particular activities are assessed for environmental impacts. The Roadmap for EIS Documentation (RSK, 2015) is provided as Appendix 1 to this document for reference. This EIA Screening and Environmental Risk Assessment does, however, summarise all impacts associated with the project and constitutes a standalone assessment.

Section 3.2.1 of the Natura Impact Screening Statement (NISS) (EACS, 2015) of the Consent to Operate application details the previously assessed and approved operational activities associated with the offshore pipeline, while Section 5.2 discusses the various permits, consents and approvals under which the activities were conducted. Tables detailing the activities that have been previously assessed, and screened as part of the appropriate assessment process, are included in Appendix 2 to this document for reference (EACS, 2015).

Impacts associated with underwater noise have been assessed in detail in this EIA Screening and Risk Assessment document, and high level EIA screening has also been undertaken for the proposed P6 Flexible Flowline replacement works to ensure that any changes in the project scope, baseline receiving environment, designations or legislative regime are considered fully. No significant changes are noted. It is therefore concluded that an EIS / EIA would not be required in relation to the proposed programme of P6 Flexible Flowline replacement works. The results of this exercise have been provided for confirmation. The report continues by providing an additional risk assessment for species with the potential to be impacted by the proposed scope of works, in particular those species that are listed under Annex IV of the EU Habitats Directive 92/43/EEC Article 12, which are considered to be the most sensitive receptors to the proposed activities.

1.3 Appropriate Assessment

This report is submitted in support of an application to the DCCAE for permission to undertake the programme of proposed works. In addition to this report a Natura Impact Statement (NIS) for Appropriate Assessment (AA) report has also been submitted in support of the application, in accordance with the Birds and Habitats Regulations (SI 477 of 2011). The NIS (RSK, 2020) has been prepared in order to assist the competent authority to undertake an Appropriate Assessment if it is deemed that there is the potential for likely significant effects on any Natura 2000 site.

It is important to note that shallow high frequency geophysical survey activities (similar to those proposed in this work scope for the As-Found and As-Left Surveys) were assessed during the Appropriate Assessment screening in 2015, as part of an overarching assessment for a number of ongoing scopes of work in relation to the operation of the Corrib pipeline (EACS, 2015), and were assessed by the Minister as part of the Section 40 Consent to Operate application, prior to consent being given.

The accompanying NIS report for this work scope describes the Natura 2000 sites in the vicinity of the proposed works and assesses the potential impacts on the integrity of these sites and their receptor habitats and species, including bottlenose dolphins (*Tursiops truncatus*), grey seals (*Halichoerus grypus*), and seabirds, as well as potential accidental impacts such as a fuel spill.

It is recommended that the NIS report be read in conjunction with this report when considering the application.

1.4 Environmental risk assessment

Under the EU Habitats Directive 92/43/EEC Article 12, member states are required to establish a system of strict protection for the animal species listed in Annex IV, which in Irish waters includes all cetaceans, some turtle species. This Environmental Risk Assessment for the proposed activities has been prepared as required under the 2011 Department of Communications, Energy and Natural Resources (DCENR[3]) "Rules and Procedures Manual for Offshore Petroleum Exploration and Appraisal Operations", (DCENR, 2011) and relates specifically to the potential impact of the proposed activities on Annex IV species. As a result, Vermilion is required to ensure that current best industry practice is applied with regard to impact mitigation and monitoring measures during operations such as site surveys, which utilise underwater acoustic sources.

Accordingly, this scope of works, specifically the geophysical surveys conducted by ROV As-Found and As-Left Surveys, will be carried out in accordance with the National Parks and Wildlife Service (NPWS) 2014 "Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters", which recently replaced the 2007 "Code of Practice for the Protection of Marine Mammals during Acoustic Seafloor Surveys in Irish waters' or the Code of Conduct (CoC)". Joint Nature Conservation Committee (JNCC) qualified Marine Mammal Observers (MMOs) will be present on the ROV support vessel in an advisory capacity, although they will have the power to delay the commencement of any operations that have been assessed as potentially posing a risk to Annex IV species. All masters and duty watchkeepers of the ROV support vessel are required to familiarise themselves with this risk assessment (particularly sections discussing mitigation).

The waters in the vicinity of the Corrib Field have the potential to support an ecologically diverse range of resident and/or migratory Annex IV designated, as well as other sensitive species. Annex IV species considered to have the potential to occur in the vicinity of the Corrib Field include five species of marine turtle: loggerhead (*Caretta caretta*), green (*Chelonia mydas*), Kemp's ridley (*Lepidochelys kempii*), hawksbill (*Eretmochelys imbricata*) and leatherback (*Dermochelys coriacea*) turtle; and approximately 18 species of cetacean: harbour porpoise (*Phocoena phocoena*); bottlenose, short-beaked common (*Delphinus delphis*), Risso's (*Grampus griseus*), white-sided (*Lagenorhynchus acutus*), white-beaked (*Lagenorhynchus albirostris*) and striped (*Stenella coeruleoalba*) dolphins; long-finned pilot (*Globicephala melas*), false killer (*Pseudorca crassidens*), killer (*Orcinus orca*), northern bottlenose whale (*Hyperoodon ampullatus*), Cuvier's beaked (*Ziphius cavirostris*), sperm (*Physeter macrocephalus*), minke (*Balaenoptera acutorostrata*), blue (*Balaenoptera musculus*), fin (*Balaenoptera physalus*), sei (*Balaenoptera borealis*) and humpback (*Megaptera novaeangliae*) whales. In addition, grey and harbour (common) (*Phoca vitulina*) seals are also present in Irish waters and are listed under both Annex II and Annex V of the EU Habitats Directive (Annex II - i.e. species of community interest whose conservation requires the designation of SACs - although not necessarily throughout all of the

[3] Since 2016 the DCENR (Department of Communications, Energy and Natural Resources) is known as the Department of Communications, Climate Action and Environment (DCCAE).

geographic range, but within their core range and Annex V – i.e. species whose taking from the wild can be restricted by European law and that any exploitation must be compatible with the maintenance of favourable conservation status. This status under Annexes II and V affords similar levels of protection to those species listed under Annex IV (strict protection), and thus are included as part of the assessment.

The primary focus of the Environmental Risk Assessment is the potential impacts from underwater noise and disturbance to marine species listed under Annex IV of the EU Habitats Directive 92/43/EEC Article 12. In addition, other key receptor species that are not designated under Annex IV, but have the potential to be impacted, are considered. These include species of fish and seabirds that have the potential to be present in the vicinity of the proposed operations. Summary risk assessment tables are provided in Section 7, that identify and assess the full range of potential impacts from the proposed scope of works, including collision risk, shipboard pollution etc, while Section 4 provides an EIA Screening assessment.

1.5 Document structure

The contents of this report are structured as follows:

Section 1 – Introduction to the EIA screening assessment and environmental risk assessment for Annex IV and other sensitive species;

Section 2 – Brief description of the baseline conditions;

Section 3 – Outline of the project description;

Section 4 – EIA screening assessment table;

Section 5 – Discussion of the potential impacts to Annex IV and other sensitive species from the proposed scope of works;

Section 6 – Outline of mitigation measures;

Section 7 – Risk assessment matrix;

Section 8 – Conclusions.

2 ENVIRONMENTAL BASELINE

2.1 Geographical setting and principal project seabed assets

The Corrib natural gas field (Corrib Field) is located in the northeast Atlantic, within frontier acreage blocks 18/20 and 18/25, approximately 65 km from the closest coast of northwest County Mayo. The Corrib Field extends over an area of 15 km^2, over which the seabed varies in depth from approximately 335 m to 425 m. An export pipeline runs from the Corrib subsea manifold to the landfall location at Glengad, Broadhaven Bay, in an approximate east/west orientation (Figure 1-1 and Figure 3-3).

2.1.1 Pipeline and umbilical

The Corrib Field has been developed as a subsea production facility, where all associated equipment has been placed directly on the seabed, and gas is brought to shore via a 20" subsea pipeline (approximately 83 km from the offshore manifold to the landfall at Glengad). An umbilical control manages conditions within the pipeline and provides for injection of chemicals such as corrosion inhibitors.

2.1.2 Bellanaboy Bridge Gas Terminal (BBGT) surface water discharge pipeline

Treated surface runoff from potentially contaminated areas of the BBGT site are collected and treated before being discharged via a long sea outfall to a discharge diffuser off Erris Head. The outfall pipeline is piggy-backed onto the main subsea pipeline for much of its length, although in places its route does differ slightly. The pipeline is protected by a combination of concrete mattresses and deposited rock filter and armour layers where required.

2.1.3 In-field flowlines and umbilicals

The infield flowlines and umbilicals at the Corrib Field link the individual wells to the Corrib central manifold. The umbilicals control the wells themselves and are used for the injection of a range of chemicals, while the infield flowlines bring gas from the wells to the central manifold. Where required the umbilicals and flowlines at the Corrib Field are protected by rock.

2.2 Physical environment

2.2.1 Bathymetry

The continental shelf is relatively narrow along the north-west coast of Ireland. The Corrib Field at a distance of 65 km offshore, is in an area of approximately 350 m water depth, on the continental slope, or continental margin, at the shelf break.

2.2.2 Waves and tidal regime

The west of Ireland faces the North Atlantic Ocean, and waves travel undisturbed for thousands of miles before reaching the coastline.

Greatest anticipated significant wave height close to the Corrib Field is 22.9 m (return period of 100 years, during winter). Overall return periods, the maximum significant waves are from the west (RSK, 2001). The currents at the Corrib Field are strongest from the south and south west, with only minor seasonal differences close to the seabed.

The predominant currents on the western coast of Ireland are formed by the weak, meandering eddies that exist on the south-east periphery of the North Atlantic current. Surface currents are generally controlled by surface fronts, with currents flowing clockwise around the Irish coast. Currents flow poleward in winter, at up to 30 cm/s, but are weaker and more variable in summer.

Nearshore currents generally flow in a south to north direction around the coast of Ireland. The tidal streams off Erris Head are stronger than those at the outer shelf.

2.2.3 Seawater quality

Seawater quality sampling has been conducted as part of a number of programmes, the most recent being November 2016, October 2014 and also May 2016. The 2014 survey sampled the most stations in the vicinity of the Corrib Field and indicated that surface waters here were well-mixed at around 15°C. Temperature was then seen to decrease gradually to 13-14°C at 40-50 m depth, where a thermocline occurred. From 75 m depth, water temperatures were relatively constant at around 11°C, reaching 10°C at the seafloor. A similar pattern was observed for salinity with 35.5 PSU in surface waters, then a halocline occurring at 40-50 m depth. A more limited programme of sampling was undertaken in 2016 whereby temperature profiles were observed to be similar to those recorded in 2014. Warmer water temperatures were observed during the Autumn 2014 programme (particularly in surface waters) in comparison with the programmes conducted in 2016 and 2013 (spring and winter respectively). One particularly noticeable feature that was observed during all recent survey programmes was the depth of the thermocline. In 2013 this was observed at around 80-100 m, in 2014 at around 40-50 m, while in 2016 was at around 30-40 m water depth. This would tend to indicate that it breaks down over the winter months due to vertical mixing.

Dissolved oxygen, turbidity, pH and nutrient measurements were also taken close to the Corrib Central Manifold location. Oxygen saturation was lowest at around 50 m water depth then increased to 200 m depth. Turbidity was generally low and constant throughout the water column at approximately 1 FTU. pH ranged between 5.8 and 6.5 and nutrient levels were also very low.

Low concentrations of trace metals, suspended particulate matter, ammoniacal nitrogen and hydrocarbons are reported in the waters off the Co. Mayo coast. This reflects the open nature of the marine environment and the limited freshwater inputs into the area. Concentrations of these parameters are even lower offshore at the Corrib Field given the fully marine conditions here.

Overall, the physio-chemical characteristics of the water column within the Corrib Field were similar to average background levels for the area.

2.2.4 Seabed sediment characteristics

Seabed surface sediments in the Corrib Field are considered to be silty sands, which overlie buried iceberg scours. The seabed in the area shows evidence of having been trawled, and there are sand ripples due to tidal currents. For a distance of about 35 km

along the pipeline route towards the coast there are also ancient iceberg scours filled with silts and sands.

A number of survey programmes have been carried out at in the vicinity of the Corrib Offshore Field, the most recent surveys being in 2014 and 2016 (RSK, 2016).

Since installation of the subsea infrastructure at the Corrib Field, benthic monitoring programmes have deliberately set sampling locations slightly away from the central manifold and any wellhead or flowline structures in order to reduce the potential for interaction. As such the minor impacts on the seabed from some of the more recent activities at the various well heads where the spatial extent of any impacts would only extend a very short distance from the point source, and for only a very short duration, would be unlikely to determined. In addition, the more localised residual effects of the original well drilling are less pronounced.

Overall the sediments of the Corrib Field are considered relatively homogenous with olive-coloured sediments classed as Fine or Very Fine Sand, with coarser sediments (>2 mm) almost entirely absent. At the Corrib manifold itself where water depths are approximately 350 m, sediments are described as 'silty sands with evidence of faunal burrows and bioturbation of sediments'. Sediments here have a Total Organic Carbon (TOC) of 2.15%. Close to the P6 wellhead, water depth is approximately 341 m and sediments were also described as 'silty sands with evidence of faunal burrows' with a TOC of 2.32%. At locations both close to the central manifold and the P6 wellhead, sediments are broadly similar comprising size fractions of around 75% sands and 25% muds. Median particle size from samples at both locations is around 0.1 mm (RSK, 2016).

Sediments consisted of 74.82% sand, 25.16% mud, median particle size was 0.105 mm and TOC 2.32%. Levels of metals in sediments at the Corrib Field were generally well below concentrations that could incur biological effects, although elevated barium concentrations were recorded in the vicinity of both the P6 wellhead and the Corrib Central Manifold. This was likely to be due to barium releases in from the well drilling and not of concern due to the low toxicity of barium compounds. Hydrocarbons recorded at the field were also low, with only low levels of base oil "Ecomul" detected. Levels of metals in sediments at the Corrib Field were generally well below concentrations that could incur biological effects, although elevated barium concentrations were recorded in the vicinity of both the P6 wellhead and the Corrib Central Manifold. This was likely to be due to barium releases from nearby drilling and not of concern due to the low toxicity of barium compounds. Hydrocarbons recorded at the field were also low, with only low levels of base oil "Ecomul" detected (RSK, 2016).

The levels of Barium and Ecomul are considered tracers of low toxicity water-based and oil-based drilling muds respectively and the levels of these were slightly higher at sampling stations close to areas where previous well drilling activities were known to have taken place. Repeated surveys since the wells were drilled during the 1990s (2007, 2008 and 2014) have shown a gradual reduction in the levels of these tracers (RSK, 2016).

2.2.5 Climatic conditions

The only greenhouse gas anticipated to be emitted from the proposed P6 flowline replacement operations in meaningful quantities is carbon dioxide, via vessel and plant

emissions, although these will be relatively limited. Overall, the project in part supports an overall strategy in Ireland to switch from solid fuels and oil to natural gas and renewables, and so contributes to a reduction in national greenhouse gas emissions.

2.3 Benthic environment

The most recent benthic survey programme (RSK, 2016) also sampled sediments across the Corrib Field for infaunal macrobenthic analysis. The benthic communities in the Corrib Field are considered to be typical of the deep water and fine sandy / silty / muddy substrate in the area. The communities have moderate to high diversity and are dominated by the tube-dwelling polychaete *Galathowenia oculata*. *Ophiocten affinis* (brittle star) and *Urothoe elegans* (amphipod) were also observed to be important community defining species, along with *Adontorhina similis* and *Axinulus crouliensis* (*Thyasirid* bivalve molluscs). Also common are spionid, terebellid and sabellid polychaetes, amphipod and isopod crustacea, opisthobranch molluscs, bivalves and juvenile echinoderms.

Other conspicuous fauna observed through video footage included *Pennatulids* (possibly *Funiculina quadrangularis*), the sand mason worm (*Lanice conchilega*), Purple Heart urchin (*Spatangus purpureus*), *paguroids* (hermit crabs), asteroid starfish, decapod shrimps, hagfish (*Myxinidae sp.*), *Gadiforme sp.*, and the anglerfish *Lophius sp* (RSK, 2016).

Overall surveys have indicated that the seabed environment at the Corrib Field is relatively pristine in nature.

2.4 Annex IV species in Irish waters

2.4.1 Cetaceans

Irish waters are known to support a diverse range of cetacean species (whales, dolphins and porpoises). Twenty-four cetacean species have been recorded in Irish waters, with harbour porpoise, short-beaked common, bottlenose, Risso's, Atlantic white-sided and white-beaked dolphins, and long-finned pilot whale, known to breed in Irish waters (Berrow, 2002).

Approximately 18 species of cetacean have been recorded off the northwest coast of County Mayo and are considered to have the potential to occur in the vicinity of the Corrib Field at least on a seasonal basis (Gordon *et al*., 1999; Ó Cadhla *et al*., 2004; RSK, 2010). In the nearshore waters of Broadhaven Bay (approximately 60 km due east of the Corrib Field), nine species of cetacean have been recorded from dedicated monitoring studies undertaken since 2001 (Coleman *et al,* 2009; Anderwald *et al*, 2013).

2.4.1.1 Distribution and seasonality

A number of dedicated studies and surveys undertaken onboard 'ships of opportunity', have provided data on the distribution of cetaceans in Irish waters (e.g. Northridge *et al*., 1995; Tasker *et al*., 1997; Reid *et al*., 2003; Ó Cadhla *et al*., 2004; Wall *et al*., 2013). In addition, the Irish Whale and Dolphin Group (IWDG) have collected data on the distribution and relative abundance of cetaceans in Irish waters since 1991. The IWDG casual and constant effort sightings schemes record data mainly from land-based

sightings and surveys. According to the IWDG's *Atlas of the Distribution and Relative Abundance of Marine Mammals in Irish Offshore Waters: 2005 – 2011* 16 species have had confirmed presence in the vicinity of the Corrib Field (Wall *et al.*, 2013). However, many gaps in spatial and seasonal coverage still exist, especially off the northwest Irish coast and in all waters outside of the summer months.

Table 2-1 (adapted from Clark and Charif, 1998; Berrow, 2002; RSK, 2001; Ó Cadhla *et al*., 2004; IOSEA1 (ERT, 2006); Anderwald *et al.,* 2013; Wall *et al.*, 2013; IWDG, 2014 and IUCN, 2019) summarises information on cetacean occurrence in the waters in the vicinity of the Corrib Field.

The distribution of marine mammals in Irish waters is thought to be closely linked to the distribution and seasonality of their prey. Baleen whales normally feed on krill and small shoaling fish. Accordingly, their distribution is related to oceanic features such as fronts and upwellings, and areas where prey items aggregate. The diet of the toothed whales (which include dolphins, beaked whales and sperm whale) consists chiefly of fish and cephalopods. The distribution of toothed whales is also thought to be strongly related to water depth (Ó Cadhla *et al*., 2004). Harbour porpoises and bottlenose dolphins are primarily coastal and continental shelf based species. Species such as pilot whales and white-sided dolphins are predominantly found in waters overlying continental slopes and oceanic areas. The deep water found off the west and northwest of Ireland provides a habitat to these species, along with others such as sperm and beaked whales. Along with Cuvier's beaked whale, mentioned in Table 2-1, other species of beaked whales may be sighted in the deep water slope and canyon habitats of the Rockall Trough, west of the Corrib Field. However, sighting usually occur in unfavourable conditions and so cannot be identified to species level, although Northern bottlenose whale (*Hyperoodon ampullatus*), Sowerby's beaked whale *(Mesoplodon bidens*), True's beaked whale (*Mesoplodon mirus*) and Gervais' beaked whale (*Mesoplodon europaeus*) may be present in offshore waters (Wall *et al*., 2013).

Incidental monitoring of marine mammals in the vicinity of the Corrib Field during an ocean bottom seismic survey in 2012, and marine mammal monitoring in Broadhaven Bay, tends to support the appraisal of cetacean distributions provided in Table 2-1. Highest numbers of sightings of cetaceans in these surveys occurred during June, followed by August, October and September.

2.4.1.2 Designated areas and cetaceans

The West Connacht Coast candidate Special Area of Conservation (SAC) (Site code: 002998) has been proposed for designation under the Habitats Directive for the presence of bottlenose dolphins. The site consists of an offshore area of 66,016 ha off the coast of the Mullet peninsula and counties Mayo and Galway.

Bottlenose dolphin are known to occur within the site throughout all seasons and the area comprises a key habitat for the species both regionally and within Irish waters as a whole. The NPWS site synopsis notes that the SAC may contain a minimum of 123 dolphins, with possibly up to 150-200 individuals or more occurring within the site as a whole. The SAC is known to be used for a variety of activities including foraging and resting, and adults closely accompanying calves are commonly observed in summer and autumn months. The SAC lies approximately 57 km from the area of proposed works at the Corrib Field at its closest point.

Other designated areas for cetaceans at increased ranges from the proposed survey operations are listed in the protected areas section (2.6) and are considered in the Natura Impact Statement (RSK, 2020) that accompanies this application.

Table 2-1: Cetacean species of the north-east Atlantic margin

Species	IUCN Red List status[4]	Occurrence	Frequency of sightings
Toothed whales (Odontocetes)			
Harbour porpoise *Phocoena phocoena*	Least concern	Common around the entire Irish coast, and present year-round. Known to breed in Irish waters. Regularly recorded in Broadhaven Bay. Less commonly encountered in the Atlantic offshore shelf waters.	Peak in August – November.
Bottlenose dolphin *Tursiops truncatus*	Least concern	This species is often associated with coastal or inshore areas, but an offshore population is also considered to be continuously distributed along Ireland's Atlantic Margin. Breeding in Irish waters. Designated species for the West Connacht Coast SAC. Regularly recorded in Broadhaven Bay. Potential for an offshore ecotype, which prefers the slopes of the Irish Shelf and offshore banks.	Year round, but peak in summer months.
Short-beaked common dolphin *Delphinus delphis*	Least concern	One of the most commonly recorded species of cetacean in Irish waters, particularly in offshore shelf areas, and is found throughout the Irish Atlantic Margin. Known to breed in Irish waters. Regularly recorded in Broadhaven Bay.	Year round, but most frequent in autumn and winter.
Striped dolphin *Stenella coeruleoalba*	Least concern	Although generally considered to be a warm-temperate oceanic species, a number of sightings occur each year in Irish waters. Sightings are rare and generally further offshore than the Corrib Field.	Most frequent in summer and early autumn months.
Risso's dolphin *Grampus griseus*	Least concern	Known to breed in Irish waters and recorded year-round. In Irish waters a preference for inshore waters is displayed. Records exist in the vicinity of the Corrib Field area, and the entrance of Broadhaven Bay (at Erris Head).	Recorded April – September, peak in summer months.
Atlantic white-sided dolphin *Lagenorhynchus acutus*	Least concern	Known to breed in Irish waters. Predominantly recorded in waters overlying the continental slope, generally not recorded with	Peak in summer months.

[4] IUCN Red List of Threatened Species

Species	IUCN Red List status[4]	Occurrence	Frequency of sightings
		regularity in coastal waters. Often sighted in deep waters of the central Rockall Trough. Recorded in Broadhaven Bay in 2002.	
White-beaked dolphin *Lagenorhynchus albirostris*	Least concern	Known to breed in Irish waters. Generally found in offshore waters off the Irish west coast along the shelf edge and on the continental shelf, occasionally coming close to shore. Recorded in Broadhaven Bay in 2002.	Peak in late summer – autumn.
Long-finned pilot whale *Globicephala melas*	Least concern	Known to breed in Irish waters. This species is often associated with offshore areas, beyond the shelf edge, and waters over 1000 m in depth. Recorded in the Rockall Trough, particularly along the lower continental shelf slopes, offshore of the Corrib Field area.	Year round, but peak in spring and summer months.
False-killer whale *Pseudorca crassidens*	Near threatened	Rare visitor to Irish waters.	Uncommon.
Killer whale *Orcinus orca*	Data deficient	Widely distributed species. In the northeast Atlantic, normal distribution is from Iceland-Norway to the Atlantic Margin waters of north-western Britain and Ireland. Occasional sightings in Irish waters, predominantly in inshore waters. Recorded in Broadhaven Bay.	Most frequent in spring and autumn.
Cuvier's beaked whale *Ziphius cavirostris*	Least concern	Beaked whale species are observed less regularly due to their offshore distributions, and other factors such as their diving physiology, but recent research efforts and stranding data have confirmed their presence in Irish waters. Particularly vulnerable to underwater sound sources.	Strandings peak in spring and summer.
Sperm Whale *Physeter macrocephalus*	Vulnerable	Sperm whales are occasionally observed in Irish waters off the continental shelf, but primarily in the Rockall Trough.	All year, but sightings more frequent in winter in the Rockall Trough.
Baleen whales (Mysticetes)			
Minke whale *Balaenoptera acutorostrata*	Least concern	Widely distributed around Ireland and throughout the Irish Atlantic Margin particularly in shelf and coastal areas. Regularly recorded throughout Irish waters, particularly in shallow shelf waters, but	Peak May – September.

Species	IUCN Red List status[4]	Occurrence	Frequency of sightings
		also in the shallower waters of Rockall Bank to the west of the Corrib Area. Recorded in Broadhaven Bay.	
Blue whale *Balaenoptera musculus*	Endangered	Few sightings in Irish waters, although acoustic monitoring has confirmed that blue whales are present in small numbers throughout the year. Migrate annually along the western seaboard.	Unclear, but thought that November – December might represent peak time.
Fin whale *Balaenoptera physalus*	Vulnerable	The annual movements of fin whales are poorly understood, although acoustic surveys show the species may be detected throughout the year. Annual migration along western seaboard. Sightings also along the northwest continental shelf slopes. A single individual was recorded in Broadhaven Bay in 2008.	Unclear, contradictory evidence as recorded more regularly in summer months, although acoustic monitoring data suggest a peak in November – December.
Sei whale *Balaenoptera borealis*	Endangered	Generally considered to be a deep-water pelagic species, surveys have recorded sei whales throughout the offshore waters of the Irish Atlantic margin. Some records of sightings in inshore Irish waters (Visser *et al*, 2010) but thought generally uncommon to the northwest of Ireland.	April – December. They have a northerly distribution in Irish Atlantic Margin waters between April and June and a more southerly distribution in late summer and autumn.
Humpback whale *Megaptera novaeangliae*	Least concern	Chiefly sighted off the Irish south coast (particularly counties Cork, Kerry, Waterford, and Wexford). Relatively uncommon in the waters of north and west Ireland. However, there have been a number of casual sightings in offshore waters off the northwest of Ireland, where animals may have been using the shelf edge as a migratory corridor.	Peak between July and January.
North Atlantic right whale *Eubalaena glacialis*	Endangered	Likely to represent a vagrant species on the edge of their range in the northeast Atlantic. Populations historically decimated due to whaling, now extremely rare in Irish waters.	Summer months, if present.

