Garrow Environmental Appraisal Report

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TABLE OF CONTENTS

Abbreviations

AHV	Anchor Handling Vessel
AIS	Automatic Identification System
BACs	Background assessment concentrations
BAP	Biodiversity Action Plan
BCs	Background concentrations
BGS	British Geological Survey
BRIG	Biodiversity Reporting and Information Group
BSL	Below Sea Level
CA	Chemical
Cefas	Centre for Environment, Fisheries and Aquaculture Science
CoP	Cessation of Production
DESNZ	Department for Energy Security and Net Zero
DP	Decommissioning Programme
DSV	Diving Support Vessel
EA	Environmental Appraisal
EPS	European Protected Species
ERL	Effect Range Low
ERM	Effect Range Median
ERRV	Emergency Response and Rescue Vessel
ESAS	European Seabirds at Sea
EUL	Energean UK Ltd.
EUNIS	European Nature Information Systems
FA/FB	Macrofaunal
FBE	Fusion Bonded Epoxy
FCS	Favourable Conservation Status
FOCI	Features of Conservation Interest
Hb	Brillouin's index
HCF	Hydrocarbon Free
HOCI	Habitat of Conservation Importance
HPI	Habitat of Principal Importance
ICES	International Council for the Exploration of the Sea
ICPOES	Inductively Coupled Plasma Optical Emission Spectrometry
JNCC	Joint Nature Conservation Committee
JUWB	Jack-up Work Barge
KP	Kilometre Point
LAT	Lowest Astronomical Tide
LV	Lift Vessel

MCV	Monohull Crane Vessel
MMMU	Marine Mammal Management Unit
MoD	Ministry of Defence
MSV	Multi-Purpose Support Vessel
MUs	Management Units
NORM	Naturally Occurring Radioactive Material
NSTA	North Sea Transition Authority
NUI	Normally Unmanned Installation
ODEAM	ODE Asset Management
OGA	Oil and Gas Authority
OEUK	Offshore Energies UK
OMAR	Offshore Major Accident Regulator
OMR	The Conservation of Offshore Marine Habitats and Species Regulations
OPEP	Oil Pollution Emergency Plan
OPRED	Offshore Petroleum Regulator for Environment and Decommissioning
P&A	Plug and Abandonment
PAH	Polycyclic Aromatic Hydrocarbons
PEXA	Practice and Exercise Area
PSD	Particle size distribution
PTS	Permanent Threshold Shift
PUK	Perenco UK Limited
ROV	Remotely Operated Vehicle
RSD	Relative standard deviation
RSR	Radioactive Substance Regulation
SAC	Special Area of Conservation
SCANS	Small Cetacean Abundance of the North Sea
SEA	Strategic Environmental Assessment
SEMS	Safety and Environmental Management System
SLV	Shear Leg Vessel
SNCBs	Statutory Nature Conservation Bodies
SNS	Southern North Sea
SOPEPs	Shipboard Oil Pollution Emergency Plans
SOSI	Seabird Oil Sensitivity Index
SPA	Special Protection Area
SSCV	Semi-Submersible Crane Vessel
SSS	Side Scan Sonar
THC	Total Hydrocarbon Content
TOC	Total Organic Carbon

TOM	Total Organic Matter
TTS	Temporary Threshold Shift
UKCS	United Kingdom Continental Shelf
WPRL	Waldorf Petroleum Resources Limited

1 Non-Technical Summary

1.1 Project Background

This non-technical summary provides an overview of the findings of the Environmental Appraisal (EA) conducted by Waldorf Petroleum Resources Limited (WPRL) as previous field operator, for the decommissioning of the Garrow installation and pipelines located in United Kingdom Continental Shelf (UKCS) Blocks 42/25, 43/21 and 43/22 in the Southern North Sea (SNS) (see Figure 1.1).

The Garrow platform, a four slot Normally Unmanned Installation (NUI), was installed in 2006 with a design life of 15 years. The first well was drilled and started production in 2007. A second well was drilled and started production in 2009. Production has since declined making the installation uneconomic and a Cessation of Production (CoP) notification will be submitted to the North Sea Transition Authority (NSTA).

The Garrow platform is located in UKCS Block 42/25, approximately 72 km to the east of the nearest landfall at Flamborough Head on the Yorkshire coast, and is tied back to the EUL owned Kilmar platform in UKCS Block 49/23AC via two 22.4 km pipelines; an 8 inch gas export pipeline (PL2160) and a 3 inch chemical pipeline (PL2161). EUL is the pipeline Operator for Garrow and Petrodec UK LIMITED is the appointed Installation and Wells Operator.

The two pipelines were installed as piggybacked pipelines into the same trench and are fully trenched and buried up to the tie-in spools, only separating at the final approaches to the Garrow and Kilmar platforms. Where the pipelines were not trenched (at the platform approaches) a combination of concrete mattresses and rock dump were installed over the pipelines to provide protection. Sufficient backfill was put in place to prevent any upward pipe movement during operational conditions and therefore no additional rock has been deposited along the trenched section.

Of note is that the Garrow platform and pipelines are located within the boundary of the SNS Special Area of Conservation (SAC), designated for the protection of harbour porpoises.

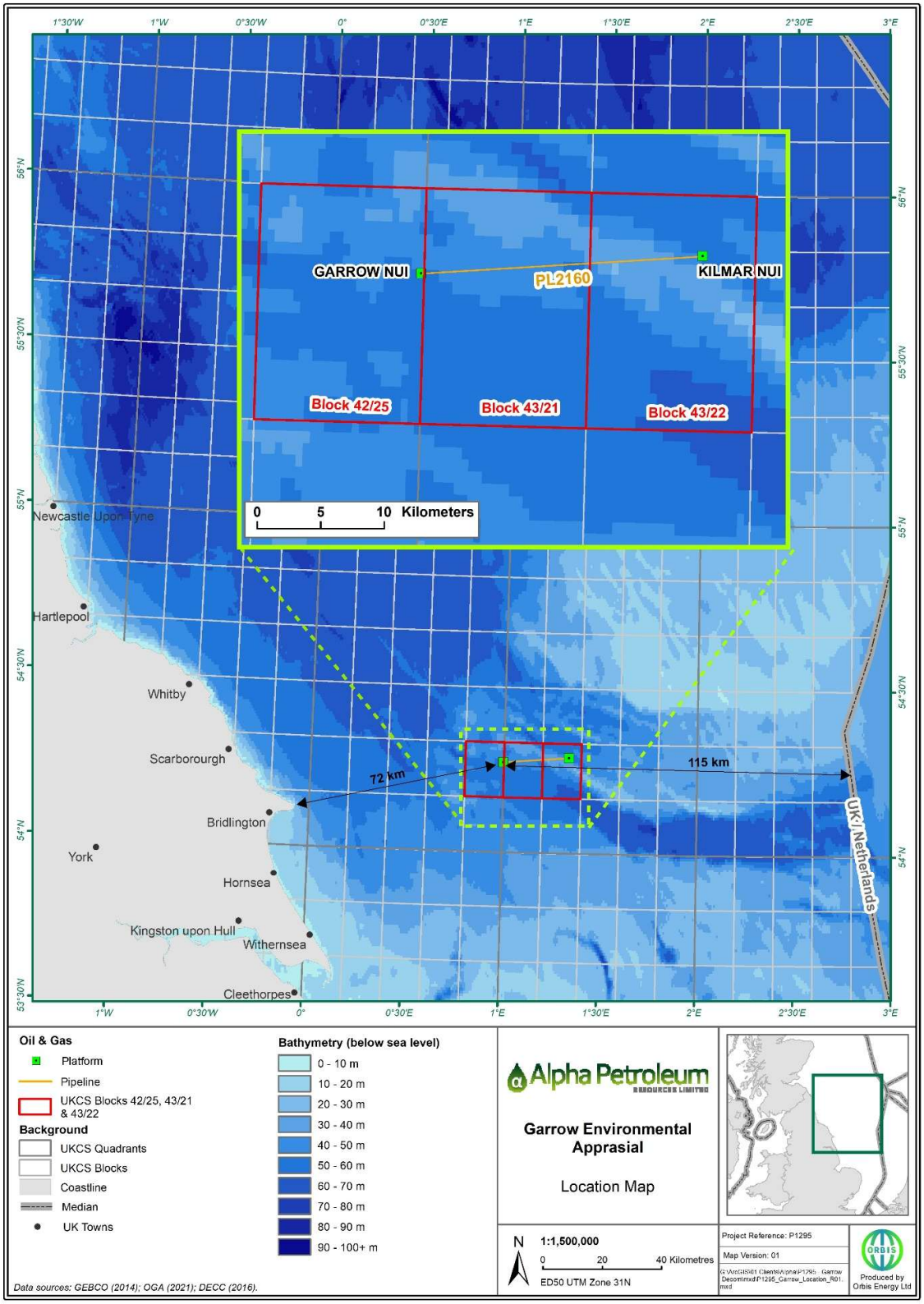
A summary of the Garrow infrastructure being decommissioned and therefore within the scope of the Garrow Decommissioning EA is provided in Table 1.1.

Table 1.1. Summary of Garrow Infrastructure Being Decommissioned

Installation	Weight	UKCS Block	Co-ordinates (ED50 31)
Garrow platform (small steel platform)	415 tonnes (topside weight) 1,030 tonnes (jacket weight)	42/25a	54° 16´ 23.7244" N; 00° 59´ 46.6892" E
Pipeline	**Length**	**From – To End Points**	**Burial Status**
Gas Export Pipeline (PL2160)	22.4 km	Garrow platform – Kilmar platform	Fully trenched and buried up to tie-in spools [Note 1]
Chemical Pipeline (PL2161)			

[1] 98.2% of the pipeline is trenched with 1% surface laid (225m). 0.8% is riser and topside pipework. Of the surface laid sections ~69% is mattress protected (155m) and ~31% is rock dump protected.

Figure 1.1. Garrow Infrastructure Location Map



1.2 Regulatory Background

The Petroleum Act 1998 (as amended by the Energy Act 2008 and 2016) is the principal legislation governing decommissioning in the UKCS. The Act requires the operator of an offshore installation or pipeline to submit a draft Decommissioning Programme (DP) for statutory and public consultation and to obtain approval for the DP from Offshore Petroleum Regulator for Environment and Decommissioning (OPRED) before initiating decommissioning work.

The DP outlines in detail the infrastructure being decommissioned and the method by which the decommissioning will take place and is supported by the EA report. For Garrow, the EA report supports the combined DPs for the Garrow Field Installations and the Garrow Pipelines.

The purpose of the EA report is to document the potential for, and significance of, environmental and societal impacts resulting from the DPs and summarise the proposed mitigations and control measures required to minimise any impacts to an acceptable level.

1.3 Proposed Decommissioning Activities

1.3.1 Garrow Platform

OSPAR decision 98/3 specifically prohibits the dumping or leaving in place of installations in the marine environment and requires that the topsides of all installations must be returned to shore and all steel installations with a jacket weight less than 10,000 tonnes in air, which is the case for the Garrow platform, must be completely removed for re-use, recycling or final disposal on land.

The removal methods which are currently being considered by EUL for the Garrow platform are summarised in Table 1.2. A final decision on the removal method will be made following an engineering feasibility and commercial tendering process. As the preferred removal option has not yet been selected, the EA has assessed the option which results in a worst-case scenario in terms of environmental and societal effects.

Table 1.2. Decommissioning Strategy and Removal Options for Garrow Platform

Installation	Decommissioning Strategy	Removal Options	Worst-case Scenario Assessed
Topside	The topside will be removed by a lift vessel and returned to shore. Re-use followed by recycle and then landfill will be the prioritised options for disposal.	1. Single lift removal along with jacket using a Semi-Submersible Crane Vessel (SSCV), Monohull Crane Vessel (MCV) or Shear Leg Vessel (SLV) 2. Single lift removal using a SSCV, MCV or SLV 3. Piece-small or piece large removal using a Jack-up Work Barge (JUWB)	The topside structure will be removed by an anchored lift vessel (LV). The LV will be towed to site using tugs and a separate anchor handling vessel (AHV) will be used to moor the LV in place. To separate the topside from the jacket an oxygen acetylene torch will be used. The LV will then lift the topside off and place it onto a barge for transport to shore. Note, in the event a JUWB is used, there is a remote possibility that rock may be required to be deposited to mitigate scour around the JUWB spud cans. This would be a worst-case scenario in terms of seabed disturbance.
Jacket	Once the topside has been removed the piles will be cut 3 m or greater below the seabed, slings attached and the jacket lifted and returned to shore to be dismantled at an onshore location. Re-use followed by recycle	1. Single lift removal along with the topside using a SSCV, MCV or SLV 2. Single lift or double lift removal using a SSCV, MCV, SLV or JUWB 3. Piece-small or piece large removal using JUWB	The piles will be cut internally using an abrasive cutting tool system. Prior to this the piles will be dredged to remove the soil inside the jacket skirts. The dredging tool will be deployed from a Diving Support Vessel (DSV). A remotely operated vehicle (ROV) will be used for assistance when running the dredging tool into the jacket sleeves. The jacket will then be removed by an anchored LV, which will be towed to site using tugs. A separate AHV will be used to moor the LV in

	will be the prioritised options.		place. The LV will lift the jacket and place it onto a barge for transport to shore. As above, in the event a JUWB is used, there is a remote possibility that rock may be required to be deposited to mitigate scour around the JUWB spud cans. This would be a worst-case scenario in terms of seabed disturbance.