2.4.2 Turtles

Five species of marine turtle have been recorded in Irish waters and are listed under Annex IV of the Habitats Directive. Of these, only the leatherback turtle (IUCN Red List status vulnerable), has been recorded with any regularity. Loggerhead (IUCN Red List status vulnerable) and Kemp's ridley turtle (IUCN Red List status critically endangered) occur infrequently, sometimes being recorded in winter and spring. Green (IUCN Red List status endangered) and hawksbill turtles (IUCN Red List status critically endangered) are considered vagrant species.

Providing an estimate of the number of leatherbacks foraging within Irish waters is difficult as their numbers may be extremely low. It is thought their northern distribution is limited by the position of the 15 °C isotherm (McMahon and Hays, 2006). As the position of this varies between years, the suitability of Irish waters for foraging leatherbacks may also vary, with favourable and unfavourable years in terms of abundance. Offshore surface water temperatures in the vicinity of the Corrib Field are reported to range from 14°C in August to 8°C in February (ERT, 2006). Leatherbacks migrate over large distances to feed on gelatinous zooplankton in temperate waters. As a result, sightings are regularly made in the summer along the entire western seaboard of Ireland.

2.5 Other designated receptor species in the vicinity of the proposed activities

2.5.1 Seals

Two species of seal breed on the west coast of Ireland, the harbour (common) seal (IUCN Red List status least concern) and the grey seal (IUCN Red List status least concern).

Grey seals are found around the entire Irish coastline. During the annual breeding season, between September and December, grey seals predominantly stay close to shore. The moulting season follows closely, occurring between the months of November and April. Grey seals are typically the most regularly observed seal species, and marine mammal, observed in the nearshore waters of Co. Mayo, in particular in Broadhaven Bay (Anderwald *et al.*, 2013). This is likely to be a result of proximity of the site to the Inishkea Islands, which represent the largest breeding and moulting colony of grey seals in Ireland (Ó Cadhla *et al*., 2007).

Adult grey seal are known to forage over large areas and may travel considerable distances from their haul-out sites. It is possible therefore that grey seals from important sites in Galway and Donegal may forage throughout the waters in the vicinity of the Corrib Field.

Important haul-out and breeding areas for harbour seals are found in counties Galway, Sligo and Donegal. Adult harbour seals generally breed in June or July each year. Soon after breeding, in August and September, harbour seals undergo their annual moult. During this time, they spend most of their time ashore. Harbour seals are also recorded regularly closer inshore in Broadhaven Bay, but in much lower numbers than that of grey seals.

The foraging range of harbour seals are thought to be much less than that of grey seals, with most trips only a few tens of kilometres from their favoured haul-out sites. However,

more recent studies have found that longer distance trips were not uncommon (ERT, 2006). It would be thus reasonable to assume that harbour seals may forage to offshore distances that potentially include the vicinity of the Corrib Field. It is recognised however that in the case of both species, that they are more likely to be encountered further inshore than the shelf break where the Corrib Field is located.

Both grey and harbour seals are listed as Annex II species under the EU Habitats Directive, i.e. species of community interest whose conservation requires the designation of SACs, as well as Annex V – i.e. those species whose exploitation must be compatible with maintaining a favourable conservation status. The SACs designated for seals are listed in the protected areas section (2.6) but are further considered in the Natura Impact Statement (RSK, 2020).

2.5.2 Fish

The offshore and coastal waters around Ireland are productive and support a diverse community of fish, with 377 marine fish species recorded. Important commercial species that occur on the continental shelf off the west coast of Ireland include pelagic species such as mackerel (*Scomber scombrus*), blue whiting (*Micromesistius poutassou*), herring (*Clupea harengus*), and albacore tuna (*Thunnus alalunga*), and demersal species such as monkfish (*Lophius piscatorius*), haddock (*Melanogrammus aeglefinus*), whiting (*Merlangius merlangus*), saithe (*Pollachius virens*), ling (*Molva molva*) and hake (*Merluccius merluccius*). Deepwater fish species present in the area include blackbelly rosefish (*Helicolenus dactylopterus*), roundnose grenadier (*Coryphaenoides rupestris*) and tusk (*Brosme brosme*). Of the fish populations in Irish waters listed here, most are considered of least concern on the IUCN Red List, however, some populations such as the European population of the roundnose grenadier are considered endangered (Cook *et al*., 2015).

None of the species are listed under Annex IV of the Habitats Directive, but the migratory fish Atlantic salmon (*Salmo salar*, IUCN Red List status vulnerable (European regional assessment)), sea lamprey (*Petromyzon marinus*, IUCN Red List status least concern), river lamprey (*Lampetra fluviatilis*, IUCN Red List status least concern), twaite shad (*Alosa fallax*, IUCN Red List status least concern) and allis shad (*Alosa alosa*, IUCN Red List status least concern) all occur in Annex II. Salmon migrate from the west coast of Ireland north towards Greenland (Marine Institute, 2019a) while the other species are more limited in their migratory pathways in coastal areas. The SACs which include these fish as designated features are listed in Section 2.6 and are considered in the Natura Impact Statement (RSK, 2020).

Important fish spawning and nursery areas are present offshore from Ireland and a “Biologically Sensitive Area” (BSA) was established by the EU Commission in 2003 as a result. This BSA is located to the south of the Corrib Field, off the south-west coast of Ireland (Marine Institute, 2019 b). There are spawning grounds off the Mayo coast for many of the demersal species found in the vicinity of the proposed survey area, including haddock, hake, cod (*Gadus morhua*), monkfish and whiting. The spawning period for most species is between late winter and spring. Eggs and young fish are pelagic, and the larvae can stay in the plankton for up to six months, and so the area is also an important nursery ground. The peak spawning for pelagic species such as mackerel is usually late spring / early summer (Coull *et al*., 1998; Marine Institute, 2009; Ellis *et al*., 2012).

However, it should be noted that spawning and nursery grounds are not fixed and may vary spatially over time, as may the spawning period.

2.5.3 Seabirds

A number of seabirds have been recorded in the vicinity of the Corrib Field. The coastal and offshore waters of Ireland are essential feeding grounds for many seabirds, including non-breeders and passage migrants, throughout the year. Species that have been recorded as present year-round include fulmar (*Fulmarus glacialis*), northern gannet (*Morus bassanus*) and European shag (*Phalacrocorax aristotelis*). Seasonal migrants include Manx shearwater (*Puffinus puffinus*) and storm petrel (*Hydrobates pelagicus*), while passage migrants include great (*Puffinus gravis*), Cory's (*Calonectris borealis*) and sooty (*Ardenna grisea*) shearwaters, and great skuas (*Stercorarius skua*) (Rogen *et al*., 2018). Most of these species are summer migrants, occurring in higher abundance between July and August, however some species such as great-northern diver (*Gavia immer*) occur mainly in winter.

Migrant and resident gull species, such as Sabine's gull (*Xema sabini*), glaucous gull (*Larus hyperboreus*), both species of black-backed gulls (*Larus marinus* and *Larus fuscus*), and black-legged kittiwakes (*Rissa tridactyla*) may also occur in the area. However, the waters in the vicinity of the Corrib Field, given their distance offshore, are regarded to have lower densities of seabirds than areas to the north and south and closer inshore during the summer months (Rogan *et al*., 2018).

Most populations of seabirds around the Irish coast are considered of least concern on the IUCN Red List. However, sooty shearwaters are considered near threatened and black-legged kittiwakes are considered vulnerable (BirdLife International, 2019).

Seabirds present in the area include species listed under Annex I of the EU Birds Directive (i.e. – those species that are of particular concern and require the designation of SPAs), and as such have coastal SPAs designated for them. These SPAs are listed in Section 2.6 and are further considered in the Natura Impact Statement (RSK, 2020).

2.6 Protected areas

Protected areas in the vicinity of the Corrib Field are shown in Table 2-2. The sites described are those with qualifying marine fauna species that could move into the area of the Corrib Field and had the potential to be impacted. These include long distance foraging and migratory species of birds, fish and marine mammals and megafauna. Nature Reserves, Natural Heritage Areas and National Parks were not considered as they are predominantly designated for terrestrial habitats and species, and these sites were geographically remote from the offshore location of the Corrib Field.

The European protected sites that have been listed in Table 2-2 are designated due to their qualifying receptor interest features of birds, fish and marine mammals that have the potential for pathway impacts as a result of the proposed activities at the Corrib Field. Sites have been included that take into consideration the likely foraging or migratory ranges of these species. Within these ranges are the potential ranges for impacts from for example underwater noise or fuel spill to the sea surface. Typical foraging / migration ranges being considered much greater are used as a worst case range for including protected sites. Typically for resident and semi-resident species of marine mammals the

foraging or migratory range has been assumed at approximately 200 km. For migratory fish and the majority of seabirds a similar distance of 200 km has been assumed. For certain species of seabirds however (northern gannet, Manx shearwater and fulmar, European storm petrel, and great skua), these ranges are extended based on the mean maximum estimated breeding season foraging ranges of these species discussed in Woodward *et al*., (2019). These can be up to 1347 km for Manx shearwater.

Figure 2-1 and Figure 2-2 shows the pertinent European sites in relation to the Corrib Field.

Table 2-2: Protected areas along the north-west Irish coast

Site name	Site code	Approximate distance from site to proposed area of works at closest point (km)
Special Area of Conservation (SAC)		
West Connacht Coast	002998	57 km
Inishkea Islands	000507	59 km
Duvillaun Islands	000495	64 km
Mullet/Blacksod Bay Complex	(000470)	64 km
Broadhaven Bay	000472	69 km
Glenamoy Bog Complex	000500	77 km
Owenduff/Nephin Complex	000534	85 km
Inishbofin and Inishshark	000278	94 km
Clew Bay Complex	001482	96 km
River Moy	002298	103 km
Mweelrea/Sheeffry/Erriff Complex	001932	105 km
The Twelve Bens/Garraun Complex	002031	111 km
Newport River	002144	111 km
Slyne Head Islands	000328	113 km
Maumturk Mountains	002008	118 km
Connemara Bog Complex	002034	118 km
Killala Bay/Moy Estuary	000458	120 km
Kilkieran Bay and Islands	002111	136 km
Lough Corrib	000297	147 km
Cummeen Strand/Drumcliff Bay (Sligo Bay)	000627	154 km
Slieve Tooey/Tormore Islands/Loughros Beg Bay	000190	154 km
Ballysadare Bay	000622	157 km
Lough Gill	001976	168 km
West of Ardara/Maas Road	000197	170 km

Site name	Site code	Approximate distance from site to proposed area of works at closest point (km)
Galway Bay Complex	000268	174 km
Rutland Island and Sound	002283	178 km
Lough Melvin	000428	178 km
Donegal Bay (Murvagh)	000133	187 km
Lough Eske and Ardnamona Wood	000163	194 km
Lower River Shannon	002165	209 km
Horn Head and Rinclevan	000147	214 km
Special Protection Area (SPA)		
Inishkea Islands	004004	59 km
Inishglora and Inishkeeragh	004084	61 km
Termoncarragh Lough and Annagh Machair	004093	64 km
Duvillaun Islands	004111	64 km
Blacksod Bay/Broadhaven	004037	65 km
Bills Rocks	004177	75 km
Stags of Broadhaven	004072	82 km
Clare Island	004136	89 km
Illanmaster	004074	91 km
Cruagh Island	004170	105 km
Connemara Bog Complex	004181	119 km
West Donegal Coast	004150	151 km
Ardboline Island and Horse Island	004135	154 km
Inishmore	004152	154 km
Inishmurray	004068	155 km
Inishduff	004115	165 km
Inner Galway Bay	004031	175 km
Cliffs of Moher	004005	185 km
Mid-Clare Coast	004182	197 km
Tory Island	004073	208 km
River Shannon and River Fergus Estuaries	004077	210 km
Loop Head	004119	210 km
Horn Head to Fanad Head	004194	215 km
Kerry Head	004189	226 km
Dingle Peninsula	004153	235 km
Blasket Islands	004008	247 km
Iveragh Peninsula	004154	264 km

Site name	Site code	Approximate distance from site to proposed area of works at closest point (km)
Puffin Island	004003	281 km
Skelligs	004007	286 km
Deenish Island and Scariff Island	004175	294 km
Beara Peninsula	004155	304 km
The Bull and The Cow Rocks	004066	309 km
Treshnish Isles	UK9003041	374 km
Rum	UK9001341	403 km
Irish Sea Front	UK9020328	530 km
Skomer, Skokholm and the Seas off Pembrokeshire / Sgomer, Sgogwm a Moroedd Penfro	UK9014051	620 km
Glannau Aberdaron ac Ynys Enlli/ Aberdaron Coast and Bardsey Island	UK9013121	635 km

As discussed in Section 2.4.1, the West Connacht Coast SAC is designated for bottlenose dolphins. The Lower River Shannon SAC is also designated for bottlenose dolphins.

The following 15 SACs listed in Table 2-2 are designated for seals:

- Inishkea Islands
- Duvillaun Islands
- Killala Bay/Moy Estuary
- Clew Bay Complex
- Cummeen Strand/Drumcliff Bay (Sligo Bay)
- Inishbofin and Inishshark
- Ballysadare Bay
- Slieve Tooey/Tormore Island/Loughros Beg Bay
- Slyne Head Islands
- Kilkieran Bay and Islands
- West of Ardara/Maas Road
- Donegal Bay (Murvagh)
- Rutland Islands and Sound
- Galway Bay Complex
- Horn Head and Rinclevan.

The following 16 SACs include one or more species of migratory fish (salmon, river and sea lamprey):

- Glenamoy Bog
- Owenduff/Nephin Complex
- River Moy
- Killala Bay/Moy Estuary
- Newport River

- Mweelrea/Sheeffry/Erriff Complex
- Cummeen Strand/Drumcliff Bay (Sligo Bay)
- The Twelve Bens/Garraun Complex
- Maumturk Mountains
- Lough Corrib
- Lough Gill
- Connemara Bog Complex
- Lough Melvin
- West of Ardara/Maas Road
- Lough Eske and Ardnamona Wood
- Lower River Shannon.

Certain SACs are also designated under the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) as Marine Protected Areas (MPAs) for marine biodiversity. These include:

- Mullet Bay/Blacksod Bay Complex (OSPAR site code: O-IE-0002972)
- Cummeen Strand/Drumcliff Bay (OSPAR site code: O-IE-0002973)
- Kilkieran Bay and Islands (OPSAR site code: O-IE-0002979)
- Galway Bay Complex (OSPAR site code: O-IE-0002969).

The SPAs that are included in Table 2-2 have qualifying species of seabird that have the potential to be present in the vicinity of the Corrib Field area at the time of the proposed P6 Flexible Flowline replacement works.

Figure 2-1 and Figure 2-2 shows the Natura 2000 designated sites listed in Table 2-2 in relation to the Corrib Field area.

The Natura 2000 sites, including the OSPAR MPAs, are discussed in more detail in the accompanying Natura Impact Statement (RSK, 2020).

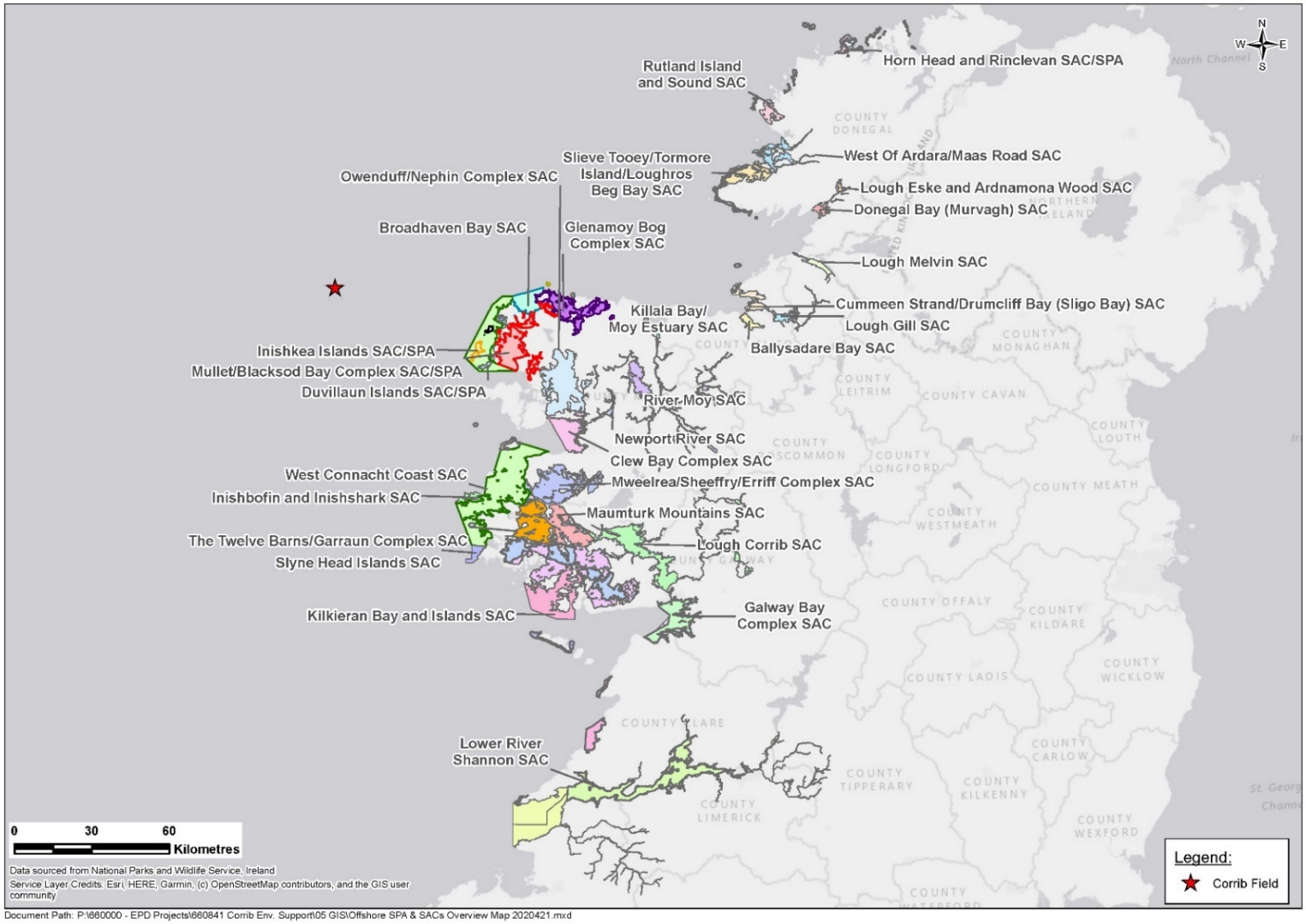

Figure 2-1: Pertinent European designated sites and their proximity (within a range of approximately 200 km) to the proposed flexible flowline replacement works at the Corrib Field

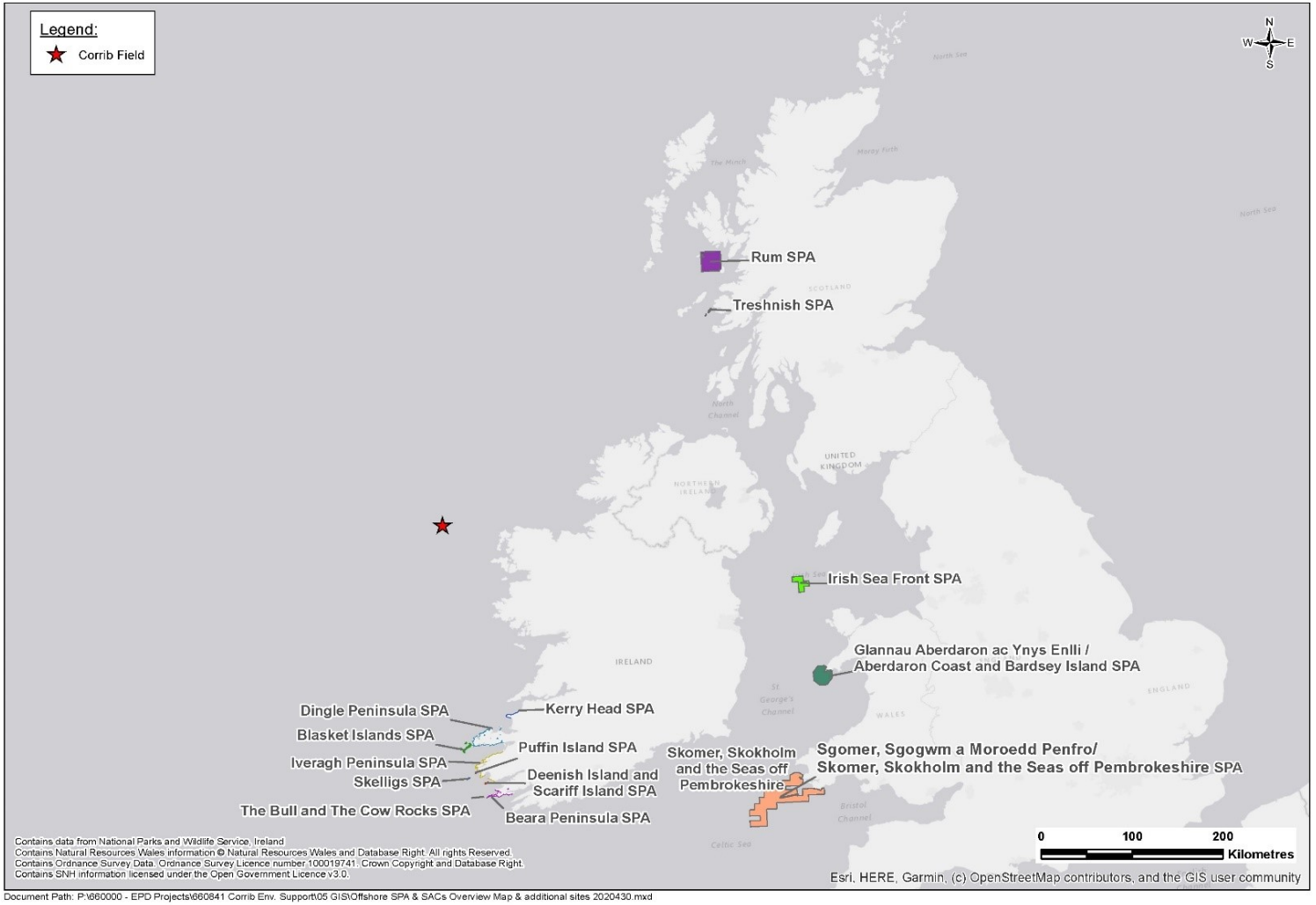

Figure 2-2: Pertinent European designated sites (SPAs) designated in part for their qualifying features of long distance foraging seabirds (gannet, fulmar, great skua, storm petrel and Manx shearwater) and their proximity (within a foraging range in excess of 200 km) to the proposed flexible flowline replacement works at the Corrib Field

2.7 Human environment

2.7.1 Fisheries

The area around the Corrib Field is considered to be of moderate value for commercial fishing, within an Irish context, and fishing activity occurs all year round when weather conditions are suitable. There is a fisheries exclusion zone within the Corrib Field at the end of the pipeline.

Based on records from fisheries observers, the main fishing ground in the Corrib Field area is the “West of Stags” area, with the demersal species the main catch: monkfish, haddock, saithe, whiting and hake (Gerritsen and Kelly, 2019). The main commercially important shellfish caught in the area include Dublin Bay prawn (*Nephrops norvegicus*), squid (*Loligo vulgaris*) and crab (*Cancer pagurus*). The Corrib Field and offshore parts of the pipeline route also lie within the spawning grounds for the Dublin Bay prawn.

Commercially important demersal species such as monkfish, haddock, saithe, whiting, ling and hake are also caught in the Corrib Field area and offshore parts of the pipeline route, by Irish, Spanish and French trawlers operating year-round. Towards the end of the pipeline there is medium fishing effort from Irish and international demersal otter trawls (Gerritsen and Kelly, 2019).

Pelagic species are fished by an international fleet of large vessels in spring and again from September to December. Irish pelagic trawls also take place. Pelagic trawl effort within the Corrib Field is spread along the pipeline, with most effort just outside the 12 nm boundary, while international long line effort is focused at the end of the pipeline. Irish pelagic trawl effort follows a similar pattern, with horse mackerel and mackerel the species landed into Ireland (Gerritsen and Kelly, 2019).

The fisheries nearer to shore focus on shellfish, and pelagic species such as mackerel, herring and blue whiting. Closer inshore to the east of the Corrib Field there is an area where herring and sprat (*Sprattus sprattus*) spawn.

Inshore fisheries in the area include those vessels operating out of Broadhaven Bay. Within Broadhaven Bay itself the most important fisheries are for crab and lobster (*Homarus gammarus*) that are fished by small, locally-based vessels mostly during the summer months, with weather conditions being restrictive at other times of the year. Potting, dredge fishing and line fishing are the main methods of fishing within the Bay.

Killybegs, Co. Donegal, is the largest port in Ireland for live fish landings and is located to the north east of the Corrib field. Killybegs lands predominately pelagic species, with a small proportion of demersal species. Small ports around Broadhaven Bay land mainly shellfish (Gerritsen and Kelly, 2019).

2.7.2 Shipping

Compared to the south and east coasts of Ireland, the north western coast has a relatively low density of shipping traffic (Figure 2-3 and Figure 2-4). The Mayo coast has only fairly minor ports, used primarily for nearshore fishing and recreational navigation. The port of Killybegs in Co. Donegal to the north east of the Corrib pipeline and Galway, Co. Galway, to the south east are the closest large ports.

Routes between Killybegs and Galway contribute to the shipping along the Co. Mayo coastline (Figure 2-3 and Figure 2-4). Shipping is generally concentrated in coastal waters, with vessels including cargo vessels, fishing vessels involved in nearshore activities and passenger vessels. Limited numbers of personal leisure boats (e.g. high speed crafts and/or sailing vessels) may also be in the coastal, inshore waters, particularly during the summer months.

Tankers and fishing vessels are generally the vessels with routes in offshore waters. The latest vessel density figures show a concentration of vessels around the end of the Corrib pipeline when compared to the surrounding area (EMODnet, 2019; Figure 2-3a), mainly related to the fishing areas described above (EMODnet, 2019; Figure 2-3b). Most vessels in the vicinity of the Corrib pipeline are likely Irish and international fishing vessels or vessels conducting works related to the Corrib pipeline itself.

2.7.3 Cultural heritage

There are no reported areas with cultural heritage significance in the Corrib Field. No features of archaeological significance were found during construction of the offshore pipeline from the Corrib Field to the landfall at Glengad.

2.7.4 Other users

Exploration activities for future oil and gas development are ongoing in the offshore acreages in the vicinity of the Corrib offshore field. The Corrib Field area is not used for military operations.

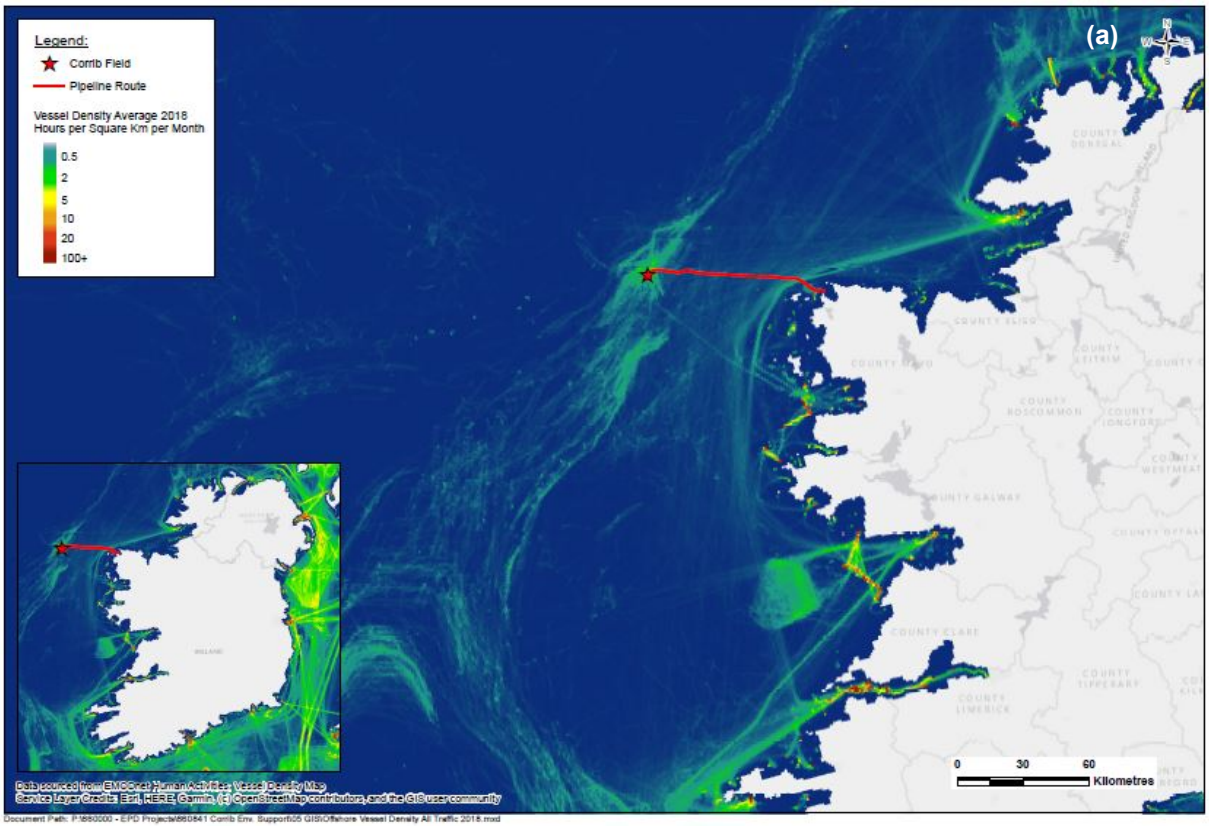

Figure 2-3: Average vessel density maps for the west coast of Ireland in 2018: (a) all vessel density, (b) fishing vessel density. Red star is the Corrib Field location. Source: EMODnet, 2019

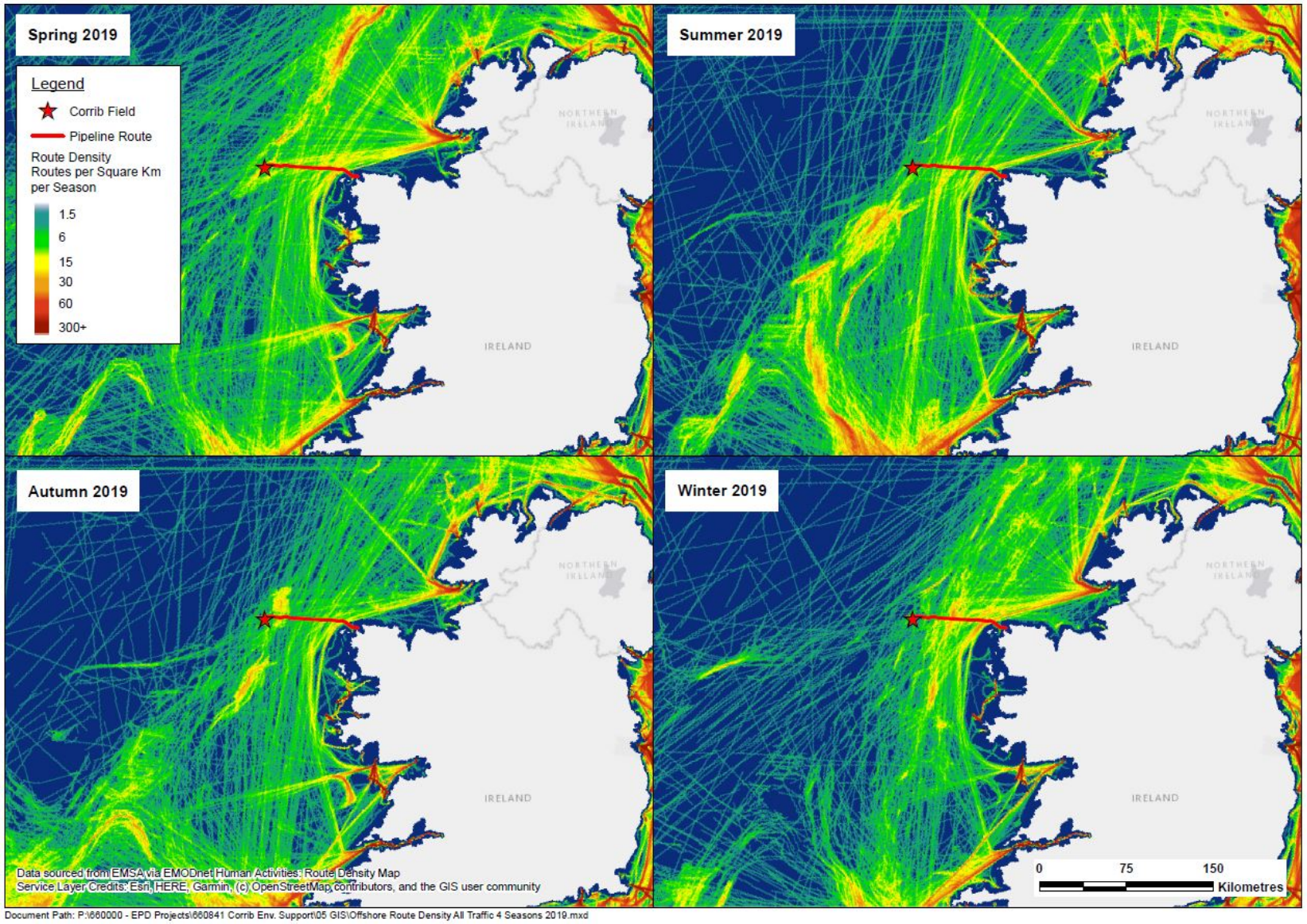

Figure 2-4. Route density around the west coast of Ireland, 2019. Source: EMSA, 2020

3 PROJECT DESCRIPTION

3.1 Introduction

The objective of the project is to replace the flowline from the P6 wellhead to the Corrib central manifold with a new shorter flowline. The proposed scope of works is as follows:

- Mobilisation of a suitable ROV support vessel (*Siem Spearfish*) and two ROVS from a UK port to the Corrib Field[5];
- Trials and verification of dynamic positioning (DP) system and ultra-short baseline system (USBL) to be undertaken outside of the 500 m Corrib Field exclusion zone;
- Completion of an As-Found Survey at the P6 work site, including underwater video/stills, acoustic geophysical survey and any seabed preparation works;
- Depressurisation and isolation of the existing flowline from the central manifold and P6 wellhead (gas displaced into subsea process system);
- Disconnection of existing flowline from central manifold and P6 wellhead (existing flowline will be left in situ on the seabed);
- Preparation of laydown area and lay route for new flexible flowline;
- Deployment of the new flexible flowline from the support vessel and connection to central manifold and P6 wellhead using ROVs;
- Pressure testing and pre-commissioning activities for new flowline;
- Installation of protective concrete mattresses along length of new flexible flowline and in places along disconnected flowline to provide stability;
- Reinstatement of the worksite and completion of an As-Left Survey including underwater video / stills and geophysical survey;
- Demobilisation of the support vessel and ROVs back to UK port.

3.2 Overview of equipment and materials

The equipment and materials required for the work scope includes, but is not limited to, the following:

- ROV construction support vessel (Figure 3-1 shows the proposed vessel *Siem Spearfish* and outline specifications for this vessel are provided in Table 3-1).
- Two work class ROVs coupled with ROV tooling that will include: rock replacement system, mattress lifting beam, water jet cleaner, ICARUS remote intervention tooling (Integrated Connection tool And ROV operated Underwater System, see Figure 3-5), and the new 158 m 8” diameter flexible flowline.

[5] It should be noted that all vessel refuelling will take place in port.

- Concrete protection mattresses including twenty for the installation of the new flowline and two for stabilising the decommissioned flowline (dimensions of 6 x 4 x 0.15 m).
- Sub-sea pre-commissioning spread (on ROV support vessel) and chemicals including Alcogel, methanol, corrosion inhibitor, biocide, oxygen scavenger and leak detection dye (see Table 3-2). It should be noted that the majority of these chemicals will not be released to sea during operations. A small quantity of treated inhibited potable water containing Alcogel and RX5225 is the exception. Further information is provided in Table 3-2 regarding the degree of toxicity, biodegradation, bioaccumulation in the aquatic environment for the chemicals that will be used as part of the work scope. Chemicals are assessed based on the OSPAR Harmonised Mandatory Control Scheme (HMCS). Chemicals are ranked according to their calculated Hazard Quotients (HQ) by the CHARM (Chemical Hazard Assessment and Risk Management) mathematical model, which uses toxicity, biodegradation and bioaccumulation data provided by the chemical suppliers. The Hazard Quotients are presented as a coloured banding from Gold to Purple (Least hazardous to most hazardous). In addition to the HMCS, chemicals can also be given a ranking under the Offshore Chemical Notifications Scheme (OCNS) based on toxicity in the water column and aquatic sediments. Chemicals are ranked A-E (greatest toxicity to least toxicity). As can be seen in Table 3-2 the chemicals proposed for use are either Gold Band or Group E.
- Sand bags or rock gabions temporarily installed as turning bollards that will be recovered to the support vessel following operations
- Survey equipment for the As-Found and As-Left surveys, detailed further in Section 3.6.

Table 3-1: Specifications of proposed ROV support vessel - *Siem Spearfish*

Parameter	Specification
Name	*Siem Spearfish* (IRM & Light Construction)
Owner	Siem Offshore
Type	ROV Survey / Construction Support Vessel
Length (overall)	120.9 m
Breadth	23 m
Deck cargo area	1,350 m^2
Tonnage (Gross)	5,000 t

Figure 3-1: Proposed ROV support vessel (*Siem Spearfish*)

Table 3-2: Composition and use of proposed chemicals

Chemical	Composition and function	Proposed use in project	Quantity (high level estimates)	Toxicity, biodegradation and bioaccumulation Information
Alcogel	Pipeline gel	Alcogel will be added to the inhibited potable water that the new flexible flowline will be prefilled with. A small volume of this inhibited potable water treated with this gel (and RX5225) will be released at the central manifold, the volume being that of the new flexible flowline (158 m in length).	1000 litres	OCNS Group E, PLONOR.
Methanol	To control hydrate formation. REACH[6] Use Descriptor Product Category Code 20: processing aids such as pH-regulators, flocculants, precipitants, neutralization agents	Methanol will be used to flush the new flexible flowline prior to connection and will be retained within the subsea process system and processed at BBGT	2000 litres	OCNS Group E, PLONOR.
RX5225	Corrosion inhibitor/ biocide/oxygen scavenger/leak detection dye	RX5225 will be used to treat the inhibited potable water that the new flexible flowline will be prefilled with. A small volume of the inhibited potable water treated with this chemical (and Alcogel) will be released at the central manifold, the volume being that of the new flexible flowline (158 m in length).	25 litres	OSPAR HMCS HQ Band Gold.
RX5208	Combined solid oxygen scavenger and biocide Globally Harmonised System (GHS) hazard statement H400: very toxic to aquatic life.	RX5208 oxygen scavenger/biocide sticks will be used to tie in the ends of the new flowline. The chemicals will be retained within the subsea process system and processed at BBGT	1.5 kg	OSPAR HMCS HQ Band Gold.
RX9034A	Leak detection dye	RX9034A dye sticks will be used during the leak test of the new	0.5 kg	OSPAR HMCS HQ Band Gold.

[6] Registration, Evaluation, Authorisation and Restriction of Chemicals (EC 1907/2006).

Chemical	Composition and function	Proposed use in project	Quantity (high level estimates)	Toxicity, biodegradation and bioaccumulation Information
	REACH Use Descriptor Product Category Code 20: see above	flowline. The chemical will be retained within the subsea process system and processed at BBGT		

An estimate for atmospheric emissions from the proposed operations to be conducted by the *Siem Spearfish* is presented below in Table 3-3. Standard industry values for fuel consumption for a typical MSV/Lift Vessel have been assumed. These are 30 tonnes/day (transit) and 20 tonnes/day (operational). These values represent a worst-case scenario but are consistent with those used in the original Corrib offshore EIS (RSK, 2001). The *Siem Spearfish* is a modern vessel that has been built according to the Clean Design class requirements and as such is fitted with fuel efficient diesel-electric propulsion and emissions control equipment.

The workscope period (operations) on site at the Corrib Field has been assumed at 6 days, with an assumed half a day transit to and from Killybegs for the mobilisation and demobilisation of personnel and equipment.

Based on the weighted values presented below in Table 3-3, greenhouse gas (GHG) emissions from the vessel for the duration of the workscope have been estimated at approximately 491 tonnes. This GHG estimate includes CO_2, CH_4 and nitrous oxides, with weightings applied to CH_4 and nitrous oxides based on those proposed by the Intergovernmental Panel on Climate Change (IPCC 2013-AR5).

Table 3-3: Estimate of air emissions generated from the *Siem Spearfish* during the P6 Flowline Replacement Programme

Survey	Average Fuel Consumption Estimate (tonnes/day)	Period (days)	Fuel Consumption for Survey Period (tonnes)	Total Emissions (tonnes)[1]							
				NO_x	CO	HC	CO_2	SO_2	CH_4	Particulates	GHG (CO_2 equivalent)
***Siem Spearfish* (transit to and from Killybegs)**	30	1	30	1.77	0.24	0.081	95.1	0.24	0.0081	0.036	98.24
***Siem Spearfish* (on Operations)**	20	6	120	7.08	0.96	0.327	380.4	0.96	0.0324	0.144	392.97
Total emissions				**8.85**	**1.2**	**0.408**	**475.5**	**1.2**	**0.0405**	**0.18**	**491.21**

[1] Source of emission parameters: 'Methods for Estimating Atmospheric Emissions from E&P Operations' Report No. 2.59/197, E&P Forum, September 1994 (medium speed emission parameters).

NO_x 59 kg/tonne of fuel
CO 8 kg/tonne of fuel
HC 2.7 kg/tonne of fuel
CO_2 3170 kg/tonne of fuel
SO_2 20 x S (assumes a sulphur content for marine diesel of 0.4% by weight). Calculated as fuel usage x 0.4 x 20/1000
CH_4 0.27 kg/tonne of fuel
Particulates 1.2 kg/tonne of fuel

GHGs have been calculated based on those emissions that are considered to be the gases having a direct greenhouse effect namely: CO_2, CH_4, and nitrous oxides. Their respective weighting is given by the Intergovernmental Panel on Climate Change (IPCC 2013-AR5): GHG (tCO_2e – 100-year time horizon, climate feedbacks included) = 1 CO_2 + 34 CH_4+ 298 nitrous oxides.

3.3 Location

The work will be carried out in the Corrib Field between the P6 wellhead and the Corrib central manifold.

The location of the Corrib Field offshore and due west of the coast of Ireland is presented in Figure 1-1 and Figure 3-2, an overview of the Corrib subsea system and the location of the P6 wellhead and central manifold is provided in Figure 3-3. A more detailed figure showing the different options for the new flowline is provided in Figure 3-4.

3.4 Workscope programme

It is anticipated that the flowline replacement works will be approximately 6 days in duration and will take place in either 2021 or 2022 (between the months of May and October)[7].

While the overall duration of the works is expected to take 6 days, the As-Found and As-Left Surveys at the beginning and end of the programme would be expected to take less than 1 day each in duration.

[7] Timescale estimates dependent on regulatory approvals and weather/ sea state conditions.

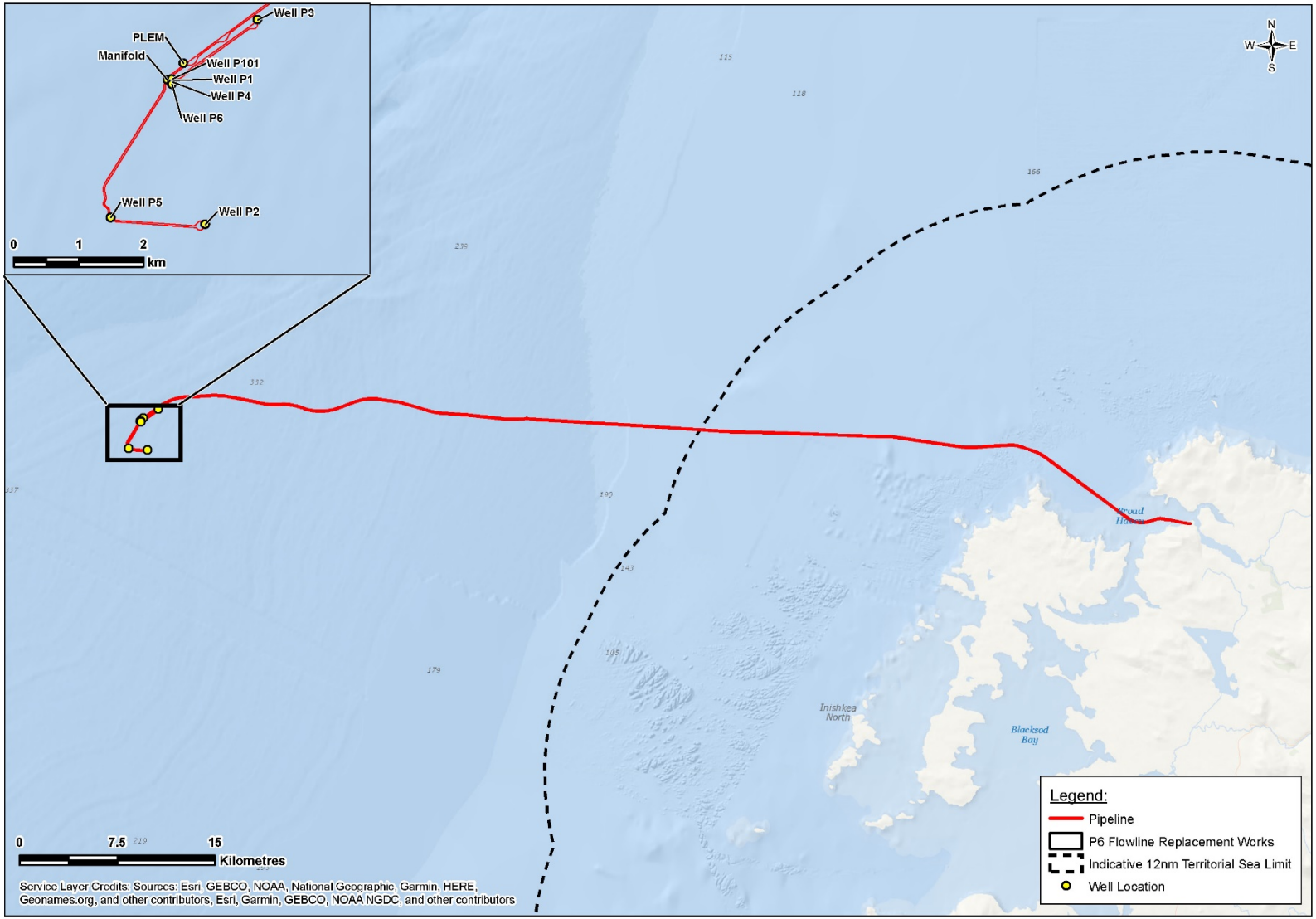

Figure 3-2: Location of Corrib Field and P6 wellhead

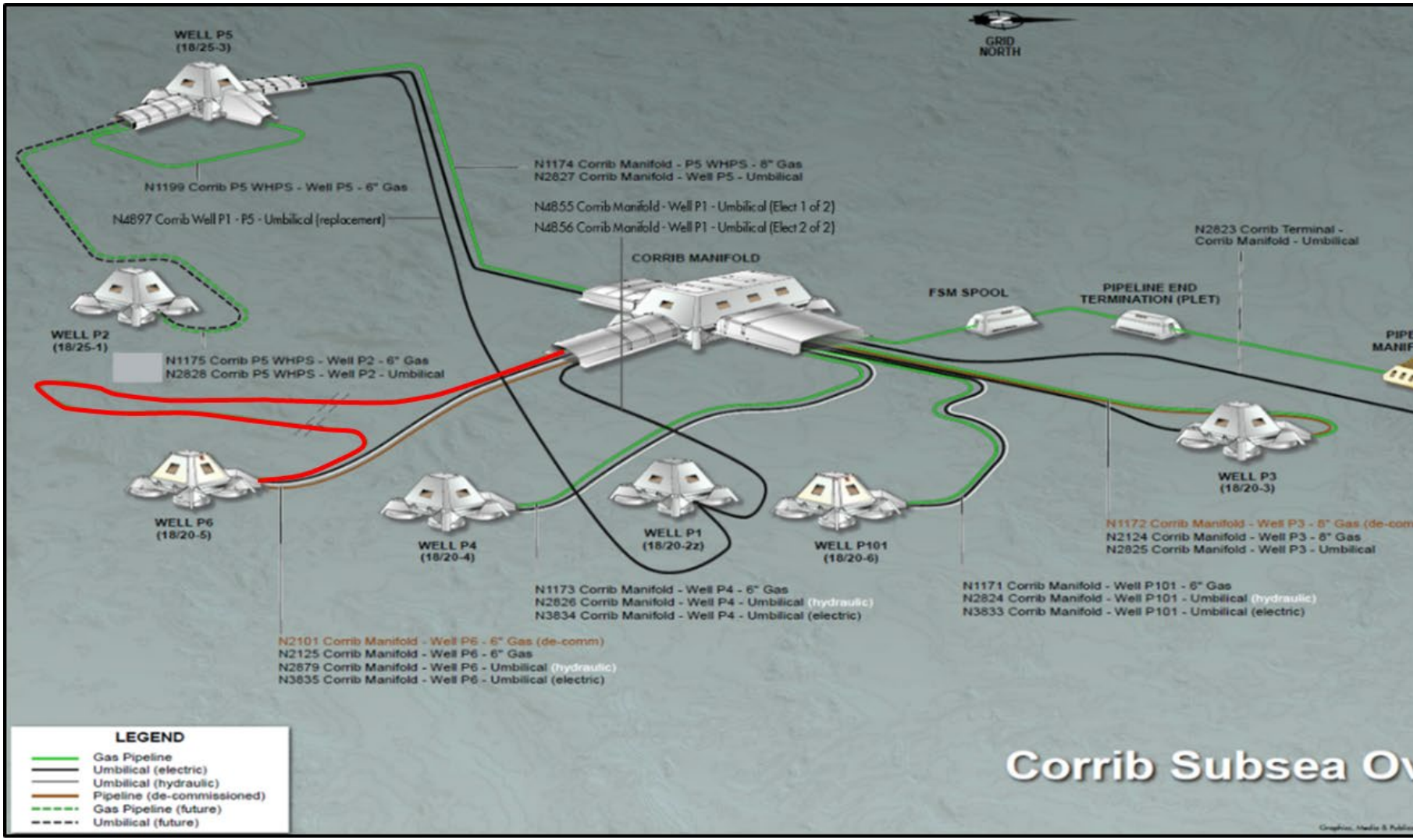

Figure 3-3: Corrib sub-sea overview and proposed P6 flowline replacement

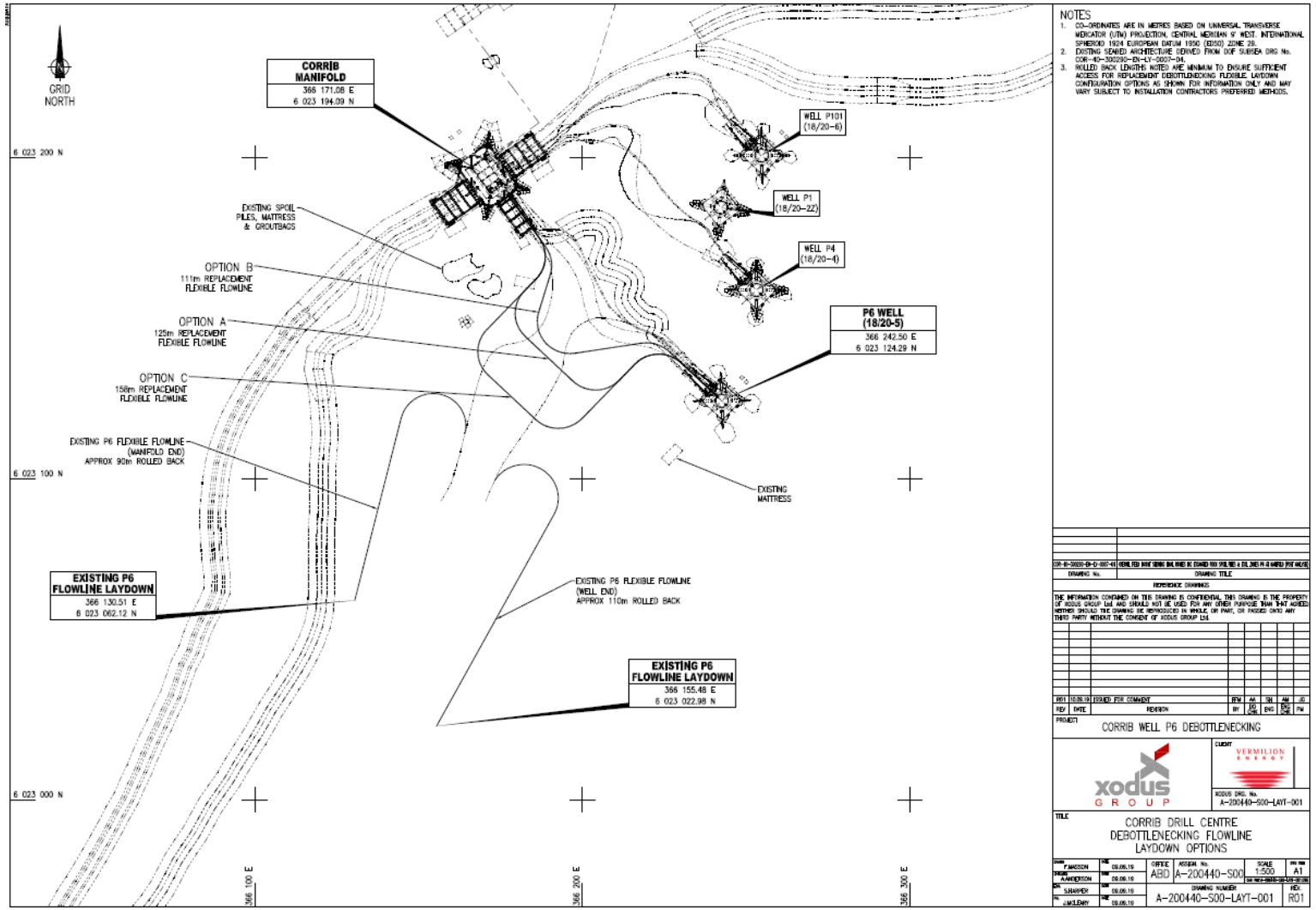

Figure 3-4: Detailed location of existing flowline to be decommissioned, and potential locations of new flexible flowline

3.5 Detailed information on flowline replacement

The following sequence of works will be conducted:

Firstly, the protection covers of the Corrib central manifold and P6 wellhead will be removed. Concrete mattresses (twenty for the new flowline and two for the existing flowline) will then be lowered to the sea surface by a vessel crane and disconnected and laid down on the seabed by ROV. The mattresses will act as target boxes for the termination heads of the new flowline. A temporary weight and buoyancy module, and temporary turning bollards (gabion bags filled with gravel or grout) will also be laid on the seabed by ROV. The turning bollards will be used to aid the turning of the new flexible flowline. The weight and buoyancy module, and turning bollards, will be recovered to the support vessel following the works.