In preparation for removal of the Garrow facilities a series of preparatory works will be undertaken, including well plug and abandonment and topside and pipelines hydrocarbon freeing activities. These activities are outside the scope of this EA report and will be consented under appropriate environmental permits and consents.

1.3.2 Garrow Pipelines and Associated Protection Material

OSPAR decision 98/3 does not include the decommissioning of pipelines, and there are no international guidelines on the decommissioning of disused pipelines. WPRL as previous field operator has therefore undertaken a Comparative Assessment (CA) in order to arrive at an optimal decommissioning solution for the Garrow pipelines and associated protective material (rock, mattresses and grout bags). The selected decommissioning options derived from the CA, based on consideration of safety, environmental, technical, societal and economic factors, are summarised in Table 1.3.

Table 1.3. Decommissioning Strategy for Garrow Pipelines and Associated Subsea Infrastructure

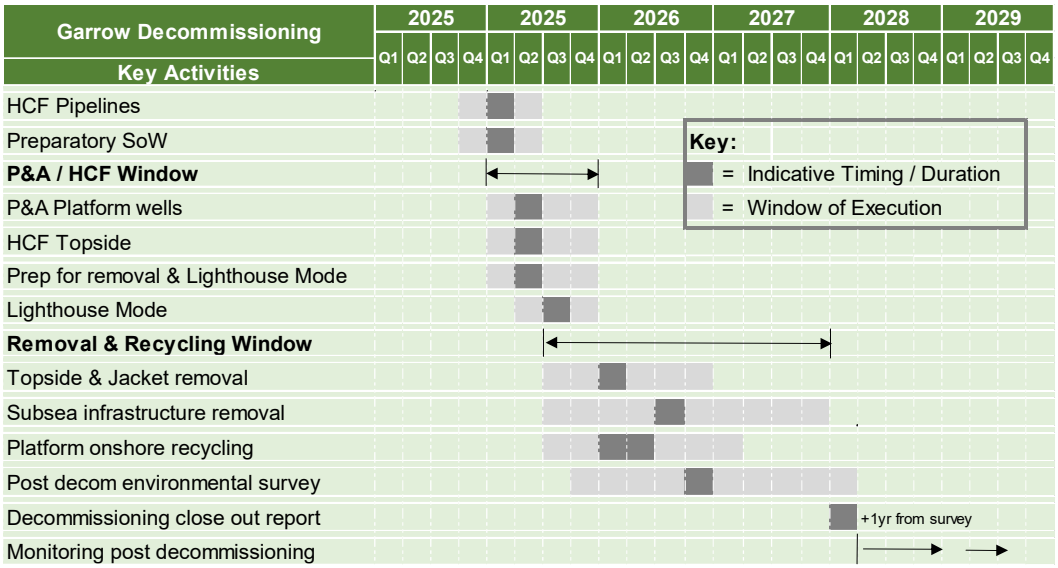
Infrastructure	Decommissioning Strategy	Main Reasons for Selection
Gas Export Pipeline (PL2160) and Chemical Injection Pipeline (PL2161)	Pipelines cleaned with main trenched and buried sections, including those sections protected by rock dump, to be left in situ.	The pipelines are already trenched and buried to > 0.6m, are in a stable state and no snagging events or damage has been reported during their operational life. Water depth comparisons for the original as backfilled survey and operational interim surveys have shown some migration back and forth of the sand waves, but no continuous migration and no pipeline exposures have been seen in any of the operational surveys. In a flooded condition (as would be the decommissioned left in situ state) the pipelines are negatively buoyant and so no upward movement of the pipelines would be expected.

Infrastructure	Decommissioning Strategy	Main Reasons for Selection
The remaining surface laid tie-in spools and pipeline sections, their associated stabilisation features (mattresses and grout bags) will be removed, returned to shore, and recycled.	Surface laid tie-in spools, platform approach pipeline sections and pipeline stabilisation features removed, returned to shore, and recycled. Pipeline sections and pipeline stabilisation features under rock dump to remain in situ. A single Mattress at each cut end may also remain to prevent a snagging hazard if the cut end is exposed and not easily covered by the existing rock dump. The pipelines will be cut using either shear cutting or diamond wire cutting tools. The mattresses will be stacked subsea and bulk lifted to the deck of a Multi-Purpose Support Vessel (MSV) or DSV reducing the number of lifts required and the risk of break-up of individual mats during the recovery process.	Although the seabed will be temporarily disturbed by the recovery work, this option allows the seabed surface to be returned to its natural status, apart from in those areas where rock dump overlies the pipelines. The equipment and technologies required to recover and break up the materials are well known to the industry and are not technically challenging.

1.3.3 Project Schedule

EUL anticipates executing the Garrow decommissioning activities between 2023 and 2027. An indicative schedule for the work is shown in Figure 1.2, which is subject to approval of the DPs, changes in economics such as gas price which could extend the life of the field and unavoidable constraints such as contractor availability (e.g. vessel availability), as well as synergies with other operations for cost savings.

Figure 1.2. Indicative Garrow Decommissioning Schedule



1.4 The Baseline Environment

An overview of the key environmental and societal features in the vicinity of the Garrow infrastructure that may be affected by the proposed decommissioning works is provided in Table 1.4. This information has been compiled from a number of published sources, as well as data collected during the Garrow pre-decommissioning environmental baseline and habitat assessment survey conducted in August 2022.

Table 1.4. Summary of Environmental and Societal Features in the vicinity of the Garrow Infrastructure

Feature	Description
Physical Features	
Location	The proposed Garrow decommissioning activities are located within UKCS Block 42/25 (Garrow platform), and Block 43/21 (Kilmar platform). The Garrow platform is located approximately 72 km east from the East Riding of Yorkshire coast and 115 km west of the UK / Netherlands median line. The Kilmar platform is located approximately 93 km east from the East Riding of Yorkshire coast and 94 km west of the UK / Netherlands median line.
Bathymetry	The water depth at the Garrow platform is 52.6 m LAT and the water depth at the Kilmar platform is 54.8 m LAT. Water depths along the route of the Garrow pipelines range from 29 m to 54 m LAT.
Seabed Sediments	Seabed sediments in the vicinity of the Garrow platform are comprised of fine to medium sandy sediments. Along the pipeline route the seabed is also predominately sandy with loose sand in the upper metre, lying on dense silty sand. Analysis of the sediment samples taken during the 2022 survey found that all stations conformed to the Folk classification of 'Sand'. The total hydrocarbon content (THC) across the survey area was low, with all stations broadly comparable to, or lower than the OEUK mean background value for the SNS (OEUK, 2001). No trend was observed between THC and distance from the Garrow platform, suggesting that the THC values present were not influenced by drilling activity. The mean bioavailable metals concentrations in the sediments were comparable to, or lower than the SNS mean background concentrations. All metals concentrations were below their respective effects range low (ERL) values and therefore unlikely to cause adverse effects on the macrofaunal communities present.
Oceanography	Tides in the SNS are predominately semi-diurnal and tidal waters offshore in this area of the SNS flood southwards and ebb northwards. Surface tidal streams in the vicinity of the Garrow infrastructure are a maximum of 0.72 and 0.41 m/s respectively for spring and neap tides and the annual mean significant wave height ranges from 1.52 m to 1.80 m.
Meteorology	Winds in the region are generally from between south and north-west. Wind strengths are generally between Beaufort scale 1- 6 (1 – 11 m/s) in the summer months, and 7 – 12 (14 – 32 m/s) in winter.
Biological Sensitivities	
Marine Protected Areas (MPAs)	The Garrow infrastructure is located within the boundary of the SNS SAC, designated for the protection of harbour porpoises. The next closest MPA is the Dogger Bank SAC, designated for the protection of the Annex I sandbanks which are slightly covered by seawater all the time, is located approximately 20km to the north-east of the Kilmar platform at its closest point. The Greater Wash SPA, which lies along the adjacent coastline approximately 72km from the Garrow platform, has also been scoped into the assessment as vessels will be transiting through this site on the way to the Garrow location. The SPA is designated for the protection of red-throated diver, common scoter and little gull during the non-breeding season, and for breeding Sandwich tern, common tern and little tern.
Plankton	The phytoplankton community in this region of the SNS is dominated by the dinoflagellate genus *Tripos (T. fusus, T. furca, T. lineatus)* along with higher numbers of the diatom, *Chaetoceros* (subgenera *Hyalpchaete* and *Phaeoceros*) than are typically found in the northern North Sea. The zooplankton community is dominated by copepods including *Calanus helgolandicus* and *C. finmarchicus* as well as *Paracalanus* spp., *Pseudocalanus* spp., *Acartia* spp., *Temora* spp. and cladorcerans such as *Evadne* spp.

Feature	Description
Seabed Communities	The sediment type identified during the 2022 pre-decommissioning survey has been classified as the EUNIS biotope complex 'Faunal communities in Atlantic offshore circalittoral sand' (MD521). 'Subtidal sands and gravel' were identified as a potential sensitive habitat. No other sensitive habitats or species were observed within the survey area. Benthic epifauna was generally sparsely distributed and consisted of starfish *Asterias rubens*, *Astropecten irregularis* and *Luidia sarsii* and hermit crabs (Paguridae). Analysis of sediment macrofauna from the 2022 survey found that the macrofaunal community was relatively homogenous across the survey area. The most dominant taxa were annelids, followed by crustacea and molluscs. The most abundant taxon was the annelid *Spiophanes bombyx* agg. The taxa encountered in the current survey were considered representative of a background SNS community.
Fish	Species likely to spawn within the vicinity of the Garrow infrastructure include cod, herring, lemon sole, mackerel, *Nephrops*, plaice (high intensity spawning ground), sandeels (*Ammodytidae* sp.) (high intensity spawning ground), sole, sprat and whiting. The location is also likely to be a nursery ground for anglerfish, blue whiting, cod, European hake, herring, horse mackerel, lemon sole, ling, mackerel, sandeels, sprat, spurdog and whiting. Juvenile fish more likely to be found in the area include herring, horse mackerel, mackerel and whiting.
Seabirds	The offshore waters of the SNS are visited by seabirds, mainly for feeding purposes in and around the shallow sandbanks. The most abundant species of seabird predicted to be present in the vicinity of the Garrow infrastructure are guillemot in the breeding season, fulmar and herring gull over winter, and guillemot during the post breeding dispersal period. Of note, in June 2021, WPRL recorded kittiwake present on the Garrow platform, although no breeding pairs or nests were observed, as well as great black-backed gull, herring gull, and lesser greater black-backed gull. Further visual surveys of the platform since then, undertaken in June, August and September 2022 and February and March 2023 have also not observed nests.
Marine Mammals	Harbour porpoise and white-beaked dolphin are considered to be regularly occurring in the SNS and both species have been observed in the vicinity of the Garrow infrastructure. Minke whale is also a frequent seasonal visitor. The Garrow platform is located within the northern two thirds of the SNS SAC which is recognised as important for harbour porpoises during the summer season (April to September). The distribution of grey seal and harbour seal in the vicinity of the Garrow infrastructure is moderate (< 10 individual per 25 km^2) and low (< 1 individual per 25 km^2) respectively.
Societal Aspects	
Fisheries	The Garrow infrastructure is located within International Council for the Exploration of the Sea (ICES) Statistical Rectangles 37F0 and 37F1. Fishing effort is relatively high in ICES Rectangle 37F0, with the mean annual fishing effort between 2016 and 2020 at 1,007 days. Fishing effort is highest in March, May and September. The majority of fishing effort is from dredgers followed by traps. Landings data (by weight) indicates that catches are largely composed of shellfish (70%) followed by pelagic species (25%). The most commonly caught species are crabs, herring and scallops. Fishing effort is low in ICES Rectangle 37F1 with the mean annual fishing effort between years 2016 to 2020 at 167 days. Fishing effort is highest in July and August. Landings data demonstrate that catches (by weight) are largely composed of shellfish (63%), followed by demersal species (37%) and the most frequently caught species are crabs, *Nephrops* and plaice.
Shipping	Shipping activity is moderate to high in the vicinity of the Garrow infrastructure, predominantly comprised of cargo ships and offshore support vessels.
Oil and Gas Activity	The Garrow field is located within a mature gas province with a comprehensive network of typically unmanned installations, larger processing hubs and associated interfield and export pipelines.
Offshore Renewables	The closest windfarm to the Garrow platform is the Hornsea Project Four (Operator: Ørsted) which is in the pre-planning stage, located approximately 7 km to the south east of the Garrow platform. The operational Hornsea Project Two wind farm turbine area (Operator: Ørsted Hornsea) is located 32 km to the south east of the Garrow pipelines and the operational Hornsea Project One (Operator: Ørsted), is located approximately 44 from the

Feature	Description
	Garrow pipelines at its nearest point.. The consented Dogger Bank export cable is located 27 km to the north of the Garrow platform.
Military activities	The Garrow area overlaps with a Ministry of Defence Royal Airforce Practice and Exercise Area (PEXA).
Wrecks	No protected wrecks or non-designated wrecks are located in the vicinity of the Garrow infrastructure.
Cables	The disused 'UK-GERMANY 6 telecom cable (Operator: TAMPNET) is located 35 km north of the Garrow NUI.
Aggregate and Dredging Activity	There are no aggregate or dredging areas within 40 km of the proposed Garrow infrastructure.

1.5 Impact Assessment

1.5.1 Environmental Impact Identification

In order to identify the potential environmental issues and impacts on the marine environment, which may arise from the proposed Garrow decommissioning activities (both from planned (routine) activities and unplanned (accidental) events), the WPRL decommissioning team as previous field operator, undertook a preliminary scoping exercise.

The scoping exercise identified that the following sources of impact could potentially result in significant environmental effects and were therefore subject to comprehensive assessment, along with the potential for transboundary and cumulative impacts:

- Physical presence;
- Seabed disturbance;
- Underwater noise.

In addition, as the Garrow infrastructure is located within the boundary of the SNS SAC, an assessment was undertaken to determine whether there will be any likely significant effects on the conservation objectives of this MPA as a result of the proposed Garrow decommissioning activities, either alone or in-combination with other plans or projects.

A summary of the results of the comprehensive assessment is provided in Section 1.5.2.

The following sources of impact were not considered to result in significant environmental effects and were therefore scoped out from detailed assessment:

- Energy use and atmospheric emissions;
- Waste management;
- Marine discharges;
- Accidental events.

The justification for this is provided in Table 1.5 below.

Table 1.5. Justification for Aspects Scoped out from Comprehensive Assessment

Aspect	Justification
Energy Use and Atmospheric Emissions	Atmospheric emissions will be produced during the proposed Garrow decommissioning activities as a result of the fuel consumed by offshore vessels, diesel-powered equipment and generators. It is predicted that these emissions will only result in localised and short term impacts on air quality, with prevailing metocean conditions expected to lead to the rapid dispersion and dilution of the emissions. The contribution to UKCS and global atmospheric emissions will be negligible.

Aspect	Justification
Marine Discharges	Routine marine discharges from the vessels proposed to be used to decommission the Garrow infrastructure will not result in significant environmental effects on the marine environment. Food waste will be macerated to increase the rate of dispersion and biodegradation at sea and waste water will be treated appropriately before being discharged to sea, in accordance with the requirements of the MARPOL convention. Ballast water discharges will be in accordance with the International Maritime Organisation Ballast Water Management Convention. As the export pipeline and chemical injection pipeline will be flushed and depressurised as part of the preparatory works, any release of residual chemicals / condensate during pipeline cutting operations will be minimal and is anticipated to dissipate before it reaches the surface with no long-term persistence expected. It is acknowledged that as the pipelines will be decommissioned in situ they will degrade overtime and contaminants contained within the pipeline material (e.g. coating) may be released into the marine environment. However, any releases are expected to occur in very small quantities, over a long period of time. Additionally, since the pipelines are fully trenched and buried, the pathway for contaminant releases will be limited.
Waste Management	The impacts of waste management are largely onshore and therefore outside the scope of the EA; however, EUL will ensure: • The principles of the Waste Management Hierarchy are followed, focusing on the reuse and recycling of wastes where possible; • Licensed waste contractors will be used; • A project Waste Management Plan will be in place to ensure compliance with relevant waste regulations; • Good housekeeping standards will be maintained on board all vessels; • Any waste disposed of outside of the UK will be in accordance with the Transfrontier Shipment of Waste Regulations 2007; • If NORM is encountered, EUL will ensure appropriate Radioactive Substance Regulation permits are in place; • Marine growth will be removed by high pressure cleaning offshore, only where necessary and practicable, with the majority of marine growth removed onshore at a dismantling yard, with appropriate odour control measures implemented.
Accidental Events (accidental releases & dropped objects)	Prior to the proposed decommissioning activities commencing, the Garrow facilities will be made hydrocarbon free. As such, the source of a worst case accidental release of hydrocarbons to sea will be from the loss of diesel inventory from a vessel used during the decommissioning activities in the unlikely event of a collision. However, diesel is a light oil, containing a large percentage of light and volatile compounds. Once spilt diesel is likely to remain on the sea surface and be subject to high rates of evaporation. It is therefore not expected to persist in the marine environment for a prolonged period of time. The risk of collision is considered low as the majority of vessels required for the proposed decommissioning activities will be present on location within the existing 500m safety exclusion zone surrounding the Garrow platform. An approved OPEP will be in place prior to the proposed Garrow decommissioning activities commencing and any spills from vessels in transit or working outside of existing 500m zones are covered by separate Shipboard Oil Pollution Emergency Plans (SOPEPs). The proposed Garrow decommissioning activities require the use of subsea hydraulic cutting tools and ROVs that could fail and result in a release of a small number of litres of hydraulic fluid into the marine environment. However, in the event this did occur, it is anticipated that the hydraulic fluid would be rapidly dispersed in the marine environment given the highly dynamic nature of the area. To minimise the risk of a release, appropriate maintenance and pre-use checks on hydraulic equipment and ROVs will be undertaken. Where possible equipment with automatic hydraulic shut-off will be used to minimise the volume of fluid released in the event of a hydraulic line failure. Dropped object procedures are industry-standard and will be employed throughout the proposed operations. Post-decommissioning debris clearance surveys will aid in the identification of any dropped objects should they occur.

1.5.2 Summary of Assessment Results

1.5.2.1 Physical Presence

The majority of vessels utilised for the proposed decommissioning activities will be present on location within the existing 500 m safety exclusion zones surrounding the Garrow and Kilmar platforms. These zones are clearly marked on navigation charts and have been in place for a number of years. If an anchored LV is used to remove the platform, the anchor lines are likely to extend outside the exclusion zone, although this should not present a significant hazard to shipping or fishing vessels as vessels are unlikely to transit immediately adjacent to an existing exclusion zone. Activity outside the existing exclusion zones will represent a short-term increment in vessel presence over that which the area normally receives and it is not considered that this will result in a significant effect on other sea users. In addition, once the Garrow platform has been removed, the 500 m safety exclusion zone surrounding the platform will be withdrawn. This will result in a positive impact as an area of circa 0.79 km^2 will be made available to other sea users.

The potential for significant impacts to other sea users is therefore limited to the risk of fishing gear snagging on infrastructure that is being decommissioned in situ. To minimise the risk of snagging, EUL is proposing to remove any exposed subsea infrastructure. The majority of the pipelines are currently buried to a depth well in excess of 0.6 m and no pipeline exposures have been seen in any of the operational surveys. The rock which has been deposited along the pipelines is very stable and there has been no migration due to seabed currents or fishing activity over the area. As the pipelines will be left in situ in a flooded condition no upward movement is expected. As such, the residual risk to commercial fishing from the legacy of infrastructure decommissioned in situ, namely the pipelines and associated stabilisation material is therefore predicted to be Low and not significant.

In the event that contingency rock dump is required to mitigate scour either prior to or during the rig/JUWB decommissioning works, once the rig/JUBW has departed the location, the profile of the rock adjacent to the spudcan locations will allow fishing nets to trawl over the rock unobstructed. Suitably graded rock will be used to minimise the risk of snagging fishing gear.

Prior to removal, the physical presence of the Garrow platform has the potential to provide nesting habitat to breeding seabirds, which forage in the SNS. Black-legged kittiwake (*Rissa tridactyla*) have previously been recorded on the platform, but no breeding pairs or nests have been observed. EUL will continue to check for the presence of nesting birds on scheduled routine visits to the platform. It is acknowledged that it is an offence to deliberately disturb wild birds or take, damage or destroy the nest of any wild bird while that nest is being used or built or take or destroy an egg of any wild bird. Therefore, if the topside is to be removed during the breeding season, data will be reviewed to confirm the absence of nesting birds and, if considered necessary, the platform will be checked by a qualified ornithologist prior to removal. As there is not a history of nesting birds on the Garrow platform no significant impacts are predicted; however, if nesting birds are observed, OPRED will be consulted to ascertain if it is possible for a Wild Birds Licence to be granted to allow the works to go ahead.

1.5.2.2 Seabed Disturbance

It is estimated that the total area of seabed likely to be disturbed by the proposed decommissioning activities is ca. 79,129 m^2 (0.079 km^2). Of this total 63,129 m^2 (0.06 km^2) will result in a temporary disturbance and ca. 16,000 m^2 (0.016 km^2) will result in a permanent disturbance.

The majority of the temporary disturbance will be as a result of anchoring of the LV during removal of the platform, footprint of the jack-up vessel used to P&A the wells, and removal of the surface laid pipeline sections / tie-in spools, including the mattresses and gravel bags at the approaches to the Garrow and Kilmar platforms. The jacket legs will be cut internally, to avoid any additional seabed disturbance from external excavation activities.

Physical disturbance of the seabed can cause displacement or mortality of benthic species, such as sessile organisms, that are unable to move out of the impacted area. However, due to the transient nature of the operations, it is expected that recovery of the affected areas will be relatively rapid

once the proposed activities have been completed. Removal of the Garrow infrastructure will also facilitate the restoration of the seabed back to its natural state.

During the proposed decommissioning activities there will be a temporary increase in turbidity through sediment resuspension resulting in smothering of some sensitive benthic species. However, the Garrow infrastructure is located within a highly dynamic area with strong near-seabed currents and highly mobile sediments and, as such, the fauna found here are robust infauna that are adapted to frequent disturbances and natural fluctuations in sediment loading and resuspension.

In addition, there will be a legacy impact in an area of seabed totalling ca. 1,280 m^2 (0.001 km^2) as result of rock dump along the pipelines which will be decommissioned in situ, as well as any mattresses redeployed to cover the cut pipeline ends, if exposed at the seabed. There will also be a permanent impact in the event rock dump is required to be deposited on the seabed to mitigate scour, which will impact an area of ca. 16,000 m^2 (0.016 km^2). The hard substrate will permanently change the habitat type and associated fauna present; however, the scale of the impact is Negligible considering the very large extent of sandy seabed available in the SNS.

In all cases, the scale of changes to the seabed and its fauna are such that effects on higher trophic levels (e.g. fish and marine mammals), and any related effect on species of commercial interest are Negligible.

In summary, based on the nature of the seabed habitats and species present in the vicinity of the Garrow infrastructure and the comparatively small area of seabed that will be impacted by the proposed decommissioning activities, residual effects on seabed communities are predicted to be Minor to Negligible and not significant.

1.5.2.3 Underwater Noise Emissions

Vessel operations (in particular the use of dynamic positioning systems) have been identified as the primary sources of underwater noise that will arise from the Garrow decommissioning operations. The cutting tools used to sever the Garrow infrastructure are unlikely to result in sufficient levels of noise to cause significant disturbance to marine fauna.

There is potential for fish to be disturbed by the continuous underwater noise emissions generated from the decommissioning vessels, leading to temporary displacement from the area. Demersal spawning species that spawn on specific habitat substrates, such as herring and sandeels, are particularly vulnerable to disturbances. However, given the relatively high level of shipping traffic in this area of the SNS, the additional underwater noise generated by the decommissioning vessels is likely to be insignificant.

The underwater noise emissions generated during the proposed Garrow decommissioning activities are not predicted to result in injury to marine mammals, but do have the potential to cause a temporary disturbance out to a distance of ca. 3 km from the noise source. However, the percentage of the relevant Marine Mammal Management Unit reference population which would be disturbed is very small.

In summary, there is no evidence to suggest that the underwater noise emissions generated during the proposed Garrow decommissioning activities would result in injury or significant disturbance to marine fauna. Although there is potential for some behavioural disturbance, any impacts will be localised and temporary. Residual effects are therefore predicted to be Minor and not significant.

1.5.2.4 Transboundary Impacts

The Garrow platform is located approximately 115 km west of the UK / Netherlands median line. Impacts arising from emissions, discharges and seabed disturbance generated as a result of the proposed decommissioning activities are predicted to be highly localised and are therefore not expected to result in any significant transboundary impacts. If it is decided to utilise disposal options outside of the UK, EUL will ensure regulations governing transfrontier shipment of waste are complied with.