The new 158 m flexible flowline (pre-filled with potable inhibited water containing Alcogel and RX5225) will be laid by ROV along the concrete mats, between the P6 wellhead and the central manifold. The existing 1560 m flowline with then be depressurised and the gas (approx. 27 m^3) displaced into the manifold and subsea process system, and isolations carried out at the P6 wellhead and manifold. The ICARUS remote tie-in tool will be used to disconnect the existing flowline and connect the new flowline to the P6 wellhead and manifold (see Figure 3-5). Prior to connection, the inhibited potable water will be displaced from the new flowline to sea and the flowline flushed with methanol via a downline from the ROV support vessel connected to the P6 wellhead. The methanol will be retained within the subsea process system and sent to BBGT.

When connected, the new flowline will be pressure tested for leaks via a downline from the support vessel to the P6 wellhead. The RX9034a leak detection dye and RX5208 oxygen scavenger and biocide used during this phase will be retained within the subsea process system and sent to BBGT.

At the end of testing, the subsea equipment protection covers will be reinstalled. The concrete mattresses will be placed on top of the new flowline and the de-commissioned flowline to provide protection cover and stability. Corrosion inhibited water will then be used to fill the disconnected flowline and end caps installed for storage on the seabed for future use as needed.

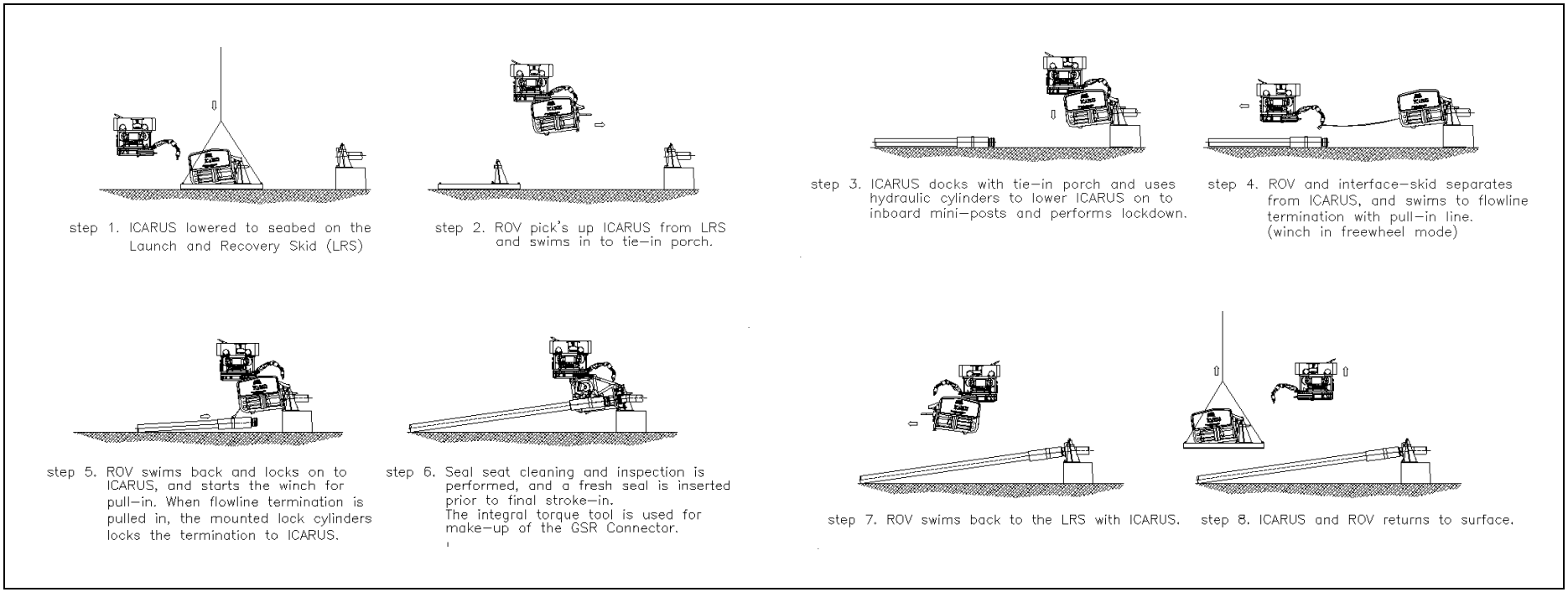

Figure 3-5: Step-by-step tie-in sequence illustration - Integrated Connection tool And ROV operated Underwater System (ICARUS)

3.6 Detailed information on navigation, positioning, communications and survey equipment

3.6.1 Navigation, positioning and communication equipment

A range of sensors will be used as part of the operations and As-Found and As-Left surveys for navigation, positioning and communication between the support vessel and ROVs including a vessel DGNSS positioning system (differential global navigation satellite system), vessel high-accuracy GPS based heading reference and motion sensor, single-beam depth sounder, obstacle avoidance sonar, vessel 501 HiPAP (high precision acoustic positioning) USBL system, ROV USBL transponder/responder, and ROV survey class gyro compass and motion sensor (for accurate positioning and speed determination).

The vessel and ROVs will use an Ultra Short Baseline (USBL) beacon system for maintaining position and communications with any deployed equipment. USBL systems operate at a frequency of between 21 and 31 kHz at a very low intensity. The ROV will utilise a Doppler Velocity Log (DVL) for accurate positioning and speed determination. This operates at a relatively high frequency of 1200 kHz, also at negligible intensity, while a similar system will operate on the vessel itself operating at an extremely high frequency of 2 MHz, at negligible source levels of intensity. The ROV will also utilise a high accuracy bathymetric sensor which operates at a frequency of around 500 kHz and an obstacle avoidance sonar system, which operates at a frequency of around 675 kHz. All of these pieces of equipment operate a low source levels of intensity.

Prior to entering the 500 m Corrib exclusion zone, trials and verifications will be undertaken of the USBL systems. The testing of the USBL systems will have an acoustic signature although this operates at a very low intensity and the test will be conducted for a short duration.

Specifications for the acoustic survey and communication equipment are provided in Table 3-4.

3.6.2 As-Found and As-Left Surveys

An As-Found Survey will be carried out at the start of the flowline replacement works in order to get an accurate record of current seabed conditions. The As-Left conditions will also be recorded by carrying out another survey at the end of the works.

The primary sensor for the collection of geophysical data will be by a ROV forward looking multi-beam echosounder (MBES). The MBES system will operate at a frequency of 400 kHz. The equipment will operate at relatively low levels of source intensity compared to lower frequency geophysical exploration surveys, which use a percussive airgun as the sound source.

A MBES is a type of sonar that is used to map the seabed. MBES systems transmit sound energy and analyse the return signal (echo) that reflects off the seafloor or other objects. The MBES system records the time for the acoustic signal to travel from the transmitter (transducer) to the seafloor (or object) and back to the receiver. Unlike other sonars, multibeam systems extract directional information from the returning soundwaves,

producing a swath of depth readings from a single ping. Specifications for this acoustic survey equipment are provided in Table 3-4.

The area of operations will be in the vicinity of the P6 wellhead and Corrib central manifold within the Corrib Field (Figure 3-3). Figure 3-3 shows the full spatial extent of the work programme including the As-Found and As-Left surveys which will focus in particular on the area of the existing P6 flexible flowline, and the area where the new flowline will be laid, as well as the areas where the ends of the existing P6 flowline will be laid down for seabed storage when it is decommissioned. To cover the full seabed extent as detailed above, it is estimated that the total coverage of MBES in the As-Found and As-Left surveys will be approximately 2 line km.

Soft start

A soft start involves a gradual ramping up of sound intensity from underwater acoustic equipment to allow marine fauna to move away from the area before they are exposed to significant noise levels.

If the intensity cannot gradually be increased from a low level to operational levels, then the equipment can be switched on and off in a sequential manner for a few seconds at a time for a soft start / ramp up period of 20 minutes prior to the equipment being used for operations (NPWS, 2014).

According to NPWS guidance (2014), soft start for acoustic surveys is required for surveys within bays, inlets or estuaries and within 1,500 m of the entrance of enclosed bays / inlets / estuaries or as advised by the relevant regulatory authority. As such, soft start procedures would not be required for the As-Found and As-Left Surveys at the Corrib Field due to the open sea location of the proposed work activities. However, in line with environmental best practice, soft start procedures will be followed during the surveys when using the MBES survey equipment. When the ROV is first put into the water alongside the survey vessel prior to commencing the As-Found and As-Left surveys the MBES and any other acoustic sensors will be activated to commence the soft-start at this time, while on the surface so that marine mammal observers can monitor a 500 m exclusion zone during the soft-start procedure. The As-Found and As-Left surveys will be commenced in daylight hours so that the soft-start and initial part of the surveys can be monitored by MMOs before the ROV descends to its operating depth to undertake the survey.

Table 3-4: Acoustic equipment specifications and operating frequency ranges

Equipment	Specification and operating frequency range
Vessel Doppler Velocity Log	2 MHz
Vessel Kongsberg 501 HiPAP USBL system	21-31 Hz
Vessel single beam echo sounder	38 kHz – 200 kHz (Typically operates at 50kHz)

Equipment	Specification and operating frequency range
Valeport MVS Sound Velocity Sensor	2.5 MHz
ROV USBL transponder / responder	21-31 Hz
ROV RDI Workhorse Doppler Velocity Log	1200 kHz
ROV high accuracy bathymetric sensor	Tritech SK704 altimeter - 500 kHz
ROV forward looking multibeam sensor (MBES)	Reson Seabat 7125 dual head Multibeam echosounder - 400 kHz
Kongsberg MS1000 obstacle avoidance sonar	675 kHz

A Valeport Mini Sound Velocity probe will also be deployed occasionally throughout the As-Found and As-Left surveys to provide salinity, conductivity, temperature and sound velocity depth information. These probes operate at an extremely high frequency of around 2.5 MHz at a very low level of intensity. This allows periodic calibration of the primary acoustic survey (MBES) sensors.

4 EIA SCREENING ASSESSMENT

Table 4-1 presents the findings of the screening assessment for an EIA based on Annex III of the amended 2014 EU EIA Directive (Directive 2014/52/EU) that sets out the criteria under Article 4 on whether a project requires an EIA. In addition, reference is made to the EIA guidance relating to the EIA Directive (European Commission EIA Screening Guidance (2017)), the original text of which was summarised in ERM (2001) and the updates in the 2014 amendments in European Commission (2017) and WYG (2017). Table 4-1 takes this guidance into consideration and is aligned with the DCCAE EIA Guidance Screening Table (DCCAE, 2019).

Table 4-1: EIA screening assessment table for the P6 Flexible Flowline installation (based on DCCAE, 2019)

Questions to be considered for further guidance on factors to be considered see the more detailed questions listed in the Scoping Guidance	Yes/No/? Briefly describe	Is this likely to result in a significant effect? Yes/No/? Why?
A description of the project activities is provided in Chapter 3.		
1. Will construction, operation or decommissioning of the project involve actions which will cause physical changes in the locality (topography, land use, changes in waterbodies, *etc*)?	Yes – installation of a new flexible flowline and concrete mattresses, de-commissioning of the old flowline. Loss of benthic habitat where the new flowline is installed, and disturbance where the old flowline terminations at the P6 wellhead and Corrib central manifold are pulled back. A small quantity of inhibited potable water containing and gel pill (Alcogel) and dye will be released to sea.	No – Area of permanent change and temporary disturbance to the benthic habitat will be limited in extent. Benthic assemblage does not include any species that are of conservation concern and is typical of the deep-water shelf environment off Ireland's Atlantic coast.
2. Will construction or operation of the project use natural resources such as land, water, materials or energy, especially any resources which are non-renewable or in short supply?	Yes – Fuel oil, diesel, lube oil will be used on the ROV support vessel.	No – Limited vessel use for surveys and flowline replacement activities.
3. Will the project involve use, storage, transport, handling or production of substances or materials which could be harmful to human health or the environment or raise concerns about actual or perceived risks to human health?	Yes - Vessel fuel, lube oil, gel pill (Alcogel), methanol, corrosion inhibitor, biocide, oxygen scavenger and leak detection dye.	No – Regulations and safety measures will limit risk from vessel fuel and other related chemicals. A small volume of inhibited potable water (containing Alcogel and RX5225) will be released to sea at the

Questions to be considered for further guidance on factors to be considered see the more detailed questions listed in the Scoping Guidance	Yes/No/? Briefly describe	Is this likely to result in a significant effect? Yes/No/? Why?
		central manifold, however this will quickly disperse, and the composition of the release will not pose a risk to the surrounding water quality or life. Other chemicals used in works scope will be retained within the subsea process system. MDSS sheets will be made available for any chemicals used in the work scope. All chemicals will be (where appropriate) those that are considered to Pose Little or No Risk to the Environment (PLONOR), as well as being registered on the Offshore Chemical Notification Scheme (OCNS) and Harmonised Mandatory Control Scheme (HMCS) and ranked accordingly based on their toxicity, biodegradation, and bioaccumulation.
4. Will the project produce solid wastes during construction or operation or decommissioning?	Yes – Relatively small quantities of shipboard solid wastes generated.	No – all shipboard solid wastes will be controlled according to MARPOL 73/78 Annex V and disposed appropriately onshore.
5. Will the project release pollutants or any hazardous, toxic or noxious substances to air?	Yes – Vessel engines and plant exhausts.	No – Low levels of emissions and temporary nature of operations. Vessel emissions controlled according to MARPOL 73/78 Annex VI.

Questions to be considered for further guidance on factors to be considered see the more detailed questions listed in the Scoping Guidance	Yes/No/? Briefly describe	Is this likely to result in a significant effect? Yes/No/? Why?
6. Will the project cause noise and vibration or release of light, heat energy or electromagnetic radiation?	Yes – Underwater noise and disturbance from the ROV support vessel movements and operation of geophysical survey equipment.	No – Limited extent of survey area affected. Minimal use of acoustic survey equipment, for As-Found and As-Left surveys only. Use of appropriate mitigation measures in the form of soft starts, adherence to NPWS guidance. Equipment frequency with minimal overlap with the auditory sensitivity of receptor species. Temporary nature of operations.
7. Will the project lead to risks of contamination of land or water from releases of pollutants onto the ground or into surface waters, groundwater, coastal waters or the sea?	Yes – Accidental releases of fuel or chemicals could impact on the receiving environment.	No – Following of industry recognised best practice and relevant regulations will minimise potential risk There are no requirements for refuelling of any deck equipment out of port Maintenance, audits and inspection plans will be in place to mitigate the risk of potential leaks at an early stage. In the extremely unlikely event of an oil/diesel spill from the vessel deck equipment, oil spill equipment will be available on-board with training provided to staff A Shipboard Oil Pollution Emergency Response Plan will be in place on the vessel. Vessel fuelling will be undertaken only under controlled conditions in port
8. Will there be any risk of accidents during construction or operation of the project which could affect human health or the environment?	Yes – Risks related to vessel operations at sea.	No – Following of industry recognised best practice and relevant regulations will minimise potential risk.

Questions to be considered for further guidance on factors to be considered see the more detailed questions listed in the Scoping Guidance	Yes/No/? Briefly describe	Is this likely to result in a significant effect? Yes/No/? Why?
9. Will the project result in social changes, for example, in demography, traditional lifestyles, employment?	No	N/A
10. Are there any other factors which should be considered such as consequential development which could lead to environmental effects or the potential for cumulative impacts with other existing or planned activities in the locality?	No	N/A
11. Are there any areas on or around the location which are protected under international or national or local legislation for their ecological, landscape, cultural or other value, which could be affected by the project?	Yes – West Connacht Coast SAC and other Natura 2000 sites. Refer to accompanying Natura Impact Statement report (RSK, 2020 as well as the summary information provided in Section 2.6).	No – Limited potential for disturbance. Short duration of survey activities.
12. Are there any other areas on or around the location which are important or sensitive for reasons of their ecology e.g. wetlands, watercourses or other waterbodies, the coastal zone, mountains, forests or woodlands, which could be affected by the project?	No	N/A
13. Are there any areas on or around the location which are used by protected, important or sensitive species of fauna or flora e.g. for breeding, nesting, foraging, resting, overwintering, migration, which could be affected by the project?	Yes – Marine mammals and seabird use the waters in the vicinity of the proposed survey operations.	No – Limited extent and temporary nature of proposed operations along with appropriate mitigation measures in place.
14. Are there any inland, coastal, marine or underground waters on or around the location which could be affected by the project?	Yes – Operation is to be undertaken at sea.	No – Likely impacts have been considered to be of only minor overall significance.
15. Are there any areas or features of high landscape or scenic value on or around the location which could be affected by the project?	No	N/A
16. Are there any routes or facilities on or around the location which are	No	N/A

Questions to be considered for further guidance on factors to be considered see the more detailed questions listed in the Scoping Guidance	Yes/No/? Briefly describe	Is this likely to result in a significant effect? Yes/No/? Why?
used by the public for access to recreation or other facilities, which could be affected by the project?		
17. Are there any transport routes on or around the location which are susceptible to congestion or which cause environmental problems, which could be affected by the project?	No	N/A
18. Is the project in a location where it is likely to be highly visible to many people?	No	N/A
19. Are there any areas or features of historic or cultural importance on or around the location which could be affected by the project?	No – The area of works is an established offshore gas field.	N/A
20. Is the project located in a previously undeveloped area where there will be loss of greenfield land?	No – The area of works is within an existing offshore gas field with established infrastructure installed on the seabed.	N/A
21. Are there existing land uses on or around the location, e.g. homes, gardens, other private property, industry, commerce, recreation, public open space, community facilities, agriculture, forestry, tourism, mining or quarrying which could be affected by the project?	No	N/A
22. Are there any plans for future land uses on or around the location which could be affected by the project?	No	N/A
23. Are there any areas on or around the location which are densely populated or built-up, which could be affected by the project?	No	N/A
24. Are there any areas on or around the location which are occupied by sensitive land uses e.g. hospitals, schools, places of worship, community facilities, which could be affected by the project?	No	N/A
25. Are there any areas on or around the location which contain important, high quality or scarce resources e.g. groundwater, surface	Yes – The area is used for sea fisheries.	No – Temporary nature of operation and consultation with fishing organisations

Questions to be considered for further guidance on factors to be considered see the more detailed questions listed in the Scoping Guidance	Yes/No/? Briefly describe	Is this likely to result in a significant effect? Yes/No/? Why?
waters, forestry, agriculture, fisheries, tourism, minerals, which could be affected by the project?		will take place in advance of planned works. The work will be scheduled to minimise the operational duration and limited to a small an area as possible.
26. Are there any areas on or around the location which are already subject to pollution or environmental damage e.g. where existing legal environmental standards are exceeded, which could be affected by the project?	No	N/A
27. Is the project location susceptible to earthquakes, subsidence, landslides, erosion, flooding or extreme or adverse climatic conditions e.g. temperature inversions, fogs, severe winds, which could cause the project to present environmental problems?	Yes – The area of works has an open aspect to the North Atlantic and is therefore subject to frequent bad weather conditions.	No – Operations are designed to be undertaken in such locations.

The screening assessment has concluded that, in all likelihood, an EIA would not be required. Further consideration of the impacts and suggested mitigation measures for species sensitive to underwater noise and disturbance, including those listed under Annex IV of the EU Habitats Directive 92/43/EEC Article 12, are discussed in Sections 5 – 7.

5 IMPACT ASSESSMENT

One of the most important environmental concerns arising from the proposed activities are the potential effects of underwater sound on different marine biota, specifically animals protected under Annex IV of the EU Habitats and Species Directive, as well as other receptor species that are potentially sensitive to the underwater noise and disturbance impacts generated from the proposed survey operations.

During the deployment of acoustic survey equipment, there exists the potential for marine life to be disturbed or displaced. In order to assess the potential impacts of acoustic geophysical surveys on receptor species, the characteristics of the sound source, sound propagation, the auditory sensitivity of the biota, and mitigation measures all need to be considered.

5.1 Primary acoustic equipment sound source characteristics

5.1.1 MBES

MBES is proposed for use as the primary survey sensor for the As-found and As-Left surveys at the Corrib Field and is proposed to be carried out using forward looking sensors on the ROV. The MBES transducers in this instance will be mounted on an ROV, allowing for the use of a higher frequency (400 kHz) than could normally be used from a vessel mounted device in deeper waters areas, such as those present in the vicinity of the Corrib Field.

Based on the proposed models of MBES (see Table 3-4), the peak source level expected, or maximum amplitude, will be in the range of 223 dB re: 1µPa @1 m.

5.1.2 Other acoustic sources

The obstacle avoidance and altimeter systems proposed for use on the ROV operate at relatively high frequencies (500 - 675 kHz), compared to that of the primary survey equipment. These high frequencies are outside of the peak hearing thresholds of most cetaceans and pinnipeds, with ~500 kHz being beyond the upper limit of harbour porpoises peak hearing frequency threshold (Southall *et al*., 2019). The migratory fish that are likely to be in the vicinity of the proposed survey activities do not have particularly sensitive hearing and are considered low frequency hearing generalists (Nedwell *et al.*, 2003, 2006; Popper, 2005), so these higher frequencies would also be beyond their typical auditory threshold. In addition, this equipment will operate at a relatively low sound pressure intensity compared with the primary MBES survey equipment.

The Sound Velocity probes and Doppler Velocity Logs operate at a very high frequency and at an extremely low sound pressure intensity level that would not be detectable to any receptor animals, while the USBL beacons operating at a much lower frequency (in the range 21-31 kHz) are within the range of hearing for small cetaceans and pinnipeds. However, these are also operating at a very low sound pressure intensity level compared with equipment that operates in a similar range (the USBL transponders are for communicating a position relative to the survey vessel); therefore, the acoustic pulses from these are not considered likely to cause undue disturbance to those animals.

In addition to spreading loss for acoustic propagation in the water column, high frequency acoustic energies are more quickly absorbed through the water column than sounds with lower frequencies. Again, most of the sound energy generated is likely to be orientated downwards towards to the seabed, over a relatively short distance. Due to these factors the use of ROV mounted acoustic equipment is considered to result in a negligible risk of an injury or disturbance to receptor species.

Table 5-1 (adapted from: Evans and Nice, 1996; Richardson *et al*., 1995, in IOSEA2 (ERT/Aqua-Fact International Services, 2007)) shows various anthropogenic sources and received levels of sound in the marine environment.

Table 5-1: Sound sources from various maritime activities

Activity	Frequency range (kHz)	Average source level (dB re 1µPa-m)	Estimated received level at different ranges (km) by spherical spreading[a]			
			0.1 km	1 km	10 km	100 km
High resolution geophysical survey; pingers, side-scan, echo sounder	10 to 400	<230	190	169	144	69
Low resolution geophysical seismic survey; seismic air gun	0.008 to 0.2[b]	248	210[c]	144[c]	118[c]	102[d]
			208	187	162	87
Production drilling	0.25	163	123	102	77	2
Jack-up drilling rig	0.005 to 1.2	85 to 127	45 to 87	24 to 66	<41	0
Semi-submersible rig	0.016 to 0.2	167 to 171	127 to 131	106 to 110	81 to 85	6 to 10
Drill ship	0.01 to 10	179 to 191	139 to 151	118 to 130	93 to 105	18 to 30
Large merchant vessel	0.005 to 0.9	160 to 190	120 to 150	99 to 129	74 to 104	<29
Military vessel	-	190 to 203	150 to 163	129 to 142	104 to 117	29 to 42
Super tanker	0.02 to 0.1	187 to 232	147 to 192	126 to 171	101 to 146	26 to 71

a Spherical spreading is calculated here using the formula presented in IOSEA2 (ERT/Aqua-Fact International Services, 2007).

b Seismic surveys produce occasional sounds with frequencies of 1 to 22 kHz (Evans, 1998)

c Actual measurements in St George's Channel, Irish Sea.

d Extrapolated figure as presented by Evans and Nice, 1996.

5.2 Sound propagation

In general sound sources that have high sound pressure levels (intensity) and low frequency (i.e. large air gun array seismic sources) will travel the greatest distances

underwater. The spread of low frequency sound in the sea is efficient, with little loss due to attenuation (i.e. due to absorption and scattering). Conversely high frequency sources (i.e. side- scan sonar and echo sounder) tend to have greater attenuation over distance. The overall degree of attenuation is dependent on the propagation conditions (propagation is impacted by varying pressure, temperature and salinity). Additionally, spherical spreading loss (the reduction in intensity caused by the spreading of waves into an ever increasing space) results in signal intensity dropping quickly.

The intensity of sound waves decay exponentially and although low-level signals travel for long distances, higher amplitude waves lose much of their energy very close to the sound source (Gisiner, 1998).

An animal's ability to detect sounds produced by anthropogenic activities depends on the amount of natural ambient or background sound. Wind, precipitation, vessel traffic, and biological sources all contribute to ambient sound.

5.3 Auditory sensitivity of key receptor species

Sections 2.4 and 2.5 list the species of marine mammal which may be present in the vicinity of the proposed survey area. These species have differing auditory ranges, and hence are not equally sensitive to the same noise sources. Table 5-2 (adapted from NPWS, 2014 and Southall *et al*., 2007 (updated in Southall *et al*., 2019)) presents the estimated auditory bandwidths for a range of marine mammals, and species that may be present in the vicinity of the proposed survey activities.