1.5.2.5 Cumulative Impacts

Cumulative impacts may arise from incremental changes caused by other past, present or reasonably foreseeable projects/proposals together with the proposed Garrow decommissioning activities. The operational Hornsea Project Two wind farm turbine area (Operator: Ørsted Hornsea) is located 40 km south east of the Garrow platform and 32 km to the south east of the Garrow pipelines and the operational Hornsea Project One (Operator: Ørsted), is located approximately 44 from the Garrow pipelines at its nearest point. The consented Dogger Bank export cable is located 27 km to the north of the Garrow NUI (Crown Estates, 2022). However, given the distances between the projects and the fact that any impacts arising from the proposed Garrow decommissioning activities will be localised, no significant cumulative effects on marine receptors are predicted.

1.5.2.6 Marine Protected Areas

The Garrow infrastructure is located within the boundary of one marine protected area (MPA), the SNS SAC designated for the protection of harbour porpoise. Garrow is located within the northern two thirds of the SAC which is recognised as important for harbour porpoises during the summer season (April to September).

The underwater noise emissions generated during the proposed Garrow decommissioning activities are not predicted to result in injury to harbour porpoise, but do have the potential to cause disturbance out to a distance of ca. of 3,163 m from the noise source, equivalent to an area of ca. 31 km^2, with impacts primarily due to vessel noise. This equates to ca. 0.08% of the SNS SAC total area and ca. 0.2% of the summer area. It has been calculated that up to 28 individuals may be temporarily disturbed within this area, which is equivalent to 0.008% of the harbour porpoise North Sea MU reference population. While sound from the decommissioning vessels in particular may result in temporary behavioural impacts on a small number harbour porpoise, significant adverse effects at the population level are not anticipated.

The majority of disturbance to the seabed habitat that could affect the prey of the harbour porpoise or their prey within the SAC will be localised and temporary. It is acknowledged that there will be a permanent loss of ca. 0.017 km^2 of habitat within the SAC due to the decommissioning in situ of the protection material (rock) along the pipeline route and in the event rock dump is required to be deposited on the seabed to mitigate scour. However, the area impacted is extremely small compared to the extent of habitat in the wider SNS SAC, approximately 0.00005% of the total area of the SAC and is not predicted to impact on harbour porpoise or their prey.

The Greater Wash SPA, which lies along the adjacent coastline approximately 72 km to the south west of the Garrow platform, has also been scoped into the assessment as vessels could be transiting through this site on the way to the Garrow location. The SPA is designated for the protection of red-throated diver, common scoter and little gull during the non-breeding season, and for breeding Sandwich tern, common tern and little tern. Of the bird species present within the SPA, common scoter and red-throated diver are vulnerable to disturbance by boats and large aggregations of these species are present within the SPA between November and March. In contrast, little gull and tern species are generally tolerant of vessel activity.

Based on the distribution of red-throated diver and common scoter within the SPA, red-throated diver are most at risk of displacement, albeit temporarily, if vessels mobilise or demobilise from either Hull, Great Yarmouth or Lowestoft. To minimise disturbance, EUL therefore proposes to implement the following mitigation measures:

- Restricting, to the extent possible, vessel movements within the Greater Wash SPA to existing navigation routes when transiting to / from the Garrow location;
- Maintaining direct transit routes;
- Avoiding over-revving of engines;
- Briefing vessel crew on the purpose and implications of vessel management practices within the Greater Wash SPA.

It should be noted that the Dogger Bank SAC, designated for the protection of the Annex I sandbanks which are slightly covered by seawater all the time, has been screened out of assessment given that it is located approximately 20km to the north-east of the Garrow pipelines and Kilmar platform at its closest point.

Given the above, the EA concluded that the proposed Garrow decommissioning activities will not have an adverse effect on the integrity of the MPAs either alone or in-combination with other plans or projects.

1.6 Conclusions

The EA has confirmed that the combined Garrow Field Installations and the Garrow Pipelines DP can be executed with no significant adverse effects on the marine environment.

An initial screening of the potential impacts to environmental and societal receptors from the proposed Garrow decommissioning activities concluded that the only aspects considered to be potentially significant and therefore requiring further assessment were physical presence, seabed disturbance and underwater noise. However, following further assessment and upon implementation of the identified mitigation measures, it has been concluded that no significant residual effects are predicted to occur, with the majority of impacts being localised and temporary in nature.

Of note is that the Garrow infrastructure lies within the boundary of the SNS SAC. However, the EA has concluded that there will not be any likely significant effects on the conservation objectives of this marine protected area as a result of the proposed Garrow decommissioning activities, either alone or in-combination with other plans or projects.

EUL operates under an integrated Safety and Environmental Management System and has established contractor selection and management procedures. As a number of contractors will be involved in the detailed planning and execution of the proposed Garrow decommissioning activities, EUL will produce a SEMS interface document for the project to help ensure the identified mitigation and control measures are successfully implemented.

2 Introduction

2.1 Background

Energean UK Ltd (EUL) is the Licence Operator of the Garrow gas field, located in United Kingdom Continental Shelf (UKCS) Blocks 42/25a and 43/21a in the SNS. The Garrow NUI is located approximately 72 km east of Flamborough Head on the East Riding of Yorkshire coast and approximately 115 km west of the UK/Netherlands transboundary line. WPRL has a 17% equity interest in Garrow, Energean UK Ltd (EUL) has a 68% equity interest (and is the licence operator) and RockRose (UKCS3) Limited has a 15% equity interest.

The Garrow field started to become sub-economic from 2015 due to the limited remaining field gas and declining production rate. In July 2020, Perenco (UK) Limited (PUK) closed the Garrow and Kilmar export route at their Trent platform and informed WPRL as previous field operator that the Trent field was due for Cessation of Production (CoP) and decommissioning. At this stage the Garrow wells were shut in. A CoP application for Garrow has been submitted to the NSTA.

2.2 Overview of the Garrow Infrastructure

The Garrow field was first discovered in 1991 is located in licence P1034. A four slot Normally Unmanned Installation (NUI) was installed on Garrow in 2006 with a design life of 15 years and the first well (G1) was drilled and started production in 2007. One subsequent well was drilled and started production in 2009 (G2). There are two 22.4 km pipelines connected from the Garrow NUI to the EUL Kilmar platform, an 8 inch gas export pipeline (PL2160) and 3 inch chemical pipeline (PL2161).

Petrodec UK LIMITED is the appointed Installation and Well Operator. Energean UK Ltd is the pipeline Operator. Details of the Garrow platform are provided in Table 2.1.

Table 2.1. Garrow Platform Details

Platform Type	Water Depth (m)	Location (ED50 31)	Topside		Jacket Weight			
			Weight (Te)	No. of modules	Weight (Te)	Number of legs	No. of piles	Weight of piles (Te)
Small Steel Platform	52.6	54° 16′ 23.7244" N 00° 59′ 46.6892" E	415	1	1,030	4	4	520

Garrow production is exported 22.4 km through an 8 inch pipeline to the EUL Kilmar NUI where it is comingled with Kilmar production and further exported 21 km through a 12 inch pipeline to the Perenco UK Limited (PUK) Trent Compression Platform. From the Trent platform there is also a 3 inch Monoethylene Glycol (MEG) pipeline, piggybacked to the export pipeline, running to the Kilmar and Garrow NUIs. At Trent, Garrow and Kilmar production is processed through a production separator, comingled with Trent production, and exported 1 km to a subsea wye manifold where it then joins the 24 inch export pipeline to the Bacton Gas Terminal (BGT) (See Figure 2.2).

The Garrow pipelines are made of steel pipe and both have a '3-Layer Polypropylene' coating. The pipelines have been fully trenched and buried except for at the platform approaches. At the Garrow platform approaches there is 40 m of spool and at the Kilmar approaches there is 55 m of spool. All spool pieces are protected by mattresses. In addition, a further 40 m at the end of the pipelines are mattress protected before rock protection through the trench transition zones. In total, there is 175 m of spools and pipelines protected by mattresses (see Table 2.3).

Figure 2.1. The Garrow Platform

Figure 2.2. Garrow Export Route

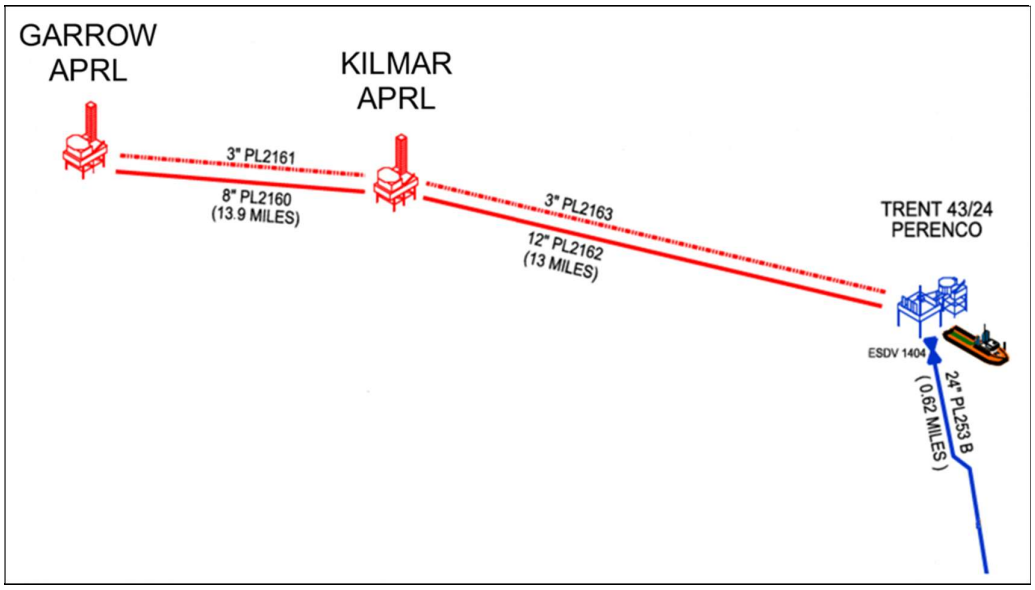


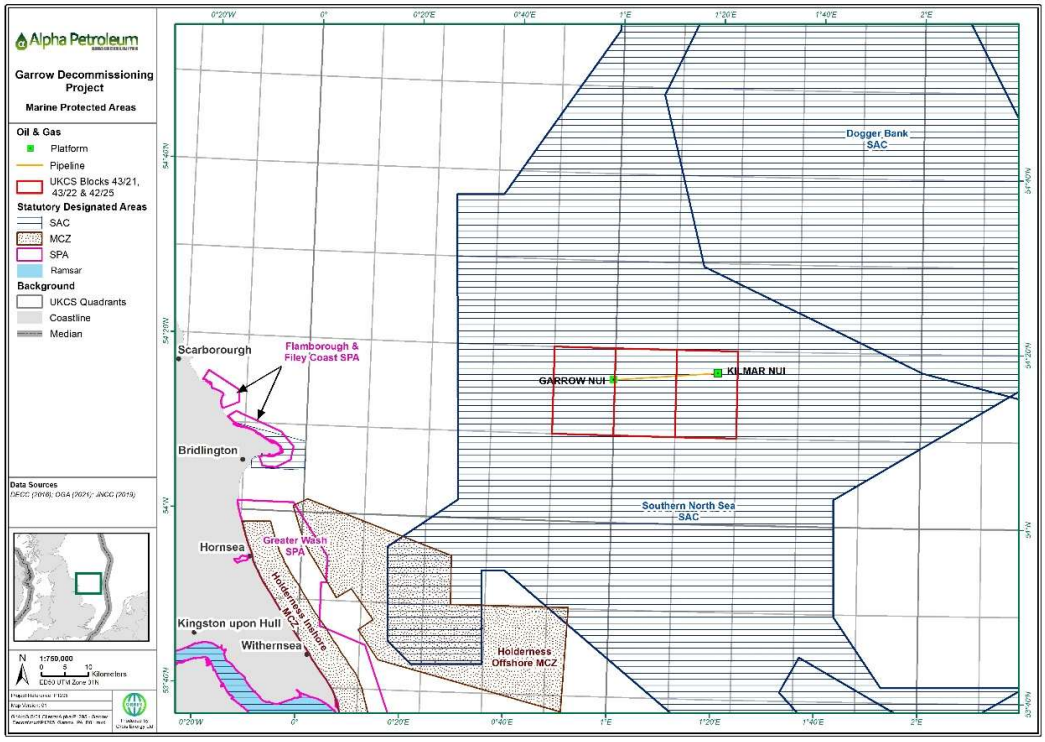
Table 2.3. Garrow Stabilisation Material Details [1]

Stabilisation Feature	No.	Weight	Location	Status
Concrete mattresses (6m x 4m x 0.15m)	24	Various: ca. 6.2 tonnes each	12 within the Garrow 500m safety zone 12 within the Kilmar 500m safety zone	Exposed with two partially rock dumped
Grout bags	ca. 150	25 kg each	Various around the concrete mattresses	Buried and exposed around the concrete mattresses
Rock dump (Garrow)	One location	ca. 750 tonnes	80m of rock stabilisation through trench transition zone. Rock berms typically 8m wide	Exposed
Rock dump (Kilmar)	One location	ca.750 tonnes	80m of rock stabilisation through trench transition zone. Rock berms typically 8m wide	Exposed

[1] The Garrow tie-in spools and associated mattresses within the Kilmar 500m safety zone will be decommissioned as part of the future EUL Kilmar decommissioning programme.

The Garrow platform and the pipeline route to Kilmar are located within the boundary of the SNS SAC, designated for the protection of harbour porpoises (see Figure 2.4 and Section 4.5.6 for further details).

Figure 2.4. Location of Garrow Infrastructure and MPAs



2.3 Regulatory Context

The Petroleum Act 1998 (as amended by the Energy Act 2008 and 2016) is the principal legislation governing decommissioning in the UKCS. The responsibility for ensuring the requirements of the Petroleum Act are complied with rests with OPRED, which sits within the Department for Energy Security & Net Zero (DESNZ).

The Petroleum Act requires the operator of an offshore installation or pipeline to submit a draft Decommissioning Programme (DP) for statutory and public consultation and to obtain approval of the DP from OPRED before initiating decommissioning work. The DP outlines in detail the infrastructure being decommissioned and the method by which the decommissioning will take place and is supported by an Environmental Appraisal (EA).

OPRED is also the competent authority on decommissioning in the UK for OSPAR (international regulations) purposes. OSPAR decision 98/3 specifically prohibits the dumping or leaving in place of installations in the marine environment and requires that the topsides of all installations must be returned to shore and all steel installations with a jacket weight less than 10,000 tonnes in air, which is the case for the Garrow platform, must be completely removed for re-use, recycling or final disposal on land.

OSPAR decision 98/3 does not include the decommissioning of pipelines, and there are no international guidelines on the decommissioning of disused pipelines. However, the Petroleum Act and Pipeline Safety Regulations 1996 provide a framework for the safe decommissioning of disused pipelines. Due to the recognition that each pipeline may have its own specific characteristic and be situated in varying environmental conditions, the OPRED decommissioning guidelines (OPRED, 2018) require all feasible pipeline decommissioning options to be considered and a 'Comparative Assessment' made of the available options.

The Marine Coastal Access Act 2009 introduced a number of measures to deliver the United Kingdom Government's vision of "clean, healthy, safe, productive and biologically diverse oceans and seas", including the introduction of marine plan areas. The Garrow installations and pipelines lie within the East Offshore Marine Plan area. EUL considers that the proposed Garrow decommissioning activities are in broad alignment with the objectives and policies of the plan (see Appendix A).

2.4 Scope and Purpose of this Environmental Appraisal Report

This EA report has been written by EUL to support the Garrow Field Installations DP and the Garrow Pipelines DP and has been prepared in accordance with the regulatory guidelines (OPRED, 2018). It sets out to describe, in a proportionate manner, the potential environmental and societal impacts resulting from the decommissioning of the Garrow installations and pipelines and demonstrate the extent to which these impacts will be mitigated and controlled to an acceptable level.

Well plug and abandonment and the flushing and cleaning operations that will be undertaken on the topside and pipelines as part of the preparatory work preceding the proposed decommissioning activities are outside the scope of this EA report and will be consented under appropriate environmental permits and consents submitted via the Portal Environmental Tracking System (PETS).

3 Project Description

3.1 Proposed Decommissioning Solution

EUL is proposing to completely remove the Garrow platform (topside and jacket) and recover to shore, as described in Table 3.1. A final decision on the removal method will be made following an engineering feasibility and commercial tendering process, but the options currently under consideration are discussed in Section 3.4.

Table 3.1. Summary of Decommissioning Solution for the Garrow Platform

Installation	Proposed Decommissioning Solution	Reason for Selection
Topside	Complete removal followed by recovery to shore for re-use, recycling, and final disposal to landfill as appropriate. The topside will be made hydrocarbon free, removed by a lift vessel and returned to shore. Re-use followed by recycle and then landfill will be the prioritised options for the topside.	Complies with OSPAR requirements and OPRED guidelines and maximises recycling of materials.
Jacket	Complete removal and re-use or recycle. Jacket will be removed and dismantled at an onshore location. Re-use followed by recycle will be the prioritised options. Jacket skirt piles will be severed at least 3 m below the seabed.	Leaves clear seabed, removes a potential obstruction to fishing operations and maximizes recycling of materials, to comply with OSPAR requirements and OPRED guidance.
Platform Wells	Plug and Abandonment (P&A) platform wells prior to platform removal in accordance with HSE 'Offshore Installations and Wells Design and Construction Regulations 1996' and 'OEUK Guidelines for the Suspension and Abandonment of wells Issue 7, November 2022'. Conductors will be cut a minimum of 3m below the natural seabed level.	Meets HSE regulatory requirements and is in accordance with OEUK and NSTA guidelines.

For the remaining subsea infrastructure, namely the pipelines, associated tie-in spools and associated protective material, WPRL as previous field operator has undertaken a Comparative Assessment in order to arrive at an optimal decommissioning solution. The Comparative Assessment is described fully in the Garrow Pipelines (PL2160 and PL2161) Decommissioning Options Comparative Assessment. The selected decommissioning options derived from the Comparative Assessment, based on consideration of safety, environmental, technical, societal and economic factors, are summarised in Table 3.2. Further detail on the decommissioning activities associated with the subsea infrastructure is provided in Section 3.4.4.

Table 3.2. Summary of Decommissioning Solution for the Garrow Subsea Infrastructure

Infrastructure	Proposed Decommissioning Solution	Main Reasons for Selection
Gas Export Pipeline (PL2160)	Pipelines cleaned with main trenched and buried sections, including those sections protected by rock dump, to be left in situ.	The pipelines are already trenched and buried to > 0.6m, are in a stable state and no snagging events or damage has been reported during their operational life. Water depth comparisons for the original as backfilled survey and operational interim surveys have shown some migration back and forth of the sand waves, but no continuous migration and no pipeline exposures have been seen in any of the operational surveys. In a flooded condition (as would be the decommissioned left in situ state) the pipelines are negatively
Chemical Injection Pipeline (PL2161)		

Infrastructure	Proposed Decommissioning Solution	Main Reasons for Selection
		buoyant and so no upward movement of the pipelines would be expected.
The remaining surface laid tie-in spools and pipeline sections, their associated stabilisation features (mattresses and grout bags) will be removed, returned to shore, and recycled. If any practical difficulties are encountered EUL will consult OPRED.	Exposed tie-in spools and pipeline stabilisation features removed, returned to shore, and recycled. Tie-in spools and pipeline stabilisation features under rock dump to remain in situ. A single Mattress at each cut end may also remain to prevent a snagging hazard if cut end exposed and not easily covered by the existing rock dump.	To leave, as far as reasonably practicable, a clear seabed to comply with OSPAR requirements and OPRED guidance. Although the seabed will be temporarily disturbed by the recovery work, this option allows the seabed surface to be returned to its natural status, apart from in those areas where rock dump overlies the pipelines. The equipment and technologies required to recover and break up the materials are well known to the industry and are not technically challenging.

3.2 Potential for Alternative Uses

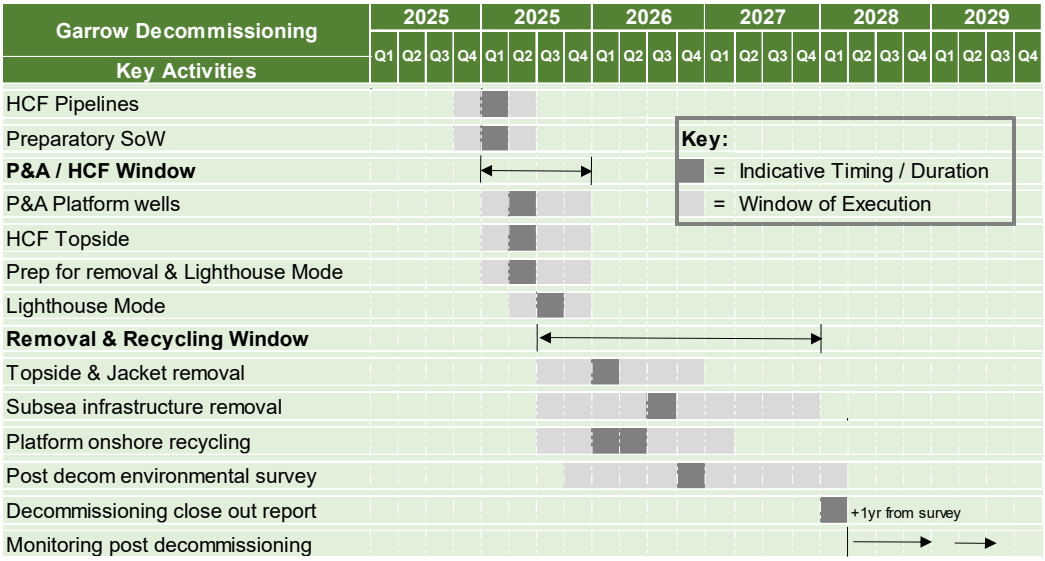
EUL has explored alternative uses for the Garrow facilities, including the possibility for in situ re-use or redevelopment, however none were found viable. The platform equipment inventory will be assessed for use as spares for the EUL asset portfolio.

Potential reuse options of the pipeline were considered including use of the pipelines as part of a possible alternative export route for the Kilmar field, however, these options were found to be uneconomic or not in the same time frames for possible third party field development programmes.

3.3 Project Schedule

EUL anticipates executing the Garrow decommissioning activities between 2023 and 2027. An indicative schedule for the work is shown in Figure 3.1, which is subject to approval of the DPs, changes in economics such as gas price which could extend the life of the field and unavoidable constraints such as contractor availability (e.g. vessel availability), as well as synergies with other operations for cost savings.

Figure 3.1. Indicative Decommissioning Schedule



A window has been programmed into the schedule in which a potential decommissioning contractor would be able to remove the platform and subsea infrastructure, following the initial preparation works to make the Garrow infrastructure hydrocarbon free. The preferred options will be to prepare the Garrow jacket for lift, then a) collaborate with other decommissioning or installation projects to share costs, and /or b) to engage in dialogue with lift vessel owners and closely monitor for opportunities where a lift vessel has unplanned availability in the vicinity and can at short notice remove the Garrow jacket.

3.4 Decommissioning Activities

3.4.1 Preparatory Works

In preparation for removal of the Garrow facilities, EUL will undertake a series of preparatory works. These activities fall outside of the scope of the DPs and this EA report and will be consented via appropriate environmental permits and consents under the OPRED PETS UK Energy Portal. These include the following hydrocarbon freeing activities:

- Topside will be cleaned, with the hydrocarbons (process fluids, fuels and lubricants) either injected into the platform wells or drained to tote tanks for transport and appropriate disposal onshore;
- Export pipeline and chemical injection pipeline will be cleaned. The cleaning methodology is not yet defined but it is likely the lines will be depressured, the 3" chemical pipeline will be flushed through with seawater into the 8" export pipeline. The 8" pipeline will then be flushed with seawater at velocity with two pipeline volumes and the contents and flushing fluids disposed of down a Garrow or Trent well. Following cleaning the pipelines will be disconnected from Garrow and Kilmar platforms;
- Platform wells will be P&A'd in accordance with HSE regulatory requirements and OEUK guidelines (vessels requirements for the P&A operations have been included in Table 3.4).

Once hydrocarbon free the Garrow platform could enter a Lighthouse Mode phase. During this time, the platform will be equipped with solar powered aids to navigation and an automatic identification system (AIS) to mark the structure until such time as it is fully removed.

3.4.2 Topside Removal

The Garrow topside structure comprises three levels with an ESDV deck underneath and weighs 415 tonnes. The primary structure measures 12.75 m x 16 m x 8.3 m high.

A summary of the removal options under consideration by EUL for the Garrow topside structure is provided in Table 3.3.

Table 3.3. Topside Removal Options

Option	Description
1. Single lift removal along with jacket using one of the following types of LV: Semi-Submersible Crane Vessel (SSCV), Monohull Crane Vessel (MCV) or Shear Leg Vessel (SLV)	Removal of topside and jacket as a complete unit followed by recovery to shore for re-use, recycling, and disposal as appropriate.
2. Single lift removal using a SSCV, MCV, SLV or JUWB	Removal of topside as a single unit followed by recovery to shore for re-use, recycling, disposal as appropriate.
3. Piece-small or piece large removal using a Jack-up Work Barge (JUWB)	Removal of topside in a series of smaller sub-units making use of the JUWB used for the well P&A activities, followed by recovery to shore for re-use, recycling or disposal as appropriate.