Table 5-2: Estimated auditory bandwidths for marine mammals

Cetaceans Low frequency 7 Hz-22 kHz	**Cetaceans Mid-frequency 150 Hz-160 kHz**	**Cetaceans High frequency 200 Hz-180 kHz**	**Pinnipeds in water 75 Hz-75 kHz**
	Peak sensitivity ~ 15 kHz	**Peak sensitivity 16 to 140 kHz**	
Baleen whales	Most toothed whales, dolphins	Certain toothed whales, porpoises	All species
Humpback whale *(Megaptera novaeangliae)* Blue whale *(Balaenoptera musculus)* Fin whale *(Balaenoptera physalus)* Sei whale *(Balaenoptera borealis)* Minke whale *(Balaenoptera acutorostrata)*	Sperm whale *(Physeter macrocephalus)* Killer whale *(Orcinus orca)* Long-finned pilot whale *(Globicephala melas)* Beaked whale species Dolphin species	Pygmy sperm whale *(Kogia breviceps)* Harbour porpoise (*Phocoena phocoena)*	Grey seal *(Halichoerus grypus)* Harbour seal *(Phoca vitulina)*

5.3.1 Cetaceans

Baleen whales are reported to have hearing sensitivity ranges in the region of 10 Hz to 20 kHz, with greatest sensitivities usually below 1 kHz (Evans, 1998). Source frequencies associated with high resolution geophysical surveys typically fall outside of this hearing range (Table 5-2). Low frequency output associated with some types of acoustic survey equipment, such as seismic surveys and low frequency sub-bottom profilers, do however overlap with the hearing range of baleen whales, which has the potential to mask long distance communication between whales over significant distances, and prevent the detection of other faint sounds (Evans and Nice, 1996).

Toothed whales rely on sound for echolocation, foraging and communication. The auditory sensitivities range for most species is considered to be from 75 Hz to 180 kHz, with greatest sensitivities around 20 kHz.

Observations undertaken during low frequency acoustic surveys (seismic surveys) in UK and adjacent waters were analysed to examine effects on cetaceans (Stone and Tasker, 2006). Sighting rates, distance from sound source and orientation were compared for periods when airguns were active and when they were silent. The results indicated that different taxonomic groups of cetaceans may adopt different strategies in response to acoustic disturbance from seismic surveys. Some small toothed whales (odontocetes) move out of the immediate area, while the slower moving baleen whales (mysticetes) orient away from the vessel and increase their distance from the source but may not move away from the area completely.

There are various potential effects of exposure to sound from anthropogenic activities on marine mammals that can be characterised as pathological, physiological or behavioural. Criteria can be established for zones of influence based on ambient sound levels, absolute hearing thresholds of the species of interest, slight changes in behaviour of the species of interest (including habituation), stronger disturbance effects (e.g. avoidance), temporary hearing impairment (TTS) and permanent hearing impairment (PTS), or other physical damage.

Southall *et al.* (2019) updated the 2007 study which carried out an extensive review of the available literature and formulated scientific recommendations for marine mammal exposure criteria based on peak pressure known or assumed to elicit the onset of TTS. For low frequency hearing cetaceans (typically baleen whales, with an auditory sensitivity range estimated at 7 Hz to 22 kHz) and high frequency hearing cetaceans (which would include bottlenose dolphins, and an auditory sensitivity range estimated at 150 Hz to 160 kHz), the sound pressure level (SPL) for TTS was set at 224 dB re 1µPa (peak) and 230 dB re 1µPa (peak) for PTS. The sound exposure level (SEL) for TTS onset is 170 dB re 1µPa2^{-s} and 185 dB re 1µPa for the onset of PTS For very high frequency cetaceans, which includes the harbour porpoise, Southall et al. (2019) set the sound pressure level (SPL) for TTS onset at 196 dB re 1µPa (peak) and 202 dB re 1µPa (peak) for onset of PTS. The SEL for TTS onset is 140 dB re 1µP^2-s and 155 dB re 1µPa for the onset of PTS.

The fundamental difference between these two parameters is that SPL can be an instantaneous value and SEL is the accumulated sound energy to which the mammal is exposed during a given duration:1 second in this case. It should be stressed that no marine mammal mortality or damage to tissue has been documented for exposure to

geophysical surveys, and that the exposure level for injury is a theoretical value extrapolated from experimental data. Also, it is recognised that many variables affect the nature and extent of responses to a particular stimulus. Such variables may include the recent experience of marine mammals with the sound stimulus, and their current activity (e.g. feeding vs. migrating).

5.3.2 Seals

The estimated auditory bandwidth for seals is thought to be in the range of 75 Hz – 75 kHz (Table 5-2). Studies dedicated to the effect of noise from acoustic survey on seals are limited, despite seals being recognised as having good underwater hearing. Of the few dedicated studies undertaken, Thompson (1998) provides an assessment of the physiological responses of grey and harbour seals to airguns. The study showed that harbour seals exhibited fright responses when a sound source (a source levels of 215 to 224 dB) was switched on, followed by strong avoidance behaviour. The seals also stopped feeding during this time. The behaviour of the harbour seals soon returned to normal after the sound source was switched off. Similar avoidance responses were recorded in grey seals at similar exposure levels, with seals changing from foraging behaviour to transiting away from the sound source. The grey seals were recorded as returning to normal behaviour within two hours of the sound source ceasing. For seals (phocid carnivores in water) (PCW) (grey and harbour seals) Southall et al. (2019) sets the SPL TTS onset at 212 dB re: 1 µPa (peak) and 218 dB re: 1 µPa (peak) for PTS onset. The SEL for TTS onset is 170 dB re 1 µP2-s and 185 dB re 1 µP2-s.

5.3.3 Fish

The auditory sensitivity of migratory fish is not well studied. However, salmonids (e.g. salmon and trout, including sea trout *(Salmo trutta trutta)*) and lamprey (both river and sea) are thought to be relatively insensitive to sound due to a lack of hearing specialist structures (Nedwell *et al*., 2003, 2006; Popper, 2005).

All fish have ears to detect sound however through their otolithic organs, which respond to particle motion of the surrounding fluid. Many fish are also able to detect sound pressure with a swim bladder which re-radiates the sound energy as particle motion to the otolithic organs (herring as an example). These fish generally have lower sound pressure thresholds and wider frequency ranges of hearing than those that rely on particle motion detection by the otolithic organs alone (Popper *et al*., 2014). Whereas other fish have a swim bladder, but it is not used in hearing (such as Atlantic Salmon) making them less sensitive to sound.

Based on auditory evoked potential experiments, salmon detect sounds between 100 and 800 Hz, while sea lamprey detect sounds between 50 and 300 Hz (Simpson and Bruintjes, 2016; Mickle *et al*., 2018). As all lamprey species are through to lack hearing specialist structures, the hearing sensitivity of river lamprey is considered similar to sea lamprey.

5.3.4 Seabirds

The auditory sensitivity of seabirds is not well studied. The potential exposure of birds to underwater noise varies greatly according to their feeding ecology. Some species may be at higher risk to noise sources either because a) they enter the water by plunge diving

directly from the air (e.g. gannets) and therefore may not be able to detect noise prior to exposure; and b) they spend a relatively long time underwater and/or dive to a deep depth (e.g. auks, scoter). Other species of seabird (such as terns, gulls and shearwaters) only have very shallow diving depths and/or spend a short time underwater, thereby inherently minimising any degree of exposure to underwater noise.

Even for those species that are potentially at higher risk to noise exposure (e.g. auks), such exposure will be inherently minimised by the nature of the survey and the locations in which it is taking place. Factors inherently reducing risk (several of which are also applicable to marine mammals and fish) are summarised below:

- Natural flight response: most surface-diving diving birds (such as auks and scoter) will, in response to moving vessels, fly out of the way, due to natural evasion behaviour. This will therefore increase the distance between them and the highest sound levels;
- Exposure to sound: as noted, the sound pressure levels from the As-Found and As-Left survey's acoustic sources are expected to attenuate rapidly in water. Furthermore, the ROV mounted acoustic sources will target sound directly downwards to the seabed from a point close to the seabed, and in a narrow band or cone. To be subjected to maximum noise levels, birds would therefore have to be very close to the sound source. In practice this would require them to be near the ROV (close to the seabed and therefore impossible). The soft start procedure will allow animals to move away from the area, or curtail a deep dive, in response to gradually increasing sound levels.
- Water depths for the work at the Corrib Field: the peak source noise levels from the ROV will be largely restricted to near the seabed in deep water (c.350 m). This depth is far beyond the maximum diving depths of the seabirds that might occur in the region (e.g. gannets and eider duck (*Somateria mollissima*) 40 m; guillemots (*Uria aalge*) 50 m; puffins (*Fratercula arctica*) 70 m; BirdLife International, 2014). Two species, the guillemot and the razorbill *(Alca torda)* dive deeper to maximum diving depths of 180 m and 140 m respectively, with maximum recorded dive times of over 3.5 minutes for guillemot. Typically, the mean depths for these species are significantly shallower (90 m and 40 m respectively) (BirdLife International, 2014). The depth of water at the Corrib Field where works will be undertaken is considerably deeper than the maximum diving depths for all species of seabird likely to be encountered, and as such these species would not be in close proximity to the noise source during the As-Found and As-Left surveys (especially given soft start procedure noted above); even if this was to occur, no injury would be expected to occur given that no fatalities of diving seabirds were recorded as a result of seismic surveys using much greater sound levels from the equipment (see below).

In addition to the above factors, it is considered highly improbable that seabirds will be impacted by the proposed work programme (using standard and widely-used survey equipment) given that there is some evidence that diving seabirds are not especially vulnerable to the much greater sound levels experienced as a result of airguns firing during seismic surveys. In a risk assessment for seismic surveys offshore from Ireland, Turnpenny and Nedwell (1994) cited research (Stemp, 1985) that considered the effects of seismic surveys on three seabird species; this concluded that no fatalities resulted,

and any variations in abundance were within natural variation. A further study found no effect of seismic activity on movements and diving of long-tailed ducks in the North Pacific (*Clangula hyemalis*) (Lacroix *et al*., 2003).

5.4 Underwater acoustic impact of the As-Found and As-Left surveys on Annex IV marine fauna

5.4.1 Cetaceans

The hearing range of most toothed whales is unlikely to overlap with the type of MBES equipment to be used in the proposed As-Found and As-Left surveys as indicated in Table 5-2.

Cetaceans which use higher frequencies, such as harbour porpoise, may be sensitive to certain frequencies within the operational capability of the MBES systems. Estimates provided by Nedwell *et al*. (2008) using comparable MBES specifications (maximum source level of 220 dB re: 1µPa @1 m and an operating frequency of 200 kHz), and using harbour porpoise as being the worst case scenario and a 90 dBht (dB values above hearing threshold) strong avoidance impact criterion (Nedwell *et al*., 2008), it was estimated that a strong avoidance reaction might occur at up to a distance of 30 m from the sound source. Again, considering the natural avoidance behaviour, the peak source level of the sound source and the SPL and SEL for injury it is unlikely that injury would occur. It should be noted that the proposed peak source level of 225 dB re: 1µPa @1 m is a maximum and will also drop exponentially due to spherical spreading and greater attenuation of high frequencies (Section 5.2).

An extrapolation of the values from Table 5-1 for the maximum source levels for the MBES, operating at the proposed frequency of 400 kHz would result in dB levels of around 180 dB at 100 m, 110 dB at 1 km, and undetectable within 5 km due to complete attenuation through the water column through spherical spreading alone.

Further to this, the employment of mitigation measures outlined in the Section 6.1 will mitigate against potential impacts.

5.4.2 Turtles

Small-scale behavioural experiments on loggerhead and green turtles have indicated that exposure to seismic sound levels over 155 dB resulted in increased swimming activity, and at over 164 dB, individuals began to exhibit erratic swimming patterns, possibly indicative of an agitated state (McCauley *et al*., 2000).

It is considered unlikely that turtle species will be encountered within the area of works at the Corrib Field. However, should any individuals be present, appropriate mitigation measures (outlined in the Section 6.1) will reduce potential impacts.

5.5 Underwater acoustic impact of the ROV Operations and As-Found and As-Left surveys on other designated species

5.5.1 Seals

The hearing range of seals is unlikely to overlap with the type of MBES, or the ROV positioning equipment proposed for use in the survey. The USBL transponders may be

audible to seals, however due to the very low intensity at which this equipment operates, impacts are considered negligible.

Given the SPL threshold for TTS onset for seals (phocid carnivores in water) according to Southall *et al.,* (2019) is 212 dB re: 1 µPa (peak) and 218 dB re: 1 µPa for PTS onset, the potential for injury to seals from the acoustic sound sources proposed for these surveys is very low, particularly given the projected rate of attenuation for the sound source. In addition, as the frequency of occurrence of seals decreases with increasing distances from areas of known coastal sensitivity, they are unlikely to be present in the vicinity of the works.

Appropriate mitigation will decrease impacts, such as the implementation of soft start procedures and the presence of a qualified MMO (see Section 6.1 for detailed information regarding mitigation).

5.5.2 Fish

Given the knowledge of the behaviour of various fish species in response to underwater noise, significant impacts to migratory fish species from the proposed survey are considered highly unlikely. However, they are briefly considered here, as it is possible that these migratory species of fish may occur in inshore areas during the time of the proposed survey, and within relatively close proximity to acoustic survey sound sources.

Although some fish species (whose auditory apparatus are closely linked with the swimbladder, such as herring) are considered to be of high sensitivity (Nedwell *et al*., 2004), salmonids (e.g. salmon and trout, including sea trout) and lamprey are thought to be relatively insensitive to sound (Nedwell *et al*., 2003, 2006; Popper, 2005). Atlantic salmon are also highly mobile and relatively large, and therefore easily able to undertake avoidance behaviour and return following cessation of the survey.

Lamprey are less mobile, but are less sensitive to higher frequency sounds, with sea lamprey showing behavioural changes, such as increased activity in response to low frequency sounds in the range of 50 - 200 Hz (Mickle *et al*., 2018). The use of soft start procedures will provide ample time for migratory fish to avoid the sound source prior to the equipment reaching full intensity.

The potential impacts described above are considered unlikely to have any significant impact on fish species, particularly given the frequency levels and intensity of the equipment to be used and that soft start procedures will be applied.

5.5.3 Seabirds

Seabirds could potentially be present in the area of the proposed works at a similar time to when works are taking place. In a worst case scenario, the presence of the ROV support vessel and equipment could prevent or reduce access to foraging seabirds. However, activities will be temporary, with the duration of the works minimised, and confined to as small an area as possible, making it unlikely that the entire area of works would be unavailable for the scheduled duration.

5.5.4 Indirect impacts on prey species

This assessment focusses on the impacts on migratory species of fish listed under Annex II of the Habitats Directive, but also considers other species of fish including those which

are likely to be prey species for cetaceans, seals and seabirds in the vicinity of the proposed activities. Impacts to the behaviour of prey species for such receptors can result in indirect impacts to the predators.

A number of species of fish, in particular those whose auditory apparatus are closely linked with a swimbladder (e.g. herring), are considered to be more sensitive to underwater noise than species which have less reliance on hearing structures (Nedwell *et al.*, 2004).

Studies on smaller species of fish that are expected to be prey species for marine mammals and seabirds are more limited but would tend to suggest that impacts are extremely localised to the immediate vicinity of the underwater noise source and that furthermore, impacts are of very short duration, and fish quickly resume normal behaviour once the sound source has passed by/ceased. Impacts on larger species such as salmonids, which could also be important prey for marine mammals, would suggest that they are less sensitive to underwater noise (Nedwell *et al*., 2003, 2006; Popper, 2005). Salmonids are also highly mobile and relatively large, and therefore easily able to undertake avoidance behaviour and return following cessation of the survey.

Due to the localised extent of the impact the overall proportion of the prey species population that is affected is likely to be minimal. The use of soft start procedures will mitigate the direct impacts on prey species of fish by gradually increasing the intensity of the equipment over time. Marine mammals and seabirds in the vicinity of the proposed activities have access to a large area for foraging and are highly mobile (as are their prey species), and consequently they have wide potential prey availability, with the ability to adjust their foraging grounds to follow prey movements. Therefore, the localised and short duration impacts on prey species will not have a significant indirect impact on the marine mammal and seabird populations in the vicinity.

5.6 Impacts from the P6 flowline replacement works

During the removal and installation works for the flexible flowline between the P6 wellhead and the Corrib Central Manifold, ROV operations will entail some limited physical intervention including laying down of the new flowline, movement of the existing flowline on the seabed, installation of concrete mattresses and turning bollards (gabions). This will result in localised suspension of sediments in the immediate vicinity. There will be a degree of disturbance to the surrounding physical seabed environment and associated benthic habitats and communities from resuspended sediments during the installation works. This disturbance will be minimal and restricted to the vicinity of the works. Currents close to the seabed at the Corrib Field are relatively weak.

There will be direct disturbance to the seabed in the movement of the existing flexible flowline terminations away from the P6 wellhead and the Corrib manifold, this will result in a degree of direct disturbance to the seabed, that will be temporary as well as a degree of permanent disturbance and alteration of habitat in the area where the existing flowline terminations are permanently positioned. It is understood that this will be limited in spatial extent. Temporary disturbance to the seabed will also result for the duration of the works from the placement of temporary concrete mattresses and gabions. These are to be removed when the worksite is reinstated at the completion of the works. Approximately 158 m (worst case) of seabed habitat will be permanently altered by the installation of the new flexible flowline. The flowline will be approximately 20 cm in width. The area of

seabed altered will be increased by any permanently placed concrete mattresses used to protect the new and existing flowlines once in position. The total area of permanent alteration of the seabed will be approximately 32 m^2 for the new flowline and an additional 528 m^2 for the 22 concrete mattresses. The overall significance of these physical impacts is determined as negligible.

The flowline replacement activities will involve displacement of approximately 5000 litres of inhibited potable water comprised of 1000 litres of flowline gel (Alcogel) and 25 litres of a corrosion inhibitor/biocide/oxygen scavenger/leak detection dye (RX5225) to the surrounding seawater at the Corrib Central Manifold. The inhibited potable water will be less dense than the seawater it is released to so will rise through the water column and potentially come in contact with fish (see Section 2.5.2) or marine mammals (see Section 2.4.1). Any interaction with marine fauna and the released fluid would be limited based on movement of the marine fauna away from the activities and the dilution of the released fluid into the surrounding water column. Alcogel and RX5225 are both primarily composed of methanol which readily biodegradable and does not bioaccumulate. Due to the small volume to the be released and rapid dilution and dispersion due to the buoyant nature of this release, the impact of this is considered to be negligible. The gel pill and the RX5225 within the inhibited potable water released is a PLONOR listed chemical and also registered on the Offshore Chemical Notification Scheme under Group E. Both are therefore considered to be of lowest toxicity on the OCNS list. Inhibited seawater will be used as part of the new flexible flowline pre-commissioning activities, and a quantity of methanol may then be used to help displace this. The methanol will not be released but will be retained within the subsea process system and sent back to the BBGT. Full characterisation of the chemicals that are proposed for use during the proposed workscope are provided in Table 3-2.

The physical presence of the ROV support vessel, ROVs, and installation equipment (including rock mattresses, gabions and the new flexible flowline) results in the potential for interaction with marine mammals (disturbance/risk of collision) and seabirds (disturbance resulting in displacement from foraging areas).

In regard to the interaction with marine mammals, activities will be temporary, with the duration at sea for the installation vessel and associated equipment minimised and confined to as small an area as possible at the Corrib Field. For any reduction in Annex IV marine mammal species abundance from the area in the vicinity of the operations, rapid repopulation is likely, as responses by marine mammals and other Annex IV species is likely to be behavioural and temporary in nature. No changes in overall species abundances are anticipated. It is recognised that the animals that are potentially in the vicinity of the proposed activities can have extensive foraging ranges. As such the potential zones of influence for these species from direct and indirect impacts could potentially be extensive. Due to the foraging distances of these species, and the suitability of the waters off the western coasts of Ireland, there is likely extensive connectivity of habitat. The west coast of Ireland supports both resident and semi-resident populations of both grey and harbour seals and a number of species of small cetacean.

The likelihood of collision with animals is considered to be extremely low, as the vessel will operate in accordance with the principles of the relevant codes of conducts at all times; and at low speeds. Also, despite the potential for animals from a wide area to be present in the vicinity at the time of the operations, the potential actual area where

impacts have the potential to occur is extremely localised to the immediate vicinity of the area of works at the Corrib Field where the ROV support vessels and near seabed installation and survey operations are likely to be relatively static for the duration of the c. 6 day work scope. The likelihood of interaction (such as entanglement) is low as acoustic survey equipment will be mounted directly to the ROVs and any lowered equipment such as the replacement flexible flowline, installation equipment and other material such as rock gabions and concrete mattresses will be lowered to the seabed by means of a taut and directly vertical cable from the ROV support vessel. In addition, the marine mammal species are all highly mobile species, that are free to move in any direction within an open marine environment in which the static nature of the proposed operations will not be acting to drive or confine animals in any particular direction. Therefore, it is unlikely that the physical presence of vessel or equipment will traumatise or interact with marine mammals.

Seabirds will occur in the vicinity of the Corrib Field. Due to the foraging distances of certain seabird species, and the suitability of the coastal waters on the western coasts of Ireland to support large seabird populations, there is likely extensive connectivity of habitat.

A number of species of offshore foraging seabird could potentially be present in the area of the proposed works at a similar time to when works are taking place. In a worst case scenario, the presence of the ROV support vessel, ROVs and equipment could prevent or reduce access to foraging seabirds. However, activities will be temporary, with the duration of the survey minimised, and confined to as small an area as possible, making it unlikely that the entire survey area would be unavailable for the scheduled duration. Seabird counts from the ObSERVE aerial surveys (Rogan *et al*., 2018) suggest that there is sufficient alternative foraging habitat in the wider area to accommodate any temporarily displaced seabirds. This would be further aided by the habitats' connectivity together with the fact that seabird species are highly mobile, and free to move in any direction in an open marine environment. Therefore, it is unlikely that the physical presence of vessel or equipment will displace seabirds permanently.

The physical presence of the ROV support vessel, ROVs and installation equipment have potential limited impacts on the human environment, such as interaction with offshore fisheries or disturbance to shipping lanes. However, due to the short duration of the works and the limited number of vessels (one vessel and two ROVs), the impact is considered negligible. The works will be entirely within the Corrib Field fisheries exclusion zone, an area where demersal fishing is not allowed so no offshore demersal fisheries will be disrupted. The ROV support vessel will be largely stationary while deploying subsea equipment and the work scope will be scheduled to minimise the duration of the works, as well as confining activities to as small an area as possible to limit the spatial extent of disturbance. Pelagic fisheries are mainly concentrated further inshore of the works area and so are unlikely to be disrupted. The works are scheduled to take place between May and October 202, during which time the maximum shipping routes were 7 per km^2 per month in the Corrib Field area in summer 2019 (Figure 2-4; EMSA, 2020); therefore disruption to shipping from the presence of one vessel at the sea surface is limited. Communication with other marine users (including consultation with relevant fisheries organisations) regarding the work scope, the location of operations and also the likely transit routes and scheduling will help further avoid any potential interactions or impacts.

The levels of carbon dioxide and greenhouse gases emitted by the marine vessel during the proposed works will be negligible and will have minimal effects on climate change. These emissions have been characterised in Table 3-3. Atmospheric emissions from the vessel during transit and operations will be minimal in terms of overall quantity and duration of emission and will be rapidly dispersed in the offshore location. Impacts from the vessel in terms of standard emissions and discharges during operation will be minimised where possible using measures such as regular maintenance of all engines onboard, in line with Maritime Registry of Shipping (MRS), MARPOL 73/78 Annex VI (as appropriate) and other similar requirements. The *Siem Spearfish* is a modern vessel that has been designed with a hull form and diesel-electric propulsion machinery specifically for fuel efficiency. The vessel has been built according to the 'Clean Design' class specifications which require the vessel to be double-hulled, with no dirty product on the outside of the hull, with advanced anti-pollution equipment, and catalysers for the engine exhaust gases. Vessel discharges and other waste streams from the vessel will also be managed in accordance with the requirements of MARPOL 73/78 as appropriate.

5.6.1 Accidental Events

Accidental events may also occur. A fuel oil spillage from the ROV support vessel could potentially result in a spill. The likelihood of such an event occurring is considered to be very low. All vessels will have appropriate spill contingency plans in place to deal with such events with the aim of reducing environmental damage as far as possible. In addition, vessel fuelling will take place in port and all deck machinery will only be refuelled within a bunded area.

While it is accepted that a spillage of fuel oil could have a significant effect on the environment, including designated species, the protocols and procedures in place to prevent this occurrence and the low probability of such an event occurring mean that the overall significance of this impact is determined as minor (very unlikely).

There are also several chemicals that will be used during the flexible flowline replacement works but retained within the subsea system and transported back to the BBGT via the process system. While there are known planned releases of certain chemicals during the P6 flexible flowline replacement works, there does also exist the potential for an unplanned release of chemicals. Chemicals that are not planned for release but would be retained within the subsea process system include methanol (approx. 2000 litres) to be used to flush the new flexible flowline prior to connection, RX5208 oxy scav/biocide sticks (approx. 1.5 kg) will be used to tie in the ends of the new flowline and RX9034A dye sticks (approx. 0.5 kg) will be used during the leak test of the new flowline. These amounts are high-level precautionary estimates and actual amounts used would likely be far lower.

Methanol is used as a hydrate inhibitor within the flowline. If released to the water column, the half-life ranges between one to seven days and depends on numerous environmental factors (AMI 1999). The main process responsible for the removal of methanol from water is biodegradation. Methanol is significantly less toxic to marine life than crude oil or gasoline, and many of the effects of short-term exposure are temporary and reversible. The US EPA Office of Pollution Prevention and Toxics (USEPA OPPT) indicated that methanol is essentially non-toxic to four aquatic fish species that were tested (1994). A large methanol spill into a surface water would have some immediate impacts to the biota in the direct vicinity of the spill. However, because of its properties methanol would rapidly

dissipate into the environment, and within fairly short distances from the spill would reach levels where biodegradation would rapidly occur. If methanol was ingested by any marine fauna, it would be rapidly metabolized and not bioaccumulate (AMI 1999).

RX5208 is a combined oxygen scavenger and biocide which is made up from 33% powdered oxygen scavenger and 67% powdered biocide. RX5208 is released into the seawater before the biocide to deoxygenate the seawater prior to the addition of the biocide. RX5208 treatment rate is based on 20 ppm of oxygen scavenger: 1 ppm dissolved oxygen so the concentration of this chemical is very low in the contained seawater. RX5208 also biodegrades and does not bioaccumulate. RX9034A is an inert pink dye used for leak detection and not harmful to the aquatic environment.

There is potential for accidental release of these chemicals into the surrounding environment, which could cause a reduction in water quality and/or a toxic effect on marine fauna. If the release is at the seafloor, the potential marine fauna that may be impacted are fish and marine mammals moving through the area at the time of the release. The release would be less dense than the seawater so would rise through the water column and not sink to the seafloor and impact the benthos. If the release is at the sea surface, seabirds may be in contact with chemicals as well. As discussed above, the potential for any of the chemicals to be toxic to marine fauna or seabirds is very low.

The likelihood of chemical leaks is extremely unlikely. In addition, the amounts of chemicals to be used are low and would be rapidly dispersed in the unlikely event of a leak. These chemicals have been selected based on their performance in the aquatic environment in terms of benign toxicity, rapid biodegradation and reduced potential for bioaccumulation.

5.7 Cumulative impacts

Due to the nature of the proposed activities, and the widespread use of underwater acoustic devices on other vessels in the area, there is potential for cumulative underwater sound impacts. Cumulative impacts may arise as a result of operation of underwater acoustic sources from this proposed scope of work, and from increased levels of vessel movements.