A final decision on the topside removal method will be made following a commercial tendering process. However, as a worst case scenario for assessment purposes, it is assumed the topside structure will be removed by an anchored LV, with eight-point mooring system. The LV will be towed to site using tugs and a separate Anchor Handling Vessel (AHV) will be used to moor the LV in place. An Emergency Response and Rescue Vessel (ERRV) will also be on location in the field. To separate the topside from the jacket an oxygen acetylene torch will be used. The LV will then lift the topside off and place it onto a barge, for transport to shore. The supporting barge will not be anchored, but will either be tethered to the LV or to its towing tugs. Alternatively, the topside will be transported to shore on the LV. OPRED will be advised when a decision on the final disposal yard is made.

In the event a JUWB is used, there is a remote possibility that rock may be required to be deposited to mitigate scour around the JUWB spud cans. However, no significant evidence of scour was observed when the Kilmar wells were initially drilled with a jack-up rig and significant scour has also not been found around the jacket during the operational life of the field. Notwithstanding this, as a worst case contingency scenario against scour either prior to or during the rig/JUWB decommissioning works, a total of up to 85,000 tonnes of rock could be required to be placed over an area of 16,000 m^2 adjacent to the existing jacket legs to prevent sinkage of the rig/JUWB legs into the seabed.

A summary of the vessel requirements for topside removal and their typical fuel consumption is provided in Table 3.4. In addition, although the well P&A activities fall outside of the scope of this EA report, for completeness, Table 3.4 also includes a summary of the vessel requirements for the proposed P&A operations (jack-up vessel, AHV and ERRV).

Table 3.4. Vessel Requirements for P&A Operations and Topside Removal

Vessel	Days on Location	Fuel Consumption Rate	Total Fuel Consumption
LV	2	30 tonnes per day	60 tonnes
AHV	9	15 tonnes per day	135 tonnes
Tugs x 2	5	25 tonnes per day	250 tonnes
Barge	5	25 tonnes per day	125 tonnes
ERRV	37	8 tonnes per day	296 tonnes

Vessel	Days on Location	Fuel Consumption Rate	Total Fuel Consumption
Jack-up Vessel	35	10 tonnes per day	350 tonnes
Fall-pipe rock placement vessel	3	15 tonnes per day	45 tonnes

3.4.3 Jacket Removal

The Garrow jacket weighs approximately 1,030 tonnes, including the weight of the pile sections to be removed, and an estimate of marine growth and lifting appurtenances. EUL proposes to remove the marine growth offshore, only where necessary and practicable, with the majority of marine growth brought back with the infrastructure and processed and disposed of onshore.

A summary of the removal options under consideration by EUL for the jacket is provided in Table 3.5.

Table 3.5. Jacket Removal Options

Option	Description
1. Single lift removal along with jacket using a SSCV, MCV or SLV	Removal of topside and jacket as a complete unit followed by recovery to shore for re-use, recycling, and disposal as appropriate.
2. Single lift removal using a SSCV, MCV or SLV or JUWB	Removal of jacket as a single or double unit followed by recovery to shore for re-use, recycling, disposal as appropriate
3. Piece-small or piece large removal using JUWB	Removal of jacket in a series of smaller sub-units, followed by recovery to shore for re-use, recycling or disposal as appropriate.

A final decision on the jacket removal method will be made following a commercial tendering process; however, it is likely the jacket removal will be a reverse of its installation, a single lift. Once the topside has been removed the piles will be cut 3 m or greater below the seabed, slings attached and the jacket lifted and returned to shore. OPRED will be advised when a decision on the final disposal yard is made.

EUL proposes to cut the piles internally using an abrasive cutting tool system. Before the cutting works can commence, the piles will be dredged to remove the soil inside the jacket skirts to a depth of ca. 4 m below the seabed to provide access for the abrasive cutting tool. The dredging tool will be deployed from a Diving Support Vessel (DSV) or JUWB and a remotely operated vehicle (ROV) will be used for assistance when running the dredging tool into the jacket sleeves. No dredging will occur around the exterior of the jacket and no explosives will be used.

For the purpose of this assessment, it is assumed the jacket will be removed by an anchored LV, with eight-point mooring system. The LV will be towed to site using tugs and a separate AHV will be used to moor the LV in place. The DSV, which will be on location to cut the piles, may be used as an ERRV once the LV has arrived on location. The LV will lift the jacket and place it onto a barge, for transport to shore. The supporting barge will not be anchored, but will either be tethered to the LV or to its towing tugs. Alternatively the jacket will be transported to shore on the LV or JUWB. A summary of the vessel requirements for jacket removal and their typical fuel consumption is provided in Table 3.6.

Table 3.6. Vessel Requirements for Jacket Removal

Vessel	Days on Location	Fuel Consumption Rate	Total Fuel Consumption
DSV	6	20 tonnes per day	120 tonnes
LV	2	30 tonnes per day	60 tonnes
AHV	5	15 tonnes per day	75 tonnes
Tugs x 2	5	25 tonnes per day	250 tonnes

Vessel	Days on Location	Fuel Consumption Rate	Total Fuel Consumption
Barge	5	25 tonnes per day	125 tonnes

3.4.4 Pipelines and Stabilisation Material

The recommendation from the CA is that a partial removal option be adopted for both the gas export pipeline and chemical injection pipeline, with the majority of the pipelines left in situ.

At the Garrow and Kilmar platform approaches, EUL proposes to cut and remove the spool sections of pipeline (40 m spools (on both the 8 inch and 3 inch pipelines) at Garrow and 55 m spools (on both the 8 inch and 3 inch pipelines) at Kilmar, remove the concrete protection mattresses and gravel bags and cut and remove the underlying pipeline sections up until the point where the pipelines are either rock dumped or buried to a depth greater than 0.6m (40 m at both Garrow and Kilmar ends). The tie-in spools and pipeline stabilisation features (mattresses and gravel bags) which are located under the rock dump will remain in situ.

The pipelines will be cut using mechanical cutting tools such as hydraulic shears or diamond wire cutters, the latter of which are more likely to be used where access is limited. The cut ends will not be capped but could be covered by reutilising a mattress. In order to recover the mattresses and cut sections of pipework a Multi-Purpose Support Vessel (MSV) or DSV will be required. It is anticipated that the mattresses will be stacked subsea and bulk lifted to the deck of the vessel reducing the number of lifts required and the risk of break-up of individual mats during the recovery process.

The recovered pipeline sections, tie-in spools and associated mattresses and gravel bags will be returned to shore for recycling or disposal. However, in the event of practical difficulties during the removal operations, EUL will consult with OPRED and an alternative method of decommissioning will be examined through a comparative assessment.

The remaining sections of the pipelines, left in their current state, would be marked on sea charts and notifications issued to fishermen / other users of the sea. If the cut ends of the pipelines are exposed at the start of the rock dump at either Garrow or Kilmar, then a mattress will be deposited over the ends to prevent a possible snagging point. The mattress will be flush with the seabed and overtrawlable. Note, it would not be practical or good environmental practise to mobilise a rock dump vessel specifically to spot rock dump the two locations at the cut ends of the pipelines, hence the proposal to use an existing concrete mattress (if necessary). Any rock dumping for scour mitigation in the unlikely event this is required for the JUWB (refer to Section 3.4.2) would be carried out ahead of the proposed pipeline cutting operations so would not be completed at the same time.

Table 3.7 summarises the types of vessels required to decommission the pipelines and stabilisation material, their anticipated duration on location and typical fuel consumption rates.

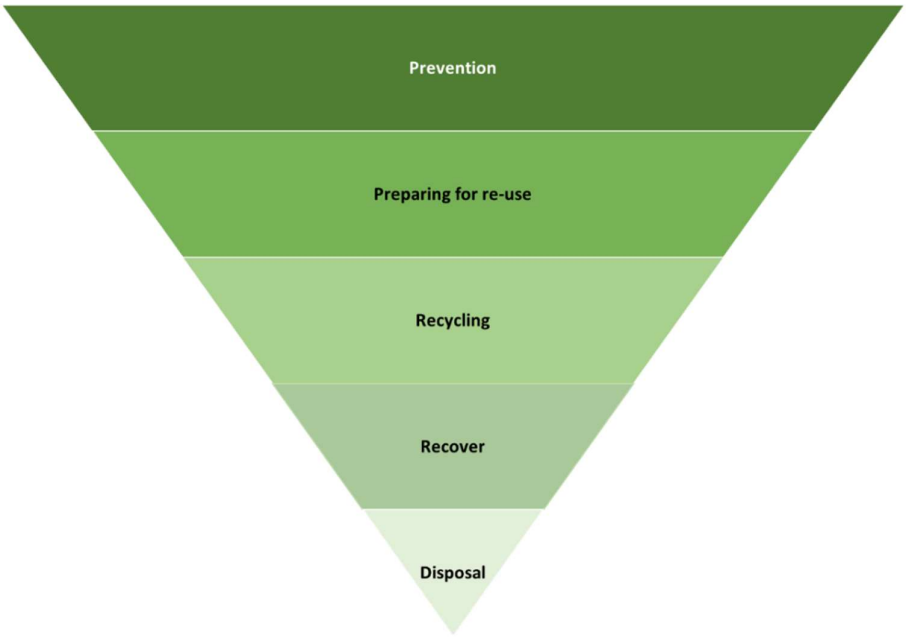
Table 3.7. Vessel Requirements to Decommission Pipelines and Stabilisation Material

Vessel	Days on Location	Fuel Consumption Rate	Total Fuel Consumption
DSV / MSV	13.5	20 tonnes per day	270 tonnes
Survey vessel	2	12 tonnes per day	24 tonnes

3.5 Waste Management

The Garrow decommissioning project will have a Waste Management Plan (WMP) in place which will describe and quantify the waste arising from the proposed decommissioning activities and identify available disposal options. The WMP will adhere to the waste hierarchy of reduce, reuse and recycle and disposal to landfill will be the last resort (see Figure 3.1).

Figure 3.1. Waste Hierarchy (EU Waste Framework Directive)

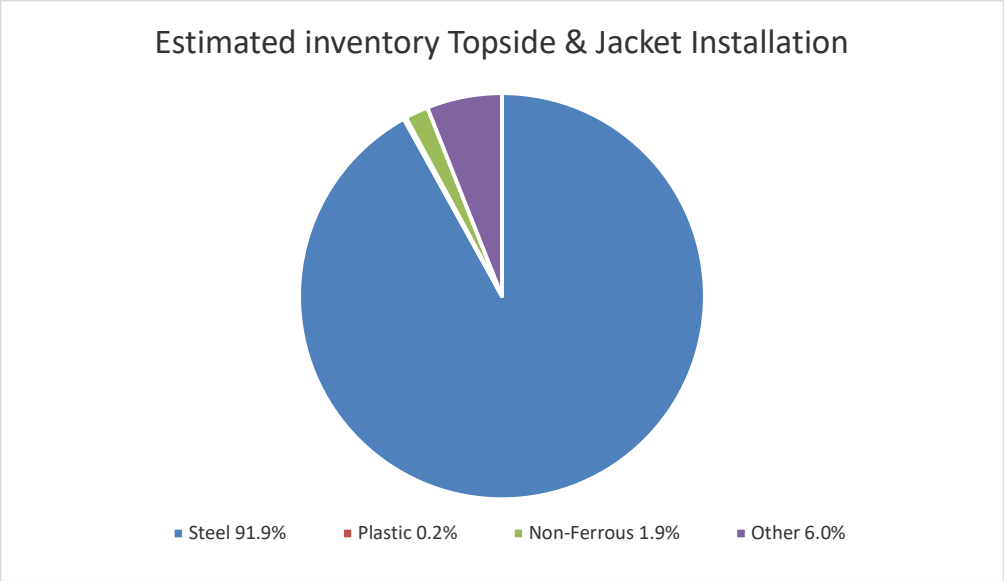


Steel and other recyclable materials are estimated to account for the greatest proportion of the Garrow materials inventory. The topside and jacket structures will be transported to an onshore decommissioning facility for segregation, re-use and recycling. The potential for transboundary shipment of waste is still under review. All other wastes generated offshore during decommissioning will be segregated by type, before being transported to onshore waste facilities.

EUL will ensure that the licensed waste contractor and chosen onshore dismantling site has a proven track record with regards to the waste stream management and can demonstrate compliance with the waste hierarchy and all applicable waste regulations.

Figure 3.2 summarises the estimated breakdown of materials relating to the topside and jacket to be removed, which equates to 1,445 tonnes. These quantities exclude piles and well materials and are limited to everything above the seabed cutline. Jacket piling below 3 m (comprising of 192 tonnes of steel) will be left in place.

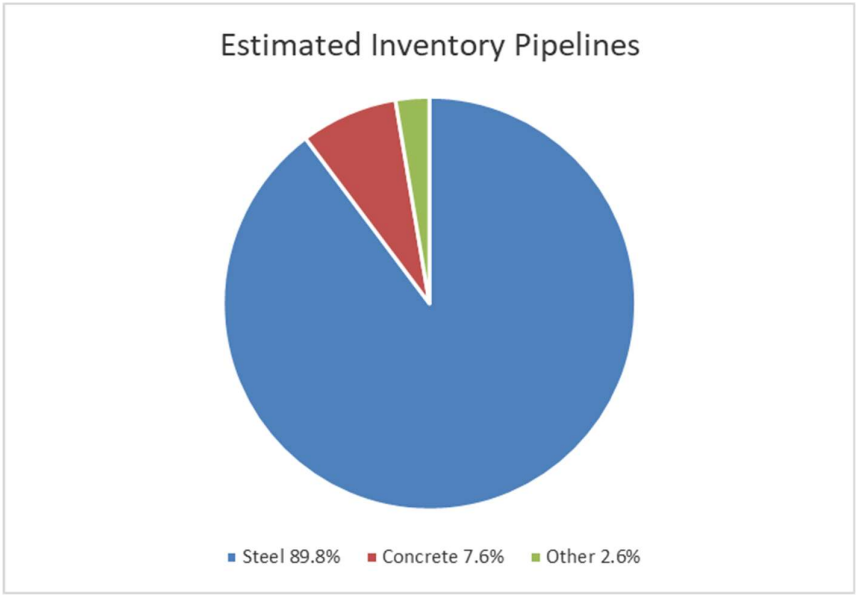
Figure 3.2. Pie Chart of Estimated Waste Inventories (Topside and Jacket Installation) [1]



[1] Total Topside & Jacket weight 1,445 Te

Figure 3.3 summarises the estimated breakdown of materials relating to the Garrow subsea infrastructure, which equates to 2,004 tonnes. It is proposed that approximately 148 tonnes of this material will be removed, with the remainder of material left *in situ*, as discussed in Section 3.1.

Figure 3.3. Pie Chart of Estimated Inventories (Pipelines) [1]



[1] Total pipelines weight 2,004 Te. This includes the pipelines, tie-in spools, anodes, mattresses and gravel bags.

No naturally occurring radioactive material (NORM) has been encountered on Garrow to date, but as a worst-case, it is anticipated that equipment contaminated with NORM scale or sludge may be encountered during the decommissioning project. EUL will ensure tests for NORM are undertaken offshore by a Radiation Protection Supervisor. If NORM is encountered, EUL will ensure appropriate Radioactive Substance Regulation (RSR) permits are in place and conditions that dictate the management and control of radioactive waste are met.

3.6 Post Decommissioning

Post decommissioning, a site survey will be carried out around the Garrow platform 500m radius and a (minimum) 100m corridor (50m either side) along the route of the Garrow pipelines where decommissioning activities have taken place to identify any oil and gas debris and confirm the seabed has no trawling obstructions. Any seabed debris related to offshore oil and gas activities will be recovered for onshore disposal or recycling in line with existing disposal methods.

EUL will provide a verification of seabed clearance to OPRED following completion of the Garrow decommissioning activities. This will be included in the Close Out Report and will also be sent to the Seabed Data Centre (Offshore Installations) at the Hydrographic Office.

A post-decommissioning monitoring programme covering the pipelines and associated stabilisation features remaining in situ will then be agreed with OPRED.

4 Environmental Baseline

This section describes the environmental and societal receptors, which could be affected by the proposed Garrow decommissioning activities. The description is largely based on data provided in the OPRED Offshore Energy Strategic Environmental Assessment (SEA) Reports (2003-2016), as well as other published data sources. The Garrow facilities are located within 'Regional Sea 2' as defined within the Offshore Energy SEA3 (DECC, 2016).

In addition, site specific data gathered during the pre-decommissioning environmental baseline survey (EBS) and habitat assessment carried out by Fugro on behalf of WPRL as previous field operator, in August 2022 has been referenced, where relevant (Fugro, 2022a, Fugro 2022b). The surveys consisted of geophysical, habitat investigation and environmental work scopes.

During the pre-decommissioning EBS survey and habitat assessment seven environmental sampling stations were sampled, arranged in a cruciform centred on the Garrow NUI and aligned with the predominant current (Figure 4.1). At each environmental sampling station, video and stills photography were to be acquired prior to the collection of one chemical (CA), one particle size distribution (PSD) and two macrofaunal (FA/FB) grab samples. Video and stills photographic data were successfully acquired along all seven proposed stations (Table 4.1). Stations suffixed with 'A' or 'B' were reruns due to tides. Grab samples were successfully acquired at all seven proposed stations and a complete suite of samples (two macrofauna, one PSD and one CA sample) were retained at all stations (Table 4.2).

Seabed samples were acquired using a 0.1 m^2 Hamon grab for the macrofaunal and PSD samples and a 0.1 m^2 Day grab for CA samples. Sediment samples were analysed for their PSD using a combination of two techniques; sieve analysis for all material retained by a 1.0 mm sieve followed by laser diffraction analysis of the finer material.

No previous surveys have been conducted at Garrow, however two surveys were conducted at the nearby Ossian-Darach and Airidh fields, in 2019 and 2008 respectively, with the data available on the UK Benthos database. The Airidh field is located approximately 17 km northwest of the Garrow NUI and the Ossian-Darch field is located 76 km northwest. Ten stations were sampled at each field, in similar water depths to the Garrow field. The methodologies for PSD and sediment hydrocarbon content were similar to the methodologies used in this study and consequently the data have been included for comparison to the wider area.

The data collected during the pre-decommissioning survey has also been compared to OEUK mean background levels of organic and inorganic substances (OEUK, 2001) to provide more general information on the typical range of environmental conditions that may be encountered in the SNS. Comparisons have also been made with the mean concentrations estimated from Area 1 (Sandbanks), as reported in the second Strategic Environmental Assessment (SEA2) conducted in 2001, as these provide more up to date and spatially comparable background concentrations (ERT, 2003a; 2003b). In addition, comparison has also made to Oslo and Paris Commission (OSPAR) background values that were derived from data collected from pristine marine sediments in the wider north-east Atlantic (OSPAR, 2014). The OSPAR background concentrations (BCs) reflect contaminant concentrations at "pristine" or "remote" sites, while background assessment concentrations (BACs) are statistically derived from background data and are defined as "values for testing whether the concentrations at a location are at or close to background" (OSPAR, 2005; 2009a).

Table 4.1. Completed transects

Station		Easting	Northing	Depth (BSL)	Length (m)	Data
GST01	SOL	369 209.5	6 016 154.8	54	35	0 min 53 sec7 stills
	EOL	369 236.5	6 016 132.7	54		
GST02	SOL	369 384.9	6 015 784.5	50	18	2 min 12 sec11 stills
	EOL	369 402.0	6 015 790.6	50		
GST03	SOL	369 556.9	6 015 738.5	53	36	3 min 37 sec11 stills
	EOL	369 520.5	6 015 738.7	51		
GST04	SOL	369 333.6	6 015 662.2	52	27	1 min 10 sec9 stills
	EOL	369 342.9	6 015 636.6	52		
GST05	SOL	369 458.6	6 015 606.7	53	26	1 min 33 sec7 stills
	EOL	369 484.5	6 015 611.1	52		
GST06	SOL	369 622.4	6 015 242.8	56	48	1 min 5 sec 4 stills
	EOL	369 667.6	6 015 227.4	51		
GST06A	SOL	369 630.2	6 015 207.4	57	56	1 min 5 sec 4 stills
	EOL	369 665.3	6 015 250.6	57		
GST07	SOL	369 821.5	6 014 761.8	57	67	1 min 46 sec7 stills
	EOL	369 879.8	6 014 795.5	58		
GST07A	SOL	369 852.6	6 014 853.4	58	98	7 min 37 sec6 stills
	EOL	369 784.6	6 014 782.9	59		
GST07B	SOL	369 821.9	6 014 778.9	58	58	1 min 23 sec15 stills
	EOL	369 879.5	6 014 781.4	57		

Notes
BSL = Below sea level
SOL = Start of line
EOL = End of line
Geodetic Parameters: WGS 84, UTM Zone 31N, CM 3°E [m]

Table 4.2. Completed sediment sampling stations

Station	Easting*	Northing*	Depth (BSL)	Sample Acquisition
GST01	369 220.4	6 016 149.3	53	FA/FB, PSD, CA
GST02	369 394.2	6 015 788.8	51	FA/FB, PSD, CA
GST03	369 528.1	6 015 733.3	52	FA/FB, PSD, CA
GST04	369 342.7	6 015 642.9	53	FA/FB, PSD, CA
GST05	369 487.6	6 015 596.7	53	FA/FB, PSD, CA
GST06	369 642.5	6 015 238.3	56	FA/FB, PSD, CA
GST07	369 856.4	6 014 788.1	58	FA/FB, PSD, CA

Notes
* = Coordinate presented for the FA grab sample
BSL = Below sea level CA = Chemical sample
FA/FB = Faunal sample A or B
PSD = Particle size distribution sample
Geodetic Parameters: WGS 84, UTM Zone 31N, CM 3°E [m]

Figure 4.1. Environmental Stations Sampled at the Garrow NUI

4.1 Physical Environment

4.1.1 Geography

The Garrow NUI is located in UKCS Block 42/25, approximately 72 km east of Flamborough Head on the East Riding of Yorkshire coast and 115 km west of the UK / Netherlands median line. The Kilmar NUI is located in UKCS Block 43/22, approximately 93 km east from the Yorkshire coast and 94 km west of the UK / Netherlands median line (Figure 1.1, Section 1.1). The Garrow pipelines also cross UKCS Block 43/21. These blocks are hereafter referred to as the 'Blocks of Interest'.

4.1.2 Bathymetry

The seabed in the vicinity of the Garrow NUI is relatively flat with numerous megaripples. The water depth at the Garrow platform is 52.6 m Lowest Astronomical Tide (LAT). The water depth at the Kilmar platform is approximately 54.8 m LAT (Gardline, 2004a; 2004b; 2004c). Along the pipeline route the general bathymetry slopes up from approximately 53 metres at the Garrow location to 44 metres in the first seven kilometres until the seabed rises to 29 metres at 12 kilometres from Garrow, and then the seabed deepens to 54 metres about 12 kilometres from Garrow (Gardline, 2004a; 2004b; 2004c).

Water depths at the Garrow infrastructure where the proposed decommissioning activities will take place are summarised in Table 4.3.

Table 4.3. Water Depth at Locations of Proposed Garrow Decommissioning Work

Infrastructure	Water Depth at Location (m)
Garrow platform [1]	52.6
Kilmar platform [1]	54.8
Garrow Pipeline [1]	29 – 54

[1] Source: Gardline, 2004a; 2004b; 2004c.

4.1.3 Seabed Sediments

Seabed sediments within the SNS generally comprise coarse sands with gravels in some areas. Sediments are highly mobile largely due to the increased near seabed currents (DECC, 2016).

The British Geological Survey (BGS) seabed sediment maps show that the area over the blocks of interest are mainly comprised of fine to medium sandy sediments (DECC, 2001). During the 2004 Gardline survey, a vibrocorer sampling survey along the Garrow to Kilmar pipeline route, sampling to a depth of between 2 to 4 m, identified a predominantly sandy seabed, with very loose to loose sand in the first upper metre, lying on dense to very dense, more silty, sand. Clay formations have been identified on three occasions, below a metre of denser, siltier sand, predominantly near the Kilmar location, and below 4 m of loose to dense sand on the Garrow location (Gardline, 2004). Borehole logs on both platform locations also indicate the presence of a dense, silty sand cover on the Kilmar location, quickly giving way to a 1 to 2 m depth to stiff clays, and 4 m of loose to very dense sand on the Garrow location, overlying stiff clay formations (Fugro, 2004).

A summary of sediment characteristics and sediment hydrocarbons analysis from the 2022 pre-decommissioning survey is provided in Table 4.4. It can be seen from this that all stations conformed to the Folk classification of 'Sand'. Sand was the dominant fraction at all stations, with values ranging from 93.53 % at station GST01 to 99.84 % at station GST02, with a mean of 95.62 % and low variability (relative standard deviation (RSD) 2 %). The gravel content ranged from 0.16 % at station GST02 to 2.44 % at station GST01, with a mean of 1.05 % and high variability (RSD 82 %), due to the low values present. The fines content ranged from 0.00 % at station GST02 to 5.04 % at station GST07, with a mean of 3.33 % and moderate variability (RSD 50 %). Five stations had a fines content higher than the SNS mean background value (3.07 %; OEUK, 2001). The mean fines content

was slightly higher than the mean from the Airidh Field (1.5 %; OEUK, 2021b) but lower than the mean value from Ossian-Darach field (7.8 %; OEUK, 2021a; Fugro, 2022a).