The actual flowline replacement works will result in impacts that are extremely localised to the seabed area and seawater quality immediately in the vicinity of the P6 well and the Corrib central manifold at the Corrib Field. Impacts resulting from the physical presence of the activities, will be limited in duration and localised in spatial extent in terms of the context of the foraging ranges of key receptor species of, marine mammals, fish and seabirds. The impacts resulting from underwater noise from the vessel operations and the As-Found and As-Left surveys have the potential to result in impacts that could have a wider spatial extent due to the ways in which these sources of underwater noise propagate.

Cumulative noise impacts associated with such underwater survey operations as those projects proposed are more difficult to quantify than effects attributed to other activities. This is because the energy from the sound sources dissipate and soon disappear when the activity is stopped. Unlike other activities that are tangible in nature, any cumulative impact that maybe attributed to acoustic surveys is intangible and can only be measured as impacts associated with receptor animals in the environment.

While there is no bioaccumulation of sound in the marine environment from project activities, there is the potential for an additive effect if sounds from one activity coincide and overlap spatially and temporally with other concurrent activities as both duration of exposure and increased intensity as well as spatial extent can all result in additive effects.

Given the high frequencies and low source levels at which the survey equipment operates, coupled with the open ocean location away from areas considered to be of high receptor sensitivity and the fact that the survey will be conducted by ROV close to the seabed, limiting the degree of propagation all result in limiting the overall spatial extent of potential impacts. As discussed in Section 5.4.1, it is expected that the underwater noise from the primary survey sensors would attenuate completely within 5 km of the source, thus resulting in a very localised spatial extent of potential impacts.

The spatial extent that has been determined for other projects to be included in this screening assessment is based on the likely impact ranges that have been discussed in above. It is however appreciated that while likely impacts are relatively localised, the actual foraging and migratory ranges of receptor species are more extensive. Therefore, the spatial extent for potential cumulative impacts includes projects within the likely ranges for these species. As such a similar range as for marine mammals, seabirds and migratory fish has been assumed based on foraging ranges for these receptors of approximately 200 km in order to capture any relevant offshore projects which may have timescales that coincide with the proposed operations at the Corrib Field.

At the Corrib Field specifically, there is likely to be an additional work programme scheduled for the summer months of 2021 and 2022, as discussed in Section 1.2.1. The annual programme consists of geophysical and visual surveys for inspection, maintenance. These surveys will cover the length of the Corrib offshore pipeline route, sections of the umbilical, the BBGT treated surface water outfall and the infield flowlines and umbilicals at the Corrib Field and between the manifold and landfall at Glengad. The competent authority has previously concluded that there would be no significant impacts to European sites or protected species as a result of these works, and also that an EIA would not be required. At this time no formal application for the annual inspection and maintenance surveys of the Corrib subsea infrastructure has been submitted for 2021 or 2022. In addition, the work scopes are to be completed by the same operator and the scheduling of these works will ensure that they will not occur concurrently, thus negating the potential for cumulative impacts. However, as the activities are proposed for a similar timeframe as the proposed flexible flowline replacement works, cumulative impacts are considered here to ensure that the assessment has been sufficiently rigorous.

A review of current applications for other offshore works that may take place in a similar timeframe has been undertaken. The study area for this project and cumulative impacts is broad enough to encompass typical foraging and migratory ranges for the primary receptor species. The information is publicly available from the DCCAE and the Department of Housing, Planning and Local Government.

The following project has been identified:

Woodside Energy (Ireland) Pty Ltd plans to conduct a geotechnical investigation involving the collection of cores from up to 22 shallow boreholes distributed throughout the Irish Atlantic Margin at water depths ranging from approximately 50 to 2,600 m. It is anticipated that these survey operations will start between June and August 2020 or a similar period in 2021 (depending on regulatory approval and contractor availability) and will be of

approximately 40 days duration. An Appropriate Assessment has been undertaken so far for this project, and the latest period of public consultation closed on 2nd May 2020.

As there is potential for additional projects to take place within the defined offshore study area off the west coast of Ireland within a similar timeframe to the flexible flowline replacement works, the potential impacts of all projects need to be considered in combination. All projects will have an underwater noise impact through the use of equipment for geophysical and visual surveys and positioning, in addition to that from vessels. In addition, there will be a disturbance impact from the physical presence of vessels and associated equipment being present in the study area. It is appreciated that the likelihood for the projects to occur over the same time periods is very unlikely as the durations of the individual projects are short and the exact timings of other works is defined only within a range of dates.

The potential impacts from underwater noise on marine mammals will be as outlined in Section 5.4.1 and 5.5.1. These species are mobile, with the ability to move in any direction and over long distances in an open marine environment, whilst the frequencies of the survey equipment are outside the peak hearing thresholds of the common cetaceans and seals in the area. Therefore, it is unlikely there will be a cumulative impact on Annex IV marine mammals, or any other designated marine mammal species.

Communication between the operators will also ensure that operations are coordinated to limit noise exposure, and the stringent application of the described statutory-required marine mammal mitigation protocols by operators for the protection of these species will result in no significant cumulative impacts. Furthermore, regarding all works undertaken as part of the Corrib offshore gas development, efforts will be made to schedule the works over different weeks. For instance, the repair of the P6 wellhead cannot take place at the same time as the connection of the new flexible flowline to it.

The impact of noise from additional vessel operations involved in the flexible flowline replacement works will be limited. The key receptors would be cetaceans and seals in the vicinity of the proposed activities.

While there exists a possibility that a number of survey projects could occur off the western coasts of Ireland with overlapping timescales, as all projects are of short-duration and take place in open marine areas allowing for rapid attenuation of underwater noise, as well as allowing scope for animals to avoid the operations and also avoid undue potential for entanglement, collision risk or entanglement.

All project operators will apply appropriate mitigation measures to protect/prevent animals from undue exposure to marine noise and the risk of collision/entanglement. Therefore, this scope of works in-combination with the other proposed survey activities from the Corrib development, and the potential for other surveys being undertaken by Woodside Energy, is unlikely to result in significant cumulative impacts on key receptor species.

5.7.1 In-combination effects

Within the flowline replacement project itself there is the potential for in-combination effects on receptors. Multiple pathways of the proposed project may interact and effect a single receptor.

Table 5-3: Receptors and impacts of the flowline replacement project

Impact \ Receptor	Cetaceans	Seals	Turtles	Fish	Seabirds	Seabed and benthic habitat	Water Quality	Human Environment (Fisheries & Shipping)
Underwater acoustic impact								
Disturbance due to suspended sediment								
Permanent habitat alteration								
Displacement of inhibited potable water							*	
Disturbance due to physical presence of ROV support vessel, ROVs and installation equipment								
Collision risk due to physical presence of ROV support vessel, ROVs and installation equipment								
Impact from standard vessel emissions and discharges							*	

Shading indicates an impact on receptor.

* Impacts to water quality will also have indirect on all species in the water column, however, discharge and emission amounts are small and so even in combination will have a negligible direct impact on the water quality and the species in the water column.

Marine mammals (cetaceans and seals) and fish are most at risk from in-combination effects, as they interact with both the vessel and the sound sources, resulting in three impacts potentially affecting them, see Table 2-1. The impact from underwater sound from ROV operations, and As-Found and As-Left surveys combines with the potential disturbance from, and collision risk due to, the physical presence of the ROV support vessel, ROVs and installation equipment; however, because these impacts affect a localised area, and as marine mammals and fish are mobile species able to disperse from noise sources, the in-combination effect of the two pathways remains negligible, especially in light of the mitigation measures associated with marine mammals. While the

in-combination effect from these impacts may also affect turtles, given the unlikely presence of turtles in the Corrib Field area, it also remains negligible.

The seabed and its associated benthic habitats along the pipeline between P6 wellhead and central manifold will be affected by one pathway, the ROV and installation equipment operations, which results in two impacts; the disturbance due to suspended sediment and permanent habitat alteration. It is unlikely that these two impacts will interact for long enough to have an in-combination effect on the receptor, due to the temporary nature of the suspended sediment disturbance.

The potential disturbance will combine with the collision risk to increase the in-combination effects associated with the physical presence of the ROV support vessel, ROVs, and installation equipment on the human environment. However, the in-combination effect on the human environment remains insignificant, as the mitigation measures in place ensures the navigation of other vessels is not compromised. The flowline replacement takes place wholly within the Corrib Field fishing inclusion zone and the presence of one support vessel ensures minimal deviation in vessel routes.

6 MITIGATION MEASURES

The NPWS "Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters" (NPWS, 2014) provides mitigation measures for the protection of Annex IV and certain other sensitive species from geophysical acoustic surveys in Irish waters, including seismic surveys and multibeam, single beam, side-scan sonar and sub-bottom profiler surveys. These measures are outlined in the sections below.

6.1 NPWS guidance

These mitigation measures are applicable to:

- all seismic surveys (including the testing and full operational use of airguns, sparkers, boomers and vertical seismic profiling (VSP) or checkshot systems) in inshore and offshore Irish waters;
- all multibeam, single beam, side-scan sonar and sub-bottom profiler (e.g., pinger or chirp system) surveys within bays, inlets or estuaries and within 1,500 m of the entrance of enclosed bays/inlets/estuaries;
- or as advised by the relevant Regulatory Authority.

The following mitigation measures will be employed during the survey in order to minimise the potential for impact to Annex IV and certain other sensitive species potentially present within and in proximity to the survey area, in accordance with the NPWS Code of Practice (NPWS, 2007), updated by the NPWS Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters (NPWS, 2014). These measures are specified by the NPWS for water depths of up to 200 m.

The mitigation measures outlined below will be in implemented for the entire extent of the pipeline and over vessels, in line with best practice.

6.1.1 General Mitigation

Generic mitigation measures that will be in place to minimise the impact of sound generated from the proposed activities are as follows:

- Use of the lowest equipment output possible in order to obtain the required data quality;
- At the start of proposed activities, power will increase slowly from a low intensity (a 'soft start') to encourage avoidance reactions by marine mammals, fish and marine reptiles;
- A qualified and experienced Marine Mammal Observer (MMO) will be present onboard the ROV support vessel. The MMO will have undergone marine mammal observation training (JNCC or equivalent) and have spent a minimum of six weeks of marine mammal survey experience at sea over a three-year period;
- The MMO must submit a report, as outlined in NPWS code of practice, within 30 days of completion of the proposed activities to the relevant Licensing Authority, and copy the report to the NPWS;

- The ROV support vessel operator must provide a report (including a daily log) on the operation of survey equipment that will indicate the soft starts and their duration to the MMO. This information will be made available to NPWS;
- The MMO must use a distance measuring stick, reticle telescope or binoculars to ascertain distances to marine mammals.

Vessel(s) working on the Corrib Project will operate in accordance with the Vessel Code of Conduct for Inspection and Maintenance Surveys (Document No. COR-14-SH-0227, 2018). This document forms part of the Operators Environmental Management Plan (EMP) and details specific measures for vessel operators to avoid impacts to marine mammals (particularly small cetaceans). Where at all possible when operating acoustic geophysical survey equipment as part of the As-Found and As-Left surveys the principles of the vessel Code-of-Conduct will be followed as a matter of good environmental practice. In addition, a number of aspect-specific mitigation measures will be in place and are described below.

6.1.2 Mitigation for cetaceans, seals and other marine megafaunal species from multibeam echo-sounder surveys (during As-Found and As-Left surveys)

6.1.2.1 Pre soft start scans (pre-start monitoring)

Sound-producing activities will only commence in daylight hours where effective visual monitoring, as performed and determined by the MMO, has been achieved. Where effective visual monitoring, as determined by the MMO, is not possible, the sound-producing activities shall be postponed until effective visual monitoring is possible.

- Effective visual monitoring determines the presence or absence of megafaunal species before sound-producing activities commence, and should be undertaken in good weather conditions, where the sea state is low and visibility is good (no fog, heavy rain).
- MMOs should survey the area for the presence of species **30 minutes** before the onset of the soft start.
- A minimum distance of **500 m** is required between the centre of the sound source and the nearest species before soft start can commence.
- If species seen within **500 m** of the centre of the sound source the start of the sound source(s) should be delayed until they have moved away, allowing adequate time after the last sighting for the animals to leave the area **(30 minutes)**. If species do not leave the area it is recommended that the vessel alters course to ensure that the animals are outside the **500 m** exclusion zone when soft start commences (This measure may not be implementable, as survey operations will be undertaken while the vessel is stationary with equipment deployed to the seabed at the Corrib Field).
- An agreed and clear on-site communication signal must be used between the MMO and the Works Superintendent as to whether the relevant activity may or may not proceed, or resume following a break (see below). It shall only proceed on positive confirmation with the MMO.
- Soft start should commence after a **500 m** area around the vessel has been confirmed clear of species for **30 minutes**.

6.1.2.2 *Soft start / ramp up procedure*

- In commencing an acoustic survey operation, the following soft start (or ramp up) must be used, including during any testing of acoustic sources, where the output peak sound pressure level from any source exceeds 170 dB re: 1µPa @1m:
    a) Where it is possible according to the operational parameters of the equipment concerned, the device's acoustic energy output shall commence from a lower energy start-up (i.e., a peak sound pressure level not exceeding 170 dB re: 1µPa @1m) and thereafter be allowed to gradually build up to the necessary maximum output over a period of **20 minutes**.
    b) This controlled build-up of acoustic energy output shall occur in consistent stages to provide a steady and gradual increase over the ramp up period (e.g., output peak sound pressure level of 170 dB→180 dB→190 dB→200 dB→200+ dB over **20 minutes**).
    c) Where the acoustic output measures outlined in steps (a) and (b) are not possible according to the operational parameters of any such equipment, the device shall be switched "on" and "off" in a consistent sequential manner over a period of **20 minutes** prior to commencement of the full necessary output.
- In all cases where a ramp up procedure is employed the delay between the end of ramp-up and the necessary full output should be minimised to prevent unnecessary high-level sound introduction into the environment.
- Once the ramp up procedure commences, there is no requirement to halt or discontinue the procedure at night-time, nor if weather or visibility conditions deteriorate nor if species occur within a **500 m** radial distance of the sound source, i.e., within the Monitored Zone.

6.1.2.3 *Break in sound input*

- If there is a break in sound output for a period greater than **30 minutes** (e.g., due to equipment failure, shut-down, survey line or station change) then all pre-start monitoring and a subsequent ramp up procedure (where appropriate following pre-start monitoring) must be undertaken.
- For higher output survey operations which have the potential to produce injurious levels of underwater sound (see Sections 3.5, 5.1 and 5.3) as informed by the associated risk assessment, there is likely to be a regulatory requirement to adopt a shorter **5 – 10 minute break** limit after which period all pre-start monitoring and a subsequent ramp up procedure (where appropriate following pre-start monitoring) shall recommence as for start-up.

6.2 Mitigation of other impacts

There will be fisheries liaison procedures in place to mitigate interaction with fisheries, or other marine users. This includes liaison with relevant fisheries and other maritime organisations to communicate the operations and survey schedule and enable activities to be planned accordingly. All works will be within the fisheries exclusion zone at the Corrib Field. In addition to the fact that works will be within the exclusion zone, the Corrib

Field is an established offshore gas field, that is well marked on nautical charts and a Notice to Mariners would be issued prior to the works commencing. The Corrib Field is not in an area of particularly dense marine vessel traffic so the potential for interactions with other vessels is minimised.

The impacts from vessel emissions and discharges will be mitigated by the following measures:

- Regular maintenance of all onboard engines to minimise emissions, in line with:
    - Maritime Registry of Shipping (MRS);
    - MARPOL 73/78 Annex VI (as appropriate); and,
    - any other similar requirements;
- The use of a modern vessel that complies with the Clean Design class requirements for fuel efficiency and emissions control.
- Management of discharges in accordance with the requirements of MARPOL 73/78 as appropriate, with the biochemical oxygen demand of sewage and galley waste discharges reduced to 50 mg/l and macerated to less than 25 mm, using a treatment process before release;
- Material Safety Data Sheets (MSDS) will be made available for any chemicals to be used. Chemicals used will be where possible PLONOR listed or registered on the OCNS and assessed under the OSPAR HMCS based on their toxicity in the aquatic environment. As detailed in Table 3-2 the chemicals considered for use as part of this work scope are assessed as having the least impacts in the aquatic environment based on toxicity, biodegradation and bioaccumulation. In addition, the volumes of chemicals that are to be discharged during commissioning of the new flexible flowline are minimal and will be rapidly diluted and dispersed as they rise through the water column. No accumulation of pollutants would be envisaged in marine fauna and consequently no impacts on human health are expected.

The existing flexible flowline will be moved only at the ends where it joins to the P6 wellhead and at the Corrib Central Manifold in order to minimise disturbance to the seabed and limit the degree of resuspension of seabed sediments.

The existing flowline will be preserved for future use in situ on the seabed, thus minimising the disturbance to the seabed environment that would be caused by its removal, but also ensuring that it can be reused in the future.

The degree of physical presence of equipment and material on the seabed during construction will be confined to as small an area as possible in order to limit the spatial extent of disturbance. Works will also be undertaken over a short duration.

At the end of the installation works, the work site on the seabed will be reinstated and where possible equipment and materials will be removed. An As-Left survey will be undertaken to confirm that the work site has been left in as good a state as possible prior to departure.

6.3 Accidental events

6.3.1 Spillage of Fuel or Chemicals

The following measures will be in place to mitigate against accidental spills:

- Refuelling of the vessel will not be undertaken at sea, but in port where spills, although unlikely to happen, can be responded to more easily, and will reduce the risk of any exposure to marine life;
- The vessel will operate with strict safety, navigational, operating and communications procedures in place in order to avoid collisions. These will include use of Automatic Identification System (AIS) tracking, adherence to the Collision Regulations, communication with other vessels, and 24 hour look ahead plans;
- The fuel to be used by the vessel is regular marine grade oil (MGO) and not heavy fuel oil (HFO) that could represent a greater environmental hazard if spilled;
- Onboard the vessel, the valves between fuel tanks will be kept closed, thereby minimising potential for complete fuel loss. Refuelling will occur according to a specific procedure;
- The vessel is built according to Clean Design class requirements and as such is of double-hulled design, further reducing the likelihood of a loss of inventory of fuel oil in the event of a collision or grounding;
- Maintenance, audits and inspection plans will be in place to mitigate the potential risk of an oil leak at an early stage;
- Shipboard Oil Pollution Emergency Plans (SOPEP), spill mitigation equipment and other facilities are kept onboard the vessel in order to contain or minimise spills; the vessel crew has been trained in the use of the plans and equipment; and
- The Emergency Response Plan will set out how all spill response resources (personnel, command structure, equipment, etc.) will interface, including co-ordination between other operational and survey operators, if applicable;
- Material Safety Data Sheets (MSDS) will be made available for any chemicals to be used. Chemicals used will be PLONOR listed or registered on the OCNS and assessed under the OSPAR HMCS based on their toxicity in the aquatic environment. As detailed in Table 3-2, the chemicals considered for use as part of this work scope are assessed as having the least impacts in the aquatic environment based on toxicity, biodegradation and bioaccumulation.

6.3.2 Potential for vessel collision or equipment entanglement with marine fauna

Vessel(s) working on the Corrib Project will operate in accordance with the Vessel Code of Conduct for Inspection and Maintenance Surveys (Document No. COR-14-SH-0227, 2018). This document forms part of the Operators Environmental Management Plan (EMP) and details specific measures for vessel operators to avoid impacts to marine mammals (particularly small cetaceans). Where at all possible when operating acoustic geophysical survey equipment as part of the As-Found and As-Left surveys the principles of the vessel Code-of-Conduct will be followed as a matter of good environmental

practice. The Vessel code of Conduct describes the measures to be taken regarding vessel speed and course changes, as well as the importance of maintaining a watch for animals to ensure that the potential for interactions with large species of marine fauna (including Annex IV species) are minimised. As part of the mitigation for undertaking an underwater acoustic survey an MMO will be present keeping watch for marine fauna during daylight hours. They will advise vessel crew of any animals that are sighted, so that the appropriate actions can be taken.

7 RISK ASSESSMENT FOR ANNEX IV SPECIES

7.1 Introduction

Impacts expected to occur despite the mitigation measures proposed are often referred to as 'residual impacts' and are covered in the first part of the risk assessment (Section 7.3). Those impacts that have the potential to occur as a result of accidental events are discussed in the second part (Section 7.4).

The following sections provide risk assessment matrices, where the proposed survey programme has been broken down into a number of activities, and impacts are identified for each activity. Activities which have potential impacts are identified as 'aspects'. The types of potential impacts have been identified for each aspect. Consideration has been given to mitigation or control measures incorporated into the design of the activities, which reduce the potential impacts. This may result in the potential for impact to be eliminated. In other cases, there remains a possibility for impact, in spite of the mitigation measures. The remaining impact is estimated where possible and listed as a predicted impact.

7.2 Evaluation of relative significance

The evaluation of the relative significance of the effects is shown in Table 7-1. The relative significance of a predicted impact is summarised from a scale from significant through to negligible (or beneficial). The evaluation considers the vulnerability, temporal sensitivity and recoverability of Annex IV species and the geographical extent of the effect. Criteria for assessing the significance of predicted impacts have been closely defined.

Table 7-1: Assessment of the significance of impact

Significance category		Severity of impact (after implementation of mitigation measures)
I	Significant	Substantial adverse changes in the ecology of Annex IV species, and/or a reduction in population number. These changes are well outside the range of natural variation. The recovery of affected species may be protracted.
II	Moderate	Moderate adverse changes in the ecology of Annex IV species. These changes may exceed the range of natural variation. The potential for recovery is good. It is recognised that a low level of impact may remain.
III	Minor	Minor adverse changes in the ecology of Annex IV species. These changes may be noticeable but fall within the range of natural variation. Effects are potentially short-lived, with a short-term recovery. It is recognised that potentially a low level of impact may remain.

Significance category		Severity of impact (after implementation of mitigation measures)
IV	Negligible	Changes in the ecology of Annex IV species that are unlikely to be noticeable (i.e. well within the scope of natural variation).
V	Beneficial	Changes resulting in positive, desirable, or beneficial effects to Annex IV species ecology.

Note: The definitions are intended to categorise predicted impacts following the implementation of mitigation measures or controls. An impact that would have been 'Significant' without action by the Project may be assessed to be 'Moderate', 'Minor', or 'Negligible', after effective mitigation or control measures are in place.

7.3 Residual risk assessment

This section summarises the aspects, potential impacts, mitigation measures, predicted impacts, and significance of the predicted impacts for the proposed activities.

It should be noted that the risk assessment focuses on the hazards and risks posed to Annex IV species as a whole (cetaceans, marine turtles and pinnipeds), and is not species specific. Furthermore, the assessment is based on a number of assumptions that should be considered when interpreting the risk assessment:

- Some Annex IV species are easier/more difficult to detect. In the case of cetaceans, smaller species such as the harbour porpoise can be difficult to detect in sea states of more than 2 on the Beaufort scale.
- It is likely that some of the species discussed in Sections 2.4 and 2.5 will not be in the proximity of the area of works during operations. This may be due to seasonality, which means animals may not be present at the time of the survey, or due to the fact the some of the species discussed are uncommon to Irish waters.
- The assumption has been made that Annex IV species will leave the area during the survey as a result of the 'soft start' approach. Some species, including cetaceans, have been known to approach geophysical vessels during acoustic survey activities.
- The assessment is based on use of soft start procedures for survey operations. There is the possibility that the soft start procedures may not be sufficient for a particular species, or an individual animal to vacate the area before commencement of full scale operations (maximum output of survey equipment).

Table 7-2 presents the aspects, potential impacts, mitigation measures, predicted impacts and an assessment of the significance of the predicted impacts for the normal scheduled operations associated with the survey. The impacts of accidental events are considered separately (see Table 7-3).

Table 7-2: Residual risk assessment of potential impacts, proposed mitigation measures and predicted impacts

Aspect *Potential impact*	Mitigation measures	Significance
Mobilisation of ROV support vessel from port to site *Physical and acoustic presence*	The work will be scheduled to minimise the duration of the ROV support vessel at sea. Activities will be confined to as small an area as possible to minimise acoustic and visual presence. The vessel will operate in accordance with the principles of the Vessel Code of Conduct (Document No. COR-14-SH-0227, 2018).	**Minor** For any reduction in Annex IV species abundance from an area, rapid repopulation is likely, as responses by animals is likely to be behavioural and temporary in nature. No changes in overall species abundances are anticipated. Likelihood of collision with animals considered extremely low. Residual risk of visual / acoustic presence of vessel traumatising Annex IV species is low.
Physical presence of the ROV support vessel, ROV, MBES and stills/video camera system *Physical presence and potential for interaction*	The work will be scheduled so as to minimise the duration of project activities and to confine activities to as small an area as possible (i.e. directly over the pipeline and umbilical route, and other seabed assets being surveyed). Dedicated MMO and vessel crew will monitor and report immediately any interactions with Annex IV species that cause concern. Acoustic survey equipment will be mounted directly to the ROV, reducing the likelihood of interaction (such as entanglement) with Annex IV species. Other equipment such as the replacement flexible flowline, rock gabions and concrete mattresses will be lowered to the seabed using a taut vertical cable, reducing the likelihood of interaction (such as entanglement) with Annex IV species	**Minor** No known records of similar animal entanglement. Residual risk of acoustic source from presence of vessel traumatising Annex IV species is low. For any reduction in Annex IV species abundance, rapid repopulation is likely as responses by animals will be behavioural and temporary in nature. No changes in overall species abundances are anticipated. Likelihood of collision or entanglement with animals considered extremely low.

Aspect *Potential impact*	Mitigation measures	Significance
	The vessel will operate in accordance with the principles of the Vessel Code of Conduct (Document No. COR-14-SH-0227, 2018).	
Operation of geophysical survey equipment *Acoustic disturbance*	The work will be scheduled so as to minimise the duration of project activities and to confine activities to as small an area as possible to minimise extent of acoustic presence (these impacts would be limited to the As-Found and As-Left surveys at the beginning and end of the proposed work scope). Soft start procedure will ensure controlled build-up of acoustic energy output is undertaken in consistent stages, providing a steady and controlled graduation of acoustic source levels that will allow animals the opportunity to vacate the area. Dedicated MMO and vessel crew on survey vessels will monitor and report immediately any interactions with Annex IV species that cause concern.	**Minor** For any reduction in Annex IV species abundance, rapid repopulation is likely, as impacts are expected to be limited to behavioural (likely to be temporary) responses or temporary disturbances. Residual risk of traumatising Annex IV species is low.
Removal and installation of the P6 Flexible Flowline *Water quality and temporary and permanent disturbance and alteration to the seabed benthic environment*	The existing flexible flowline will be moved only at the ends where it joins to the P6 wellhead and at the Corrib Central Manifold in order to minimise disturbance to the seabed and limit the degree of resuspension of seabed sediments. The existing flowline will be preserved for future use in situ on the seabed, thus minimising the disturbance to the seabed environment that would be caused by its removal, but also ensuring that it can be reused in the future. The degree of physical presence of equipment and material on the seabed during construction will be confined to as small an area as possible in order to limit the spatial extent of disturbance. Works will also be undertaken over a short duration.	**Minor** The effect on prey and food sources of Annex IV species would be extremely localised and recovery would be expected to be short-term. No known records of similar animal entanglement. Likelihood of collision or entanglement with animals considered extremely low. All chemicals for routine discharge during installation and commissioning will be of small volume and of benign toxicity. Any discharges will be in an open sea area where dilution and dispersion will be extremely rapid. No toxicity in the

Aspect *Potential impact*	Mitigation measures	Significance
	At the end of the installation works, the work site on the seabed will be reinstated and where possible equipment and materials will be removed. An As-Left survey will be undertaken to confirm that the work site has been left in as good a state as possible prior to departure. Any chemical releases during installation and commissioning will be of small volume and chemicals to be used will have been PLONOR listed or registered on the OCNS and OSPAR HMCS based on an assessment of their toxicity in the aquatic environment (under which they will have the highest rating). The ROV support vessel would be largely stationary and confined to the immediate area of operations at the Corrib Field. Equipment that was required to be lowered to the seabed via the vessel crane would be undertaken using a taught vertical cable, limiting the potential for entanglement.	marine environment will occur including no bioaccumulation of toxicity in marine fauna
Vessel operations / routine emissions and discharges *Water quality and toxicological effects.*	All waste will be handled in accordance with the vessels waste management plan, which will operate in accordance with all national and international legislation/regulations and corporate guidelines. Compliance with MARPOL 73/78. Vessel is modern and built according to Clean Design requirements, with fuel efficient diesel-electric propulsion and emission control equipment. The work will be scheduled so as to minimise the duration of project activities and to confine activities to as small an area as possible.	**Minor** Potential attraction of Annex IV species to the area, due to potential attraction of prey species (vertebrates and invertebrates) at certain times (during discharges). There is a chance for this to result in an increased potential for laceration with propeller / interaction with the vessel or equipment, although the likelihood of this is considered to be extremely low. All vessel discharges will be in compliance with MARPOL 73/78. There is not considered any potential for bioaccumulation of toxicity in marine fauna as a consequence of routine vessel discharges

Aspect *Potential impact*	Mitigation measures	Significance
	Air emissions will be minimised through regular maintenance of all engines onboard, in line with Maritime Registry of Shipping (MRS), MARPOL 73/78 Annex VI and other similar requirements.	

7.4 Accidental events – risk assessment

The proposed survey has the potential to affect Annex IV species within a relatively localised area in the vicinity pipeline route. However, accidental events such as a large oil or chemical spill, has the potential to affect a wider geographical area.

This following table summarises the aspects, potential impacts, mitigation measures, and predicted impacts to Annex IV species from accidental events, which may occur during the planned survey. The potential for accidental events to occur during planned activities have also been considered and summarised in Table 7-3.

Table 7-3: Accidental events: risk assessment of potential impacts, proposed mitigation measures and predicted impacts

Aspect *Potential impact*	Mitigation measures	Predicted impact / significance
Vessels operations, fuel and oil spills from the vessel Vessel Collision – Loss of fuel inventory *Water quality and toxicological effects*	No refuelling of the vessel will take place at sea. Refuelling operations will be managed through detailed vessel specific procedures and be supported by emergency response plans. The use of a well-maintained and modern vessel, with modern navigational systems to identify / avoid obstacles. All fuels and chemicals aboard the ROV support vessel will be stored according to regulations and manufacturer's directions. Material Safety Data Sheets (MSDSs) for all chemicals stored onboard will be readily available. Procedures will be in place for dealing with spills and leaks. Chemicals used will be PLONOR listed or registered on the OCNS and OSPAR HMCS based on an assessment of their toxicity in the aquatic environment. The vessel deck will have measures in place to contain fuel / lubricant / chemical leaks, such as bunding. Spill response equipment will also be present on board the vessel and personnel will be trained in its usage. Maintenance, audits and inspection plans will be in place and followed, to ensure early detection of any potential oil leaks. Vessel is modern and built according to Clean Design requirements, which specifies that it be of double-hulled construction, thus further minimising the potential for loss of fuel oil inventory in the event of collision/grounding. The vessel will operate with strict safety, navigational, operating and communications procedures in place in order to avoid collisions.	**Minor** In the event of significant loss of fuel in an open offshore environment, spills would be rapidly dispersed and diluted with little long-term residual impact. Any reduction in Annex IV species abundance would be low and rapid repopulation is likely. The effect on prey and food sources of Annex IV species would be localised and recovery would be expected to be short-term.

Aspect *Potential impact*	Mitigation measures	Predicted impact / significance
	These will include use of Automatic Identification System (AIS) tracking, adherence to the Collision Regulations, communication with other vessels, and 24 hour look ahead plans. Use of marine grade oil (MGO), rather than traditional heavy bunker fuel. In the event of a release of oil, this will disperse more readily in the offshore environment.	
Accidental loss of equipment during operations Vessel collision risk with Annex IV species *Physical presence and potential for interaction*	Acoustic survey equipment will be mounted directly to the ROV, reducing the potential for entanglement and loss of equipment. The vessel will operate in accordance with the principles of the Vessel Code of Conduct (Document No. COR-14-SH-0227, 2018). Sightings of Annex IV species in the vicinity of the Corrib Field are comparatively low due to the distance offshore. Risks of vessel collision will be minimised due to the vessel operating in accordance with the principles of the Vessel Code of Conduct (Document No. COR-14-SH-0227, 2018). In addition, an MMO will be present at all times keeping watch during daylight hours. The vessel will be largely stationary for the majority of its operations at the Corrib Field. The ROV support vessel will be equipped with two ROVs and in the event of an issue with one ROV, the other can be deployed along with the crane aboard the ROV support vessel to recover it. An As-Found survey at the start of works and As-Left survey prior to leaving the site on completion will identify an equipment or materials that are required to be removed from the seabed. The worksite is to be reinstated on completion of works.	**Negligible** In the event of a loss of equipment, which ultimately could not be recovered, there is a possibility that equipment may become entangled in other seabed obstacles and / or fishing gear, which in turn may provide a potential source of entanglement to Annex IV species. Due to the measures described, the likelihood of an occurrence is considered to be extremely unlikely. Due to the measures described, the likelihood of an occurrence of a project vessel striking any Annex IV animals is considered to be very unlikely.

8 CONCLUSIONS

This assessment has undertaken an initial screening assessment for an EIA and considered the potential impacts to Annex IV species associated with the proposed programme of infrastructure works at the Corrib Field. Potential impacts to Natura 2000 sites and any species or habitats that are included as designating features of these sites are considered in the Natura Impact Statement report in support of an Appropriate Assessment (if required), which also accompanies this application.

The auditory ranges of the majority of cetaceans and seals are unlikely to overlap significantly with the typical operating frequencies of the MBES equipment proposed for the As-Found and As-Left surveys. It is important to consider that the source levels at which this equipment operates are considerably less than the lower frequency and higher source levels used in exploration seismic surveys.

Impacts will be mitigated by the use of soft start procedures and MMO's, and the surveys will be carried out following the NPWS best-practice guidance: "Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters" (NPWS, 2014).

The disturbance to animals by the direct presence of the ROV support vessel and ROVs and the deployment and recovery of equipment and material to the seabed at the Corrib Field are also not considered likely to result in any significant impacts. The vessel will be relatively slow moving, and not prone to sudden or erratic changes in direction. Furthermore, it will remain in a relatively static position over the P6 well and Corrib Central Manifold for the duration of the works. Animals will therefore have the opportunity to move away from the vessel. MMO's will be present on board the ROV support vessel and when working the vessel will operate according to principles of the inspection and maintenance survey Code-of-Conduct for vessels and personnel operating within and adjacent to Broadhaven Bay SAC (Document No. COR-14-SH-0227, 2018). This outlines specific guidance for vessels to avoid disturbance or injury to marine mammals (in particular, small cetaceans) and while this document has been drafted specifically for nearshore waters, many of the principles contained within it will be followed as a matter of environmental good practice while undertaking works at the Corrib Field.

The screening assessment has concluded that this project would not require an EIA. The impact assessment for Annex IV and other designated / protected species has concluded that the shallow geophysical survey techniques and any direct disturbance from the vessel itself is not likely to have an adverse effect on the species that have been identified as key receptors within the zone of influence of the proposed works. Additionally, the other activities which are part of the proposed works, to replace the flexible flowline between the P6 wellhead and the Corrib Central Manifold, are unlikely to result in adverse effects. Any impacts that do occur will be limited to short-term avoidance behaviour of minor or negligible magnitude, with no lasting ecological effects.

9 REFERENCES

American Methanol Institute (AMI). 1999. Evaluation of the Fate and Transport of Methanol in the Environment. Technical Memorandum. http://www.methanol.org/wp-content/uploads/2016/06/White-Paper-The-Fate-Transport-of-Methanol-in-the-Environment-1999.pdf [accessed May 2020]

Anderwald, P., Brandecker, A., Haberlin, D., Coleman, M., Collins, C., O'Donovan, M., Pinfield, R. and Cronin, M. 2012. *Marine mammal monitoring in Broadhaven Bay 2011*. Progress Report to RSK Environment Limited Group. Coastal and Marine Research Centre, University College Cork, Ireland.

Berrow, S. 2002. Biological diversity of cetaceans (whales dolphins and porpoises) in Irish waters In: Nunn JD (Ed) Marine Biodiversity in Ireland and Atlantic waters. Proceedings of a conference 26 to 27 April 2001. Ulster Museum Belfast (MAGI publication no 008)

Birdlife International. 2014. BirdLife Seabird wikispace. http://seabird.wikispaces.com/home [accessed June 2014]

BirdLife International, 2019. IUCN Red List for birds. http://www.birdlife.org [accessed August 2019]

Clark, C.W. and Charif, R.A. 1998. *Acoustic monitoring of large whales to the west of Britain and Ireland using bottom-mounted hydrophone arrays, October 1996 – September 1997*. JNCC Report No. 281. JNCC. Peterborough. 25pp.

Coleman, M., Philpott, E., O'Donovan, M., Denniston, H., Walshe, L., Haberlin, M. and Englund, A. 2009. Marine Mammal Monitoring in Broadhaven Bay SAC, 2008. *Project report to RSK Environment Ltd*. Coastal and Marine Resources Centre, University College Cork.68pp.

Cook, R., Fernandes, P., Florin, A., Lorance, P. and Nedreaas, K., 2015. *Coryphaenoides rupestris*. The IUCN Red List of Threatened Species 2015: e.T15522149A45136880.[accessed August 2019]

Coull, K.A., Johnstone, R. and Rogers, S.I., 1998. Fisheries Sensitivity Maps in British Waters. Aberdeen: UKOOA Ltd.

DCCAE, 2019. Department of Communications, Climate Action and the Environment. EIA Guidance Screening Table https://www.dccae.gov.ie/documents/CopyofEIAScreeningTableSeismic.pdf [accessed July 2019]

DCENR, 2011. *Rules and Procedures Manual for Offshore Petroleum Exploration and Appraisal Operations*. Petroleum Affairs Division of the Department of Communications, Energy and Natural Resources, Dublin, Ireland. 77pp.

EACS, 2015. Corrib Gas Pipeline: Operation under Section 40 of the Gas Act 1976 (as amended) - Screening Report for Appropriate Assessment. 27 July 2015.

Ellis, J.R., Milligan, S.P., Readdy, L., Taylor, N. and Brown, M.J., 2012. *Spawning and nursery grounds of selected fish species in UK waters. Lowestoft: Centre for Environment, Fisheries and Aquaculture Science (CEFAS).* Report No. 147.

EMSA, 2020. European Maritime Safety Agency (EMSA) Route Density Data. Accessed via EMODnet. [accessed May 2020]

EMODnet, 2019. European Marine Observation and Data Network (EMODnet) Human Activities: Shipping - Vessel Density. https://www.emodnet-humanactivities.eu/ [accessed May 2020]

EPA, 2017. *Guidelines on the Information to be Contained in the Environmental Impact Assessment Reports*, Draft August 2017.

ERM, 2001. *Guidance on EIA: Screening*. Report prepared by Environmental Resource Management, Edinburgh, UK on behalf of the European Commission.

ERT, 2006. *First Strategic Environmental Assessment for oil and gas activity in Ireland's offshore Atlantic waters: IOSEA1 Slyne, Erris and Donegal Basins*. Environmental Report. Department of Communications, Energy and Natural Resources.

ERT/Aqua-Fact International Services, 2007. *Second Strategic Environmental Assessment for Oil and Gas Activity in Ireland's Offshore Atlantic Waters: IOSEA2 Porcupine Basin, Environmental Report*. Department of Communications, Energy and Natural Resources.

European Commission, 2017. *Environmental Impact Assessment of Proposed Developments Guidance on Screening* (Directive 2011/92/EU as amended by 2014/52/EU). http://ec.europa.eu/environment/eia/pdf/EIA_guidance_Screening_final.pdf

European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477 of 2011)

European Union (Environmental Impact Assessment) (Petroleum Exploration) Regulations 2013 (S.I. 134 of 2013)

European Union (Environmental Impact Assessment) (Petroleum Exploration) (Amendment) Regulations 2019 (SI 124 of 2019)

European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 (S.I. No. 296 of 2018).

Evans, P.G.H., 1998. *Biology of Cetaceans of the North-east Atlantic (in relation to seismic energy)*. Seismic and marine mammals workshop, London, 23 to 25 June 1998.

Evans, P.G.H. and Nice H., 1996. *Review of the effects of underwater sound generated by seismic surveys on cetaceans*. Sea Watch Foundation, Oxford.

Gerritsen, H.D. and Kelly, E. 2019. Atlas of Commercial Fisheries around Ireland, third edition. Marine Institute, Ireland. ISBN 978-1-902895-64-2. 72 pp. With data from the Fisheries theme accessed through Ireland's Marine Atlas at http://atlas.marine.ie/, [07 May 2020]

Gisiner, R.C.,1998. Proceedings on workshop on the effects of anthropogenic noise in the marine environment. 10-12 February 1998. Marine Mammal Science Program, Office of Naval Research, VA, USA.

Gordon, J. Berrow, S.D., Rogan, E. and Fennelly, S., 1999. Acoustic and visual survey of cetaceans off the Mullet Peninsula, Co. Mayo. *Irish Naturalists Journal*. 26 (7/8): 251-259.

Government of Ireland, 2018. *Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment* (Government of Ireland, August 2018);

Irish Whale and Dolphin Group (IWDG), 2014. www.iwdg.ie

IUCN, 2019. The IUCN Red List of Threatened Species. 2019-2. https://www.iucnredlist.org/ [accessed August 2019].

Lacroix, D.L., Lanctot, R.B., Reed, J.A. and McDonald, T.L., 2003. Effect of underwater seismic surveys on molting male Long-tailed Ducks in the Beaufort Sea, Alaska. *Canadian Journal of Zoology* 81(11):1862-1875.

Marine Institute, 2019a. Salmon Life Cycle. https://www.marine.ie/Home/sitearea/ areas-activity/fisheries-ecosystems/salmon-life-cycle?language=ga [accessed June 2019].

Marine Institute, 2019b. Biologically Sensitive Area. https://www.marine.ie/Home/sitearea/areas-activity/fisheries-ecosystems/biologically-sensitive-area [accessed June 2019].

Marine Institute, 2009. Species Distribution – Sea Fisheries, Species Spawning and Nursery Areas (Dataset). Galway: Marine Institute.

McCauley, R.D., Fewtrell, J., Duncan, A.J., Jenner, C., Jenner, M.N., Penrose,.J.D., Prince, R.I.T., Anita, A., Murdoch, J. and McCabe, K., 2000. *Marine Seismic Surveys: analysis and propagation of air-gun signals; and effects of air gun exposure on humpback whales, sea turtles, fishes and squid*. Prepared for Australian Petroleum Production Exploration Association.

McMahon, C.R. and Hays, G.C., 2006. Thermal niche, large-scale movements and implications of climate change for a critically endangered marine vertebrate. *Global Change Biology*, 12, 1330-1338

Mickle, M.F, Miehls, S.M., Johnson, N.S., and Higgs, D.M., 2018. Hearing capabilities and behavioural responses of sea lamprey (*Petromyzon marinus*) to low-frequency sounds*. Canadian Journal of Fisheries and Aquatic Science*.

National Parks and Wildlife Service (NPWS), 2007. *Code of Practice for the Protection of Marine Mammals during Acoustic Seafloor Surveys in Irish Waters.* Version 1.1. Department of the Environment, Heritage and Local Government. August 2007. http://www.npws.ie/en/media/Media,5176,en.pdf

National Parks and Wildlife Service (NPWS), 2014. *Guidance to manage the risk to marine mammals from man-made sound sources in Irish Waters*. Department of Arts, Heritage and Gaeltacht. January 2014.

Nedwell J.R., Langworthy, J., and Howell, D., 2003. *Assessment of sub-sea acoustic noise and vibration from offshore wind turbines and its impact on marine wildlife; initial measurements of underwater noise during construction of offshore windfarms, and comparison with background noise*. Subacoustech Report Reference: 544R0424 submitted to COWRIE.

Nedwell J.R., Edwards, B., Turnpenny, A.W.H. and Gordon, J. (2004). *Fish and marine mammal audiograms: a summary of available information.* Subacoustech Report Reference: 534R0214.

Nedwell, J,R, Turnpenny, A.W.H, Lovell, J.M., Edwards, B., 2006. An investigation into the effects of underwater piling noise on salmonids. *Journal of the Acoustic Society of America* 120, 5, 2550-2554.

Nedwell, J. R., Ward, P. D., Lambert, D., Watson, D., Goold, J., Englund, A., Bendell, A. And Barlow, K., 2008. *Assessment of potential for significant disturbance/ disruption to cetaceans present in and around Broadhaven Bay, Co. Mayo, from pipeline construction operations*. Subacoustech Report No. 824R0113 for RSK Environment Ltd.

Northridge, S.P., Tasker M., Webb, A., and Williams, J.M., 1995. Distribution and relative abundance of harbour porpoises, white-beaked dolphins and minke whales around the British Isles. *ICES Journal of Marine Science* 53, 55-56;

Ó Cadhla, O., Mackey M., Aguilar de Soto, N., Rogan, E and Connolly N., 2004. *Cetaceans and seabirds of Irelands Atlantic margin. Volume II- Cetacean distribution and abundance.* Report on the research carried out under the Irish Petroleum Infrastructure Programme.

Popper, A.N., 2005. *A Review of Hearing by Sturgeon and Lamprey*. U.S. Army Corps of Engineers, Portland District.

Popper A. N., Hawkins A. D., Fay R. R., Mann D. A., Bartol S., Carlson T. J., Coombs S., *et al*., 2014. Sound Exposure Guidelines. In ASA S3/SC1. 4 TR-2014 *Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report prepared by ANSI-Accredited Standards Committee S3/SC1 and registered with ANSI*, pp. 33–51. Springer, New York.

Reid, J.B., Evans, P.G.H., and Northridge S.P., 2003. *Atlas of cetacean distribution in north-west European waters*. Peterborough. JNCC;

Richardson, W.J., Greene, C.R., Malme, C.I. and Thomson, D.H., 1995. Marine Mammals and Noise. Academic Press Ltd, London.

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

RSK, 2001. *Environmental Impact Statement - Corrib Field Development (Offshore Field to Terminal)*. Prepared on behalf of Enterprise Energy Ireland Ltd. October 2001

RSK, 2010. *Environmental Impact Statement - Corrib Field Development (Offshore Field to Terminal) - Offshore Supplementary Update Report.* Prepared on behalf of Shell E&P Ireland Ltd. May 2010.

RSK, 2015. *Operational Impacts of the Corrib Gas Pipeline - Roadmap for EIS Documentation.* Prepared on behalf of Shell E&P Ireland Ltd. July 2015.

RSK, 2016. *Corrib Offshore Baseline Environmental Surveys 2014 and 2016 - Treated Surface Water Outfall (SW1) and Corrib Offshore Gas Field (SW3).* Prepared on behalf of Shell E&P Ireland Ltd. August 2016.

RSK, 2019 a. *EIA screening and environmental risk assessment for Annex IV species – Corrib Subsea Inspection, Maintenance and Infrastructure Renew Surveys 2019.* Prepared on behalf of Vermilion E&P Ireland Ltd. June 2019

RSK, 2019 b. *Natura Impact Statement – Corrib Subsea Inspection, Maintenance and Infrastructure Renew Surveys 2019.* Prepared on behalf of Vermilion E&P Ireland Ltd. June 2019.

RSK, 2020. *Natura Impact Statement – Corrib Field P6 Flexible Flowline Installation.* Prepared on behalf of Vermilion E&P Ireland Ltd. September 2020.

Shell E&P Ireland Ltd, 2018. *Corrib Vessel Code of Conduct for Vessels and Personnel Undertaking Survey, Operations or Maintenance Activities on the Corrib Offshore Pipeline.* Document No: COR-14-SH-0227. Document forms part of the Operators overall Environmental Management Plan (EMP)

Southall, B. L., Bowles, A. E., Ellison, W. T., Finneran, J. J., Gentry, R. L., Greene, C. R., Kastak, D., Ketten, D., Miller, J. H., Nachtigal, P. E., Richardson, W. J., Thomas, J. A. and Tyack, P., 2007

Marine mammal noise exposure criteria: initial scientific recommendations. *Aquatic Mammals*, 33, pp. 411- 521.

Southall B L, Finneran J J, Reichmuth C, Nachtigall P E, Ketten D R, Bowles A E, Ellison W T, Nowacek D P, Tyack P L (2019). Marine Mammal Noise Exposure Criteria: Updated Scientific Recommendations for Residual Hearing Effects. *Aquatic Mammals 2019, 45(2),* 125-232, DOI 10.1578/AM.45.2.2019.125.

Stemp, R., 1985. Observations on the effects of seismic exploration on seabirds, pp. 217- 233. In: G.D. Greene, F.R. Engelhardt and R.J. Paterson (eds), Proceedings of the Workshop on Effects of Explosives Use in the Marine Environment, January 29-31, 1985, Halifax. Canada Oil and Gas Lands Administration, Environmental Protection Branch, Technical Report No. 5

Stone, C. J., and Tasker, M. L., 2006. The effects of seismic airguns on cetaceans in UK waters. *Journal of Cetacean Research and Management*, 8, 255-263.

Thompson, D., 1998. *Biology of seals of the north-east Atlantic in relation to seismic surveys*. Paper presented at the seismic and marine mammals workshop, 23-25 June 1998, London.

Turnpenny, A.W.H. and Nedwell, J.R., 1994. *The Effects on Marine Fish, Diving Mammals and Birds of Underwater Sound Generated by Seismic Surveys*. Report from Fawley Aquatic Research Laboratories Ltd, FCR 089/94.

United States Environmental Protection Agency. Office of Pollution Prevention and Toxics (USEPA OPPT). 1994. Chemical Summary for Methanol. Report No. EPA 749-F-94- 013a.

Visser, F., Coleman, M., Denniston, H., O'Donovan, M. Walshe, L., Ponzo, A. and Cronin, M., 2010. *Marine mammal monitoring in Broadhaven Bay 2009*. Progress report to RSK Environment Limited Group. Coastal and Marine Resources Centre, University College Cork, Cork.

WYG, 2017. *Guidance on 2017 changes to EIA and Planning Regulations. WYG Press Release – February 2017*. https://www.wyg.com/news-and-press-releases/guidance-on-2017-changes-to-eia-and-planning-regulations [accessed March 2018]

Woodward, I., Thaxter, C.B., Own, E., and Cook, A.S.C.P, 2019. *Desk-based revision of seabird foraging ranges used for HRA screening*, BTO Research Report No. 724. 139pp

APPENDIX 1

Shell E&P Ireland Ltd

Corrib Gas Pipeline

Operational Impacts of the Corrib Gas Pipeline

Appendix A to the Cover Letter:

Roadmap for EIS Documentation

P40036

JULY 2015

RSK GENERAL NOTES

Project No.: P40036/04

Title: Corrib Gas Pipeline
Operational Impacts of the Corrib Gas Pipeline Roadmap for EIS Documentation

Client: Shell E&P Ireland Limited

Date: 28th July 2015

Office: Helsby

Status: Final

Author	Wendy Hogben/ David Watson	**Technical reviewer**	W.Hogben
Signature		Signature	
Date:	28th July 2015	Date:	28th July 2015

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Where field investigations have been carried out, these have been restricted to a level of detail required to achieve the stated objectives of the work.

This work has been undertaken in accordance with the quality management system of RSK Environment Ltd.

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1 INTRODUCTION

The Corrib Gas Field Development is divided into a number of distinct but inter-related and inter-dependent elements as follows:

- Offshore seabed installation (subsea wellheads and manifold at the Gas Field);
- Offshore gas pipeline (between wellheads and landfall);
- Onshore gas pipeline (between landfall and gas terminal at Bellanaboy); and
- Bellanaboy Bridge Gas Terminal (BBGT).

The Corrib Pipeline includes both onshore and offshore, between the Corrib Gas Field and the BBGT received Ministerial Consent under Section 40 of the Gas Act in April 2002. SEPIL applied for consents for a modified route for the onshore gas pipeline in February 2009, including an application to the Minister for Department of Communications, Energy and Natural Resources (the "Minister").

Further modifications to the proposed onshore gas pipeline development, requested by An Bord Pleanála in November 2009, necessitated the preparation of a new/revised application to the Minister, including a revised Environmental Impact Statement (EIS) for the onshore gas pipeline. This revised application was submitted in June 2010. As the consents processes under the Gas Act apply to the Corrib Pipeline in its entirety (both onshore and offshore), a revised 2010 Supplementary Update Report in respect of the offshore section of the Corrib Pipeline for the 2001 Offshore EIS was also submitted, as outlined in Table 1. Additional information was also submitted to the Minister as part of the application, as listed in Table 1. A new consent was required for the Corrib Pipeline in order to implement the proposed modifications to the onshore pipeline route. This was granted on 25 February 2011 (the 2011 Section 40 Consent).

Table 1: Documentation submitted in respect of the Corrib Pipeline (2011 Section 40 Consent)

Project Element	Environmental Impact Statement / Natura Impact Statement
Offshore Seabed Installation Offshore Gas Pipeline	▪ Corrib Offshore Field to Terminal EIS October 2001 ▪ Offshore Supplementary Update Report May 2010
Onshore gas pipeline between landfall valve installation at Glengad and the Bellanaboy Bridge Gas Terminal	▪ Corrib Onshore Pipeline EIS May 2010, including Appendix P Natura Impact Statement (NIS)
Offshore and Onshore Pipeline	Additional Information ▪ (a) Non-Technical Summary; ▪ (b) Additional Information to the May 2010 Onshore Pipeline (Volume 1) (which included an Errata and Addendum to the EIS) ▪ (c) Geotechnical Data package (Sruwaddacon Bay Ground Investigation Data) 2010 (Vol. 1, 2 and 3), and ▪ (d) Engineering Integrity Material

The likely significant impacts of the construction and the operation of the Corrib Pipeline from the offshore facilities to the BBGT were fully considered and assessed in the documentation listed above.

SEPIL is applying for consent to operate an upstream pipeline, which includes both offshore and onshore elements, under Section 40 of the Gas Act (as amended) from the Minister of Communications, Energy and Natural Resources.

1.1 Purpose of this Roadmap Document

This Roadmap Document simply indicates where the information concerning the impacts associated with the operation of the Corrib Pipeline have been considered, this includes both offshore and onshore elements which have been considered and assessed in the documentation listed in Table 1.

The key information, extracted from the above documentation, includes:

- A description of the potential impacts[1] of the operation of the Corrib Pipeline on the environment.
- A summary of residual impacts[2] and a description of the mitigation measures envisaged in order to avoid, reduce and, if possible, remedy significant adverse effects.

Table 2 lists all environmental aspects for which there was potential for impacts during the operation of the Corrib Pipeline. It sets out where these aspects were primarily but not exclusively considered in the EIS documentation. Table 3 (provided in Section 2 of this document) lists those aspects/activities for which residual operational impacts are anticipated. Where no residual impacts were predicted, these are not outlined further in this Roadmap Document. The 2001 Offshore EIS, 2010 Offshore Supplementary Update Report (SUR) and 2010 Onshore EIS all listed the key residual impacts within their respective summary chapters, (Section 16, Section 16 and Section 18 respectively). For ease of consideration and review , cross referencing these documents is provided throughout Table 3. Direct extracts are taken from the respective EIS documentation and as such in some cases refer to construction vessels. Where such impacts are identified they are clearly applicable to the use of both construction and operational vessels.

[1] Potential impacts are those which could potentially occur if no mitigation measures were in place

[2] Residual impacts are those impacts after implementation of mitigation measures

Table 2: Operational Impacts of the Corrib Pipeline

Aspect	Offshore Pipeline	Reference	Onshore Pipeline	Reference	LVI	Reference
Human/Socio Economic	√	Chapter 6 2001/2010 Offshore EIS/SUR*	√	Chapter 6 2010 Onshore EIS	√	Chapter 6 2010 Onshore EIS
Ecology	√	Chapter 7 2001/2010 Offshore EIS/SUR	√	Chapters 12 -14 2010 Onshore EIS	√	Chapters 12 2010 Onshore EIS
Soils & Geology	√	Chapter 8 2001/2010 Offshore EIS/SUR		Chapter 15 2010 Onshore EIS		Chapter 15 2010 Onshore EIS
Water/Hydrology	√	Chapter 9 2001/2010 Offshore EIS/SUR		Chapter 15 2010 Onshore EIS	√	Chapter 15 2010 Onshore EIS
Air	√	Chapter 10 2001/2010 Offshore EIS/SUR		Chapter 8 2010 Onshore EIS		Chapter 8 2010 Onshore EIS
Noise	√	Chapter 11 2001/2010 Offshore EIS/SUR		Chapter 9 2010 Onshore EIS	√	Chapter 9 2010 Onshore EIS
Landscape		Chapter 12 2001/2010 Offshore EIS/SUR		Chapter 10 2010 Onshore EIS	√	Chapter 10 2010 Onshore EIS
Climate		Chapter 13 2001/2010 Offshore EIS/SUR		Chapter 8 2010 Onshore EIS		Chapter 8 2010 Onshore EIS
Cultural Heritage		Chapter 14 2001/2010 Offshore EIS/SUR		Chapter 16 2010 Onshore EIS		Chapter 16 2010 Onshore EIS
Waste	√	Chapter 15.2 2001/2010 Offshore EIS/SUR		Chapter 11 2010 Onshore EIS	√	Chapter 11 2010 Onshore EIS
Traffic		Chapter 15.3 2001/2010 Offshore EIS/SUR	√	Chapter 7 2010 Onshore EIS	√	Chapter 7 2010 Onshore EIS
Agriculture		N/A	√	Chapter 11 2010 Onshore EIS	√	Chapter 11 2010 Onshore EIS

Legend: √ refers to Residual Impact. Reference refers to where aspect is primarily but not exclusively considered in the EIS documentation. **Note:** The shaded grey areas relate to where aspects were considered to have no residual impact or not applicable for assessment e.g. agriculture not relevant to the offshore pipeline. * Supplementary Update Report.

2 SUMMARY OF RESIDUAL IMPACTS

Table 3 provides a summary of predicted residual impacts and a description of the mitigation measures included in the EIS documentation submitted with the Section 40 Consent to Operate application, such as the 2010 Onshore EIS, the 2001 Offshore EIS and the 2010 Offshore Supplementary Update Report and Additional Information.

Table 3: Residual Operational Impacts of the Corrib Pipeline

Aspect	Potential Impact	Mitigation Measures	Residual Impact	Extract Reference
Offshore Gas Pipeline				
Human Beings	Section 6.5.2 During normal operations, there will be no employment opportunities associated with the offshore development, except for those associated with the long-term maintenance and monitoring of the offshore pipeline and production facilities. These activities will require the employment of specialist contractors at regular intervals.	Section 6.7.2 No mitigation measures are considered necessary.	**POSITIVE** Section 6.7.2 Proposed development is likely to have an overall positive economic impact on the existing residential community through enhanced use of local services and goods.	2001 Offshore EIS, Section 6 Human Beings
Air Quality	Section 10.5.2.6 Once the pipeline and subsea equipment are in place, scheduled releases to the atmosphere are not anticipated as a result of routine operation. Occasionally, there will be small atmospheric emissions from marine vessels used for inspection surveys of the pipeline.	Section 10.7 Combustion emissions associated with transportation will be minimised through appropriate vessel selection and vehicle management plans. A programme of regular maintenance will be put in place to ensure that fuel use is as efficient as possible and emissions are within acceptable limits. Regular pipeline inspections and examinations using pipeline integrity gauges (PIGs), surface gas detectors (onshore) and inspections of the offshore route using survey vessels, will ensure that the integrity of the pipeline is maintained. These measures can	**NEGLIGIBLE** Section 10.8. In general, there are no resident sensitive receptors offshore and impacts will be negligible	2001 Offshore EIS, Section 10 Air Emissions

Aspect	Potential Impact	Mitigation Measures	Residual Impact	Extract Reference
Offshore Gas Pipeline				
		be expected to be completely effective in eliminating any potential for release of gas from the pipeline and are used routinely worldwide.		
Water Quality	Section 9.5.1 Estimates of the volume of black and grey wastewaters, discharged from vessels during the remaining offshore and nearshore works, are provided in Table 9-2. Estimates have also been provided for galley wastes from the installation vessels.	Section 9.5.1 Such discharges will be quickly dispersed by wave and tide action, and discharges during future installation operations will not be "additive".	**NEGLIGIBLE** Section 9.5.1 Given the wide area and long period over which the discharges will be made, the magnitude of the impact is classified as negligible.	2010 Offshore Supplementary Update Report, Section 9 Water
Noise impact on cetaceans	Section 11.8.1 Relatively low noise levels will be generated by the installation vessels, these are likely to result in a negligible impact to cetaceans.	Section 11.7 In terms of mitigation against the noise generated by the marine construction vessels, a code of practice for dredging works was implemented in 2008 and 2009 (in agreement with the NPWS), and will be implemented during the next construction period. The code includes requirements such as a qualified and experienced Marine Mammal Observer (MMO) to be on board near shore construction vessels. The MMO is responsible for ensuring, through visual observations, that an exclusion zone of 1000m around the vessel is free of marine mammals for 30 minutes before operations commence.	**NEGLIGIBLE** Section 16 Negligible	2001 Offshore EIS, Section 11 Noise, 16 Assessment of Environmental Effects 2010 Offshore Supplementary Update Report, Section 11 Noise

Aspect	Potential Impact	Mitigation Measures	Residual Impact	Extract Reference
Offshore Gas Pipeline				
Solid Waste	Section 15.2.8.3 Once the pipeline, umbilical and discharge pipe are operational, very little waste will be produced. It should be noted that small amounts of scale could be produced during maintenance operations. This waste will arise in the Terminal and therefore, is discussed in detail in the Terminal EIS. There will also be some solid waste generated by vessels carrying out survey or maintenance work along the pipeline route. This waste is held on board and there will no impact from this.	Section 16 .2 • inspection of pipeline integrity is routine, ensures that the pipeline functions correctly and removes scale build up; • scale is disposed of to licenced landfill site; and • subsea equipment is designed for project life. Replacement would not be a routine event. Written procedures would be followed.	**NEGLIGIBLE** Section 16	2001 Offshore EIS, Section 15 Material Assets, Section 16 Assessment of Environmental Effects
Post Construction Surveys (include Geophysical Surveys)[3]	Section 16.2 The length of the pipeline route from landfall to field will be surveyed • emissions to air from survey vessel; subsea noise; and • interference with other sea users.	Section 16.2 • survey will use low energy sonar, which has negligible effects on cetaceans; and • fishery liaison procedures will be employed.	**NEGLIGIBLE** Section 16.2 • emissions to air: refer to Chapters 10 and 13 • interaction with other sea users: refer to Chapter 15.	2001 Offshore EIS, Section 16 Assessment of Environmental Effects
Marine Ecology	Section 9.8.2 Leaching of trace metals from the sacrificial anodes is anticipated to have a negligible impact on the marine environment, as they will dissolve very slowly over the life of the pipeline. This will release small	Section 9.7.2 The sacrificial anodes used for cathodic protection will be designed to dissolve slowly, such that only low concentrations of metals are released over a long time period.	**NEGLIGIBLE** Section 9.10 There could be a slow breakdown of the sacrificial anodes if the pipe is left on the seabed, releasing metal ions into the water. This is expected to provide a negligible	2001 Offshore EIS, Section 9 Water

[3] Geophysical surveys include side scan sonars

Aspect	Potential Impact	Mitigation Measures	Residual Impact	Extract Reference
Offshore Gas Pipeline				
	amounts of metal ions into the water column which will be diluted by the natural water movements along the pipeline route. Any metals which leach from anodes which are covered by the sediment may take longer to disperse.		impact because of the slow rate of release and high dilution available	
Water Quality (Discharge pipe (outfall pipe) and Umbilical	Section 9.8.2 During operation, the discharge from the outfall location north of Erris Head will consist of treated surface water run-off from hard surfaces around the terminal, effectively treated rain water and therefore no impacts are predicted. The discharge on the seabed in the Corrib field will consist of produced water, which has been treated to reduce contaminant concentrations to those required by the existing IPPC licence. The concentrations specified in that licence were such that there would not be damage to marine organisms. No effects are therefore predicted.	Section 9.7 For all offshore aspects of the project other than the pipeline installation in Broadhaven Bay, and the discharge off Erris Head and in the Corrib Field, the mitigation measures as proposed in 2001 Offshore EIS remain valid. Section 7.5 The treated surface water run-off from hard surfaces around the terminal will be discharged through a pipeline that terminates around 12.5km from the landfall. The produced water will be subject to three stages of treatment before it is discharged via the umbilical to the Corrib Field. The contaminants likely to be present in the produced water discharge have been identified on the basis of the fluids analysed from well testing operations. These contaminants will be	**NEGLIGIBLE** Section 9.10 Based on the assessments made in the 2001 Offshore EIS and further consideration of the potential impacts carried out by the EPA in granting the IPPC licence, the reinstatement and residual impacts are still considered negligible	2010 Offshore Supplementary Update Report, Section 9 Water and 7 Flora and Fauna

Aspect	Potential Impact	Mitigation Measures	Residual Impact	Extract Reference
Offshore Gas Pipeline				
		treated to their respective Environmental Quality Standards (EQS) (Water Framework Directive (2000/60/EC)).		
Rock Placement[4] **Offshore Geology**	Section 8.5 The rock placement in Broadhaven Bay will disturb an area of seabed equivalent to the design footprint of the rock berm. Seabed geology over the berm footprint will be entirely covered. An estimate assuming worst case scenario calculates the footprint to range from 15000m2 to 30,000m2 in addition to the existing project footprint associated with the offshore pipeline/umbilical and seabed infrastructure at the offshore gas field.	Section 8.7 All of the rock material that is to be deposited to protect the pipeline in the Bay will be inert hard rock that has been washed following quarrying and grading. As such, the potential for rock dust to be introduced into the water column is considered extremely low. The majority of the seabed of the Bay is sandy in nature, and as such the rock berm will introduce hard substrate for colonisation by epibenthic species. This introduced hard geology will be consistent with the exposed bedrock that necessitates the rock placement, as well as the subtidal cliffs at the peripheries of the Bay. Hard rock substrates are characterised by increased species richness compared with the sandy seabed.	**MINOR** Section 8.10 There will be a residual impact related to the presence on the seabed of the pipeline. This impact is considered to be minor, in that the area of seabed taken by the pipeline is very small and does not exhibit any geological features that are unique and which would be lost or damaged.	2010 Offshore Supplementary Update Report, Section 8.5/8.7 Geology 2001 Offshore EIS, Section 8.10 Geology and Sediment

[4] Impacts from concrete mattressing are as for from rock placement

Aspect	Potential Impact	Mitigation Measures	Residual Impact	Extract Reference
Offshore Gas Pipeline				
Rock Placement **Water Quality**	Section 9.8.1 Placement of rock over the pipeline section in Broadhaven Bay, and the burying of the umbilical using a subsea plough/jetting tool, will have a minor, short-term, localised impact (see Table 3-1 for installation period), creating increased turbidity. Given that the installation period has been extended, the impacts will be perceived over a longer time period, though they will effectively be negligible.	Section 9.7 For all offshore aspects of the project other than the pipeline installation in Broadhaven Bay, and the discharge off Erris Head and in the Corrib Field, the mitigation measures as proposed in 2001 Offshore EIS remain valid.	**NEGLIGIBLE** Section 9.10 The reinstatement and residual impacts are still considered negligible.	2010 Offshore Supplementary Update Report, Section 9 Water

Aspect	Potential Impact	Mitigation Measures	Residual Impact	Extract Reference
Onshore Gas Pipeline				
Human Beings	Section 6.4.2.3 The proposed onshore pipeline development, as part of the overall Corrib Gas Field Development, is likely to have the following impacts during its operation: • Create new jobs and demand for local services, benefiting the working community of the area.	Section 6.5.2 No remedial or reductive measures are considered necessary.	**POSITIVE** Section 6.6.2 The overall Corrib Gas Field Development will directly employ approximately 55 no. people during its operation at the Bellanaboy Bridge Gas Terminal, in a variety of occupations, both skilled and unskilled. Based on the classification of people by principal occupation and social class profile above, much of the population in the local vicinity of the subject site are likely to be qualified to benefit from the type of new employment which will be created. This is a significant positive impact for the local and wider community.	2010 Onshore EIS, Section 6 Community and Socio-Economics
Terrestrial Ecology	Section 12.4 Potential impacts on habitats and species are summarised in sections 12.4.2 and 12.4.3 while the predicted level of post construction impacts are outlined for the short term and long term in Section 12.7. Appendix P (NIS) Section 5.2 and Table P14.	Section 12.5 The following sections provide summary details on the mitigation measures proposed to ameliorate against those potential impacts outlined in Section 12.4. A full description of the proposed mitigation measures are provided in Appendix J(1). Appendix P (NIS) Section 6.	**No long term significant impacts** Section 12.6 Residual impacts are summarised in sections 12.7.1 – 12.7.4 and in Table 9 in Appendix J (1). The terminology for impact duration is in accordance with the EPA Guidelines (2003). Long term significant impacts are not expected because of the nature of pipeline construction and the fact that, with the exception of the landfall valve installation footprint, habitats can be reinstated.	2010 Onshore EIS, Section 12 Terrestrial Ecology Appendix J1, including Table 9, Summary of expected impacts on habitats and species Appendix P (NIS), including Table P14. 2010

Aspect	Potential Impact	Mitigation Measures	Residual Impact	Extract Reference
Onshore Gas Pipeline				
				Onshore EIS, Section 12 Terrestrial Ecology
Traffic	Section 7.5.2 There will be very little traffic associated with the operation of the Corrib Onshore Pipeline. The traffic movements associated with the occasional safety checks and maintenance will be negligible and will not generate a potential traffic impact on the surrounding road network.	Section 7.6.1 The development of the pipeline will have minimal traffic associated with it during its operation apart for safety checks and maintenance purposes. This means no mitigation measures will be required for the operational stage of the pipeline.	**NEGLIGIBLE** Section 7.7 The results show that no operational difficulties are expected.	2010 Onshore EIS, Section 7 Traffic
Agriculture	Section 11.2.2 The extent of permanent exclusion from future development is defined by the area of the on-land permanent pipeline wayleave – in this case the width of the permanent wayleave is generally 14 metres (and 20m wide in peatland and forestry). Furthermore, potential development in close proximity to a gas pipeline must be controlled on the grounds of public safety, with exclusion areas normally calculated in reference to current pipeline design safety codes.	Section 11.4.1 1 Permanent landtake, permanent loss of areas for harvesting timber and temporary loss of areas for grazing or grass harvesting will be dealt with by compensation	**MINOR** Section 11.5.1 The proposed development will have a minor, long term residual impact on forestry production within the permanent wayleave. The residual impact on the remaining lands used for grazing and grass production will be short term and minor.	2010 Onshore EIS, Section 11 Material Assets

Aspect	Potential Impacts	Mitigation Measures	Residual Impact	Extract Reference
LVI				
Human Beings	Section 6.4.2.3 The proposed onshore pipeline development, as part of the overall Corrib Gas Field Development, is likely to have the following impacts during its operation: • Create new jobs and demand for local services, benefiting the working community of the area.	Section 6.5.2 No remedial or reductive measures are considered necessary.	**POSITIVE** Section 6.6.2 The overall Corrib Gas Field Development will directly employ approximately 55 no. people during its operation at the Bellanaboy Bridge Gas Terminal, in a variety of occupations, both skilled and unskilled. Based on the classification of people by principal occupation and social class profile above, much of the population in the local vicinity of the subject site are likely to be qualified to benefit from the type of new employment which will be created. This is a significant positive impact for the local and wider community.	2010 Onshore EIS, Section 6 Community and Socio-Economics
Traffic	Section 7.5.2 Once every 4-5 years the LVI will require a maintenance inspection, which will require the use of heavy machinery, but this will not involve a high number of traffic movements.	Section 7.6.1 The development of the pipeline will have minimal traffic associated with it during its operation apart for safety checks and maintenance purposes. This means no mitigation measures will be required for the operational stage of the pipeline.	**NEGLIGIBLE** Section 7.7 The results show that no operational difficulties are expected.	2010 Onshore EIS, Section 7 Traffic
Hydrogeology	Section 15.3.3.2 A perforated drainage pipe network will intercept both groundwater and surface water and divert elevated groundwater from the LVI site to a concealed outfall in the cliff face.	Section 15.3.3.2 No remedial or reductive measures are proposed.	**IMPERCEPTIBLE** Section 15.3.3.2 Only imperceptible impacts on local groundwater levels and groundwater flow in the area would be expected during the operational stage of the proposed project.	2010 Onshore EIS, Section 15 Hydrology and Hydrogeology

Aspect	Potential Impacts	Mitigation Measures	Residual Impact	Extract Reference
LVI				
Noise	Section 9.4.5 There will be no continuous operational noise generated by the proposed development.	Section 9.5.6 Residents of the nearest receptors will be notified well in advance prior to any major maintenance works at the LVI, or if the LVI pipeline restart system needs to be operated.	**NEGLIGIBLE** Section 9.6 The only noise to be generated by the development during operations will be from weekly visits to the LVI, and any maintenance works. The additional traffic generated by this activity will be negligible in comparison to the existing traffic flows.	2010 Onshore EIS, Section 9 Noise and Vibration
Landscape	Section 10.4.1.1. The LVI will become a new but non-prominent feature of this landscape.	Section 10.4.1.1. It is located approximately 50m from the landfall in (Glengad) and has been set down in a 'dished' area approximately 3m below existing ground level. The careful siting of the installation at reduced ground levels results in low levels of change in landscape resource.	**MODERATE** Section 10.6 The LVI will not be a prominent feature in the landscape at the headland at (Glengad) due it is low-lying nature and design mitigation measures. No significant visual impacts are predicted for properties with a potential view across the location of the restored LVI.	2010 Onshore EIS, Section 10 Landscape and Visual Impact Assessment
Terrestrial Ecology	Section 12.4.4.2 There will be a small permanent loss of habitat at the footprint of the landfall valve installation (approximately 20m x 22m) and along the access road. This will be located in an area of improved agricultural grassland of low ecological value. Impacts are expected to be long term, localised, direct, and moderate. Normal operation of the LVI will not have any impact upon wildlife using the area, including the occasional	Section 12.5.4.2 Following construction this topsoil will then be used on the slopes of the facility, which will then be left to revegetate naturally. It is proposed therefore that no seed or topsoil will be imported into the cSAC in order to prevent the introduction of non-native genotypes which could result in the genetic pollution of the local plant populations, also to protect against the introduction of pest species.	**SLIGHT/MODERATE** Section 12.6.4 In the short term impact level is expected to be moderate for the footprint of the LVI, but imperceptible to slight for other areas associated with the LVI. Long term impacts are expected to be slight to moderate (LVI footprint) and imperceptible to slight for reinstated areas. Although there will be slight loss of foraging habitat for birds and small mammals, it is	2010 Onshore EIS, Section 12 Terrestrial Ecology and Appendix J1, Table 9, Summary of expected impacts on habitats and species Appendix P (NIS), including

Aspect	Potential Impacts	Mitigation Measures	Residual Impact	Extract Reference
LVI				
	otter holt and the Sand Martin colony close by. The facility will not require illumination during night-time. Regular monitoring checks at the LVI will involve one or two individuals with a small vehicle or jeep and are not expected to impact on species using the site any more than current agricultural activities impact on the area. If works or servicing is required at the LVI at any stage, then this may temporarily disturb faunal species for the duration of the work, but no lasting impact is expected.	To aid topsoil stability and grass growth, a geotextile membrane will be laid on the slopes of the facility. Appendix P (NIS) Section 6.	expected that in the long term - with likely further agricultural improvement in the locality - the residual impact will be slight. In addition, the provision for naturally regenerated grassland areas on the slopes of the facility and on level areas will compensate to some extent, for the loss of the pre-existing grassland. The residual impact in vegetation and faunal terms and also in the context of the present function of this area as a buffer zone within the cSAC, is expected to be slight.	Table P14
Agriculture	11.3.2.1 Approximately 0.5 hectares of farmland will be required for the LVI (and permanent access road) at Glengad. This land is in the ownership of SEPIL.	Section 11.4.1.1 Permanent landtake, permanent loss of areas for harvesting timber and temporary loss of areas for grazing or grass harvesting will be dealt with by compensation.	**MINOR** Section 11.5.1 The proposed development will have a minor, long term residual impact at the LVI due to loss of land for production.	2010 Onshore EIS, Section 11 Material Assets

3 CONCLUSION

The tables in this document outlines where consideration has been made of the potential and residual impacts and mitigation measures associated with the operation of both the onshore and offshore elements of the Corrib Pipeline.

APPENDIX 2

Table A2 – Table 3.1 (EACS, 2015) Summary of planned and previously approved pipeline operational activities

Location	Activity	Frequency	Scope	Reference Document(s) /Assessments	Note
Offshore / nearshore pipeline	Annual/Biennial post start-up offshore pipeline and umbilical surveys	At least every two years	Geophysical survey to assess the integrity of the pipeline. Inshore and offshore elements.	• Offshore EIS (RSK, 2001) • Offshore Supplementary Update Report (RSK, 2010) • Corrib Ocean Bottom Cable Seismic Survey Natura Impact Statement (to support the AA Process for the proposed West Connacht Coast SAC) February 2013† • Corrib Offshore Pipeline Inspection Survey 2014 – Screening for AA • Corrib Offshore Protection Works - Geophysical Survey 2014 Screening for AA • Corrib Nearshore Protection Works Surveys – 2015 Screening for AA	† *West Connacht Coast SAC was first notified in 2012.*
	Cathodic protection survey	Every two years	Resistivity survey along the length of the pipeline undertaken by small inshore vessel and an ROV further offshore	• Offshore EIS (RSK, 2001) • Plan of Development 2001 • Offshore Supplementary Update Report (RSK, 2010)	
	Intelligent Pipeline Integrity Gauge (PIG) run	Once at initial operation, and as required thereafter dependent on initial results [2]			*The PIG will be launched from the subsea manifold at the field and contained within the pipeline, so this activity has no potential to impact on any European site.*
	Rock placement	Currently estimated to be every two years	Placement of rock material[3] to protect seabed assets. Mitigation against scouring, free-spanning, pipeline exposure etc.	• Offshore EIS (RSK, 2001) • Plan of Development 2001 • Offshore Supplementary Update Report (RSK, 2010) • Corrib Water Outfall Line Remedial Works Screening for Appropriate Assessment (2015)	*Also assessed separately prior to rock placement in 2009 in relation to Broadhaven Bay SAC, and marine mammals (See 5.3.1.3).*
Onshore					
Landfall Valve Installation (LVI)	Regular inspection and routine corrective maintenance	Minimum weekly visits	One work vehicle accessing the site, with two personnel	• Corrib Onshore Pipeline EIS (RPS, 2010)	
	Maintenance of safety shutdown valves	Once every 5 years	45 tonne crane, if deemed necessary, and up to six truck movements and personnel cars		
	Emergency shutdown of the LVI system	Unknown	Potentially 2 vehicles and 4 personnel		
Onshore pipeline wayleave	Geotechnical inspection	Annual	Two personnel - on foot	Corrib Onshore Pipeline EIS (RPS, 2010)	*Geotechnical instrumentation is installed along the wayleave that is monitored from the terminal so frequent access not required.*
Onshore pipeline wayleave	Pipeline inspection	Monthly	Two personnel - on foot	Landowner Liaison Strategy and Plan (Condition No 42,, Section40)	*As a base case, SEPIL in line with I.S. 328 intend to perform monthly walk downs /ground patrols of the complete onshore pipeline route*

[2] Estimated to be no more frequent than once every 5 years

[3] Impacts from concrete mattressing are as for rock placement.

Table A2 – Table 5.2 (EACS, 2015) Consented offshore surveys / activities - NIS/ Screening reports

NIS/Screening Report		Report Date	Consenting Body	Date of approval
i	Corrib Ocean Bottom Cable Seismic Survey Natura Impact Statement (to support the Appropriate Assessment Process for the proposed West Connacht Coast SAC)	February 2013	*DCENR*	04 March 2013
ii	Corrib Field Rig Site Survey and Well Intervention Works Screening for Appropriate Assessment	February 2014	DCENR	28 February 2014
iii	Corrib Offshore Pipeline Inspection Survey 2014 Screening for Appropriate Assessment	June 2014	DCENR	30 July 2014
iv	Corrib Offshore Protection Works - Geophysical Survey 2014 Screening for Appropriate Assessment	July 2014	DCENR	30 July 2014
v	Corrib Water Outfall Line Remedial Works Screening for Appropriate Assessment *(Note: this included an assessment of acoustic and visual surveys)*	April 2015	DCENR	• Surveys:15 April 2015 • Protection Works Method Statement: 04 June 2015 • Remedial Works: 04 June 2015 • Protection Works Method Statement Addendum: 09 July 2015
vi	Corrib Nearshore Protection Works Surveys – 2015 Screening for Appropriate Assessment	July 2015	DCENR	• 22 July 2015