The median particle size (µm) ranged from 267 µm at station GST01 to 347 µm at station GST02, with a mean value of 305 µm and low variability (RSD 8 %). The Wentworth description, assigned from mean particle size, categorised all stations as medium sand (Fugro, 2022a).

The Total Organic Carbon (TOC) values across the Garrow survey area were low and typical of this region of the SNS. TOC content ranged from 0.07 % at station GST01 to 0.16 % at station GST05, with a mean of 0.12 % and low variability (RSD 25 %) (Fugro, 2022a).

The Total Hydrocarbon Content (THC) across the survey area was low and no trend was observed between THC and distance from the Garrow NUI, suggesting that the THC values present were not influenced by drilling activity. THC values ranged from 1.5 µg/g at station GST04 to 6.4 µg/g at stations GST02 and GST06, with a mean of 4.1 µg/g and moderate variability (RSD 48 %). The mean value was lower than the mean from a previous survey at Ossian-Darach (6.3 µg/g; OEUK, 2021a) but higher than the mean from Airidh (2.6 µg/g; OEUK, 2021b) and the SEA2 Area 1 survey (1.6 µg/g; ERT, 2003a). Three stations had THC values slightly above the SNS mean background concentration (4.34 µg/g; OEUK, 2001). However, all stations were broadly comparable to, or lower than the mean background value for the SNS (OEUK, 2001) and broadly comparable to other surveys within the region (OEUK, 2021a; OEUK, 2021b; ERT, 2003a), therefore could be ascribed as background. All THC values were below the OSPAR 50 ppm ecological effects threshold (Fugro, 2022a).

The gas chromatographic profiles obtained within the survey area shared a common underlying hydrocarbon distribution, with evidence of biogenic and petrogenic inputs, commonly found in sediments in the SNS (Fugro, 2022a). However, no evidence of drilling fluids was present in the Garrow GC-FID profiles.

Total n-alkane (nC12 to nC36) concentrations ranged from 0.12 µg/g at station GST04 to 0.51 µg/g at station GST06, with a mean of 0.32 µg/g and moderate variability (RSD 43 %). The mean value was higher than the mean from Ossian-Darach (0.12 µg/g; OEUK, 2021a) and the SEA2 Area 1 survey (0.16 µg/g; ERT, 2003a) but comparable to the mean value from Airidh (0.29 µg/g; OEUK, 2021b). Three stations had values slightly higher than the SNS mean background concentration (0.33 µg/g; OEUK, 2001) (Fugro, 2022a).

Total 2 to 6 ring PAH concentrations ranged from 0.0429 µg/g at station GST04 to 0.224 µg/g at station GST05, with a mean of 0.152 µg/g and moderate variability (RSD 46 %). The mean value was higher than the mean from the SEA2 Area 1 survey (0.058 µg/g; ERT, 2003a). Station GST05 was slightly higher than the mean from the SNS mean background concentration (0.208 µg/g; OEUK, 2001). Total US EPA 16 PAH concentrations displayed moderate variability across the survey area (RSD 48 %), with values ranging from < 13.3 ng/g at station GST04 to < 63.7 ng/g at station GST06, and a mean of 39.4 ng/g (Fugro, 2022a).

Results for heavy and trace metal analysis are provided in Table 4.5. The concentrations of metals were lower, or broadly comparable to their respective SNS mean background concentrations (OEUK, 2001) and the regional SEA2 Area 1 survey, and therefore were characteristic of background conditions for the region. Station GST05 (located 110 m, 151° from the Garrow NUI) had slightly higher concentrations of all metals when compared to the wider survey area, suggesting a very minor influence from drilling operations, with a higher total barium concentration also observed at this station. All metals concentrations were below their respective ERLs (Fugro, 2022a).

Table 4.4. Summary of Sediment Characteristics and Sediment Hydrocarbons

Station	Distance (m)*	Bearing (°)*	TOC (%)	Fractional Composition			Folk Description (BGS modified)	Mean Particle Size			THC[3]	n-alkanes[3]			Pr/Ph Ratio
				Gravel (%)	Sand (%)	Fines (%)		(µm)[1]	(phi)[1]	Wentworth (1922) Description [2]		nC12-20	nC21-36	nC12-36	
GST01	500	335	0.07	2.44	93.53	4.03	Sand	267	1.9	Medium sand	2.1	0.06	0.11	0.17	4.16
GST02	100	337	0.13	0.16	99.84	0	Sand	347	1.52	Medium sand	6.4	0.19	0.24	0.43	1.1
GST03	100	67	0.12	2.09	94.13	3.77	Sand	321	1.66	Medium sand	3.6	0.11	0.19	0.3	7.99
GST04	100	241	0.12	0.58	96.88	2.53	Sand	305	1.72	Medium sand	1.5	0.05	0.07	0.12	4.2
GST05	110	151	0.16	0.51	95.02	4.47	Sand	310	1.71	Medium sand	5.5	0.14	0.27	0.41	5.91
GST06	500	155	0.09	0.92	95.63	3.44	Sand	305	1.73	Medium sand	6.4	0.21	0.3	0.51	3.04
GST07	1000	155	0.12	0.65	94.31	5.04	Sand	284	1.82	Medium sand	3.5	0.13	0.2	0.33	7.73
Minimum			0.07	0.16	93.53	0		267	1.52		1.5	0.05	0.07	0.12	1.1
Maximum			0.16	2.44	99.84	5.04		349	1.9		6.4	0.21	0.3	0.51	7.99
Mean			0.12	1.05	95.62	3.33	-	304	1.72	-	4.1	0.13	0.2	0.32	4.88
Standard deviation			0.029	0.867	2.16	1.67		25.8	0.121		2.00	0.06	0.083	0.141	2.5
RSD [%]			25	82	2	50		8	-		48	47	42	43	51
Ossian-Darach 2019 (OEUK, 2021a)†															
Mean			-	-	-	7.8	-	-	1.71	-	6.3	-	-	0.12	-
RSD [%]			-	-		35	-	-	-	-	36	-	-	61	-
Airidh 2008 (OEUK, 2021b) ‡															
Mean			-	-	-	1.5	-	-	1.99	-	2.6	-	-	0.29	-
RSD [%]			-	-	-	35	-	-	-	-	55	-	-	63	-
Southern North Sea (OEUK, 2001)#															
Mean			-	-	-	3.07	-	-	2.04	-	4.34	-	-	0.33	-
95th Percentile			-	-	-	12.59	-	-	3.28	-	11.39	-	-	0.78	-
SEA2 Area 1 (ERT, 2003a) ∓															
Mean			-	-	-	-	-	-	-	-	1.6	0.06	0.09	0.16	2.51
RSD [%]			-	-	-	-	-	-	-	-	106	200	156	163	31
EET Value (OSPAR, 2006)															
EET			-	-	-	-	-	-		-	50	-	-	-	-

Notes
TOC = Total organic carbon, THC = Total hydrocarbon content, Pr/Ph = Ratio of pristane to phytane, RSD = Relative standard deviation, SNS = Southern North Sea
* = Distance and bearing from the Garrow NUI
† = Mean and relative standard deviation values from an environmental survey in the Ossian-Darach field (OEUK, 2021a)
‡ = Mean and relative standard deviation values from an environmental survey in the Airidh field (OEUK, 2021b)
# = Mean and 95th percentile estimated from data reported at stations farther than 5 km from nearest platform in the central North Sea from 1975 to 1995 (OEUK, 2001)
∓ = Mean and relative standard deviation value from the regional SEA2 Area 1 (Sandbanks) survey (ERT, 2003a)
[1] Folk and Ward method (Gradistat statistics), [2] Wentworth description (Wentworth, 1922), [3] Concentrations expressed as µg/g of dry sediment

Table 4.5. Sediment Metals Analysis

Station	Distance (m)*	Bearing (°)*	Al	As	Ba	TBa†	Cd	Cr	Cu	Fe	Hg	Ni	Pb	Sn	V	Zn
GST01	500	335	1720	8.99	5.95	163	< 0.01	5.98	0.7	5680	< 0.03	2.7	5.4	< 0.1	15.9	8.8
GST02	100	337	1830	9.78	19.8	167	< 0.01	6.91	0.8	6470	< 0.03	3.2	4.9	< 0.1	16.8	11.7
GST03	100	67	2040	8.6	7.78	163	< 0.01	7.01	0.8	7560	< 0.03	3.2	4.4	< 0.1	19.9	9.7
GST04	100	241	1660	8.86	7.07	158	< 0.01	6.35	0.6	6640	< 0.03	3.1	5.1	< 0.1	16.7	10.8
GST05	110	151	2490	12.5	42.9	257	0.01	8.85	0.9	8250	< 0.03	4.1	6	0.11	20.7	12.1
GST06	500	155	1770	8.97	6.24	171	< 0.01	8.33	0.7	6470	< 0.03	3.2	5.4	< 0.1	17.2	11.2
GST07	1000	155	2080	4.74	12.1	162	< 0.01	6.4	0.6	5750	< 0.03	2.8	4.3	< 0.1	15.9	9.4
Minimum			1660	4.74	5.95	158	< 0.01	5.98	0.6	5680	< 0.03	2.7	4.3	< 0.1	15.9	8.8
Maximum			2490	12.5	42.9	257	0.01	8.85	0.9	8250	< 0.03	4.1	6	0.11	20.7	12.1
Mean			1940	8.92	14.5	177	-	7.12	0.7	6690	-	3.2	5.1	-	17.6	10.5
Standard Deviation			289	2.28	13.4	35.4	-	1.07	0.11	930	-	0.45	0.6	-	1.93	1.25
RSD [%]			15	26	92	20	-	15	15	14	-	14	12	-	11	12
SEA2 Area 1 (ERT, 2003b)‡																
Mean			-	10.9	-	-	-	4	-	8246	-	-	-	-	17	10
RSD [%]			-	75	-	-	-	38	-	51	-	-	-	-	43	52
Southern North Sea (OEUK, 2001)#																
Mean			-	-	70.14	-	0.16	10.7	3.83	7595.33	0.02	5.47	8.39	-	18.53	15.88
95th Percentile			-	-	272.4	-	0.72	44.77	13.86	18555	0.05	21.45	21.03	-	35.76	35.8
CEMP Assessment Criteria (OSPAR, 2014)																
ERL			-	-	-	-	1.2	81	34	-	0.15	-	47	-	-	150

Notes
Concentrations expressed in ìg/g dry sediment
Al = Aluminium As = Arsenic Ba = Barium TBa = Total barium Cd = Cadmium Cr = Chromium Cu = Copper Fe = Iron Hg = Mercury Ni = Nickel Pb = Lead Sn = Tin V = Vanadium Zn = Zinc
RSD = Relative standard deviation ERL = Effects Range Low OSPAR = Oslo and Paris Commission CEMP = Coordinated Environmental Monitoring Programme
* = Distance and bearing from Garrow NUI, † = Determined by alkali fusion, ‡ = Mean and relative standard deviation values from the regional SEA2 Area 1 (Sandbanks) survey (ERT, 2003b), # = Mean and 95th percentile from data reported at stations farther than 5 km from nearest platform in the SNS from 1975 to 1995 (OEUK, 2001)

Key: Light Yellow cell = Above SNS background mean Orange cell = Above SNS background 95th percentile Red cell = Above ERL

4.1.4 Seabed Features

The seafloor at Garrow generally comprises featureless sands and areas of megarippled sands. A number of sand waves exist along the Garrow to Kilmar pipeline route. Operational surveys undertaken along the pipeline route show clear differences in the peak locations of each sand wave through time, although migration of the sand waves is not in a continuous direction. 2008 and 2016 surveys indicate a westerly migration; however, the 2010 and 2013 peak locations appear to be more in line with the original 2005 locations. Any movement appears to be back and forth.

4.1.5 Oceanography

Tides in the SNS are predominately semi-diurnal and tidal waters offshore in this area of the SNS flood southwards and ebb northwards (DECC, 2016). Surface tidal streams flow in a south easterly direction and switch to a northerly direction at high water (Hydrographer of the Navy, 2011). Surface tidal streams in the vicinity of the blocks of interest are a maximum of 0.72 and 0.41 m/s respectively for spring and neap tides (Hydrographer of the Navy, 2011).

As the tidal front keeps the water column permanently vertically mixed, preventing the development of thermoclines (OSPAR, 2010), there is little variation between sea surface and bottom temperatures, as well as in the annual mean temperatures, which are approximately between 9^{o}C and 10^{o}C (Marine Scotland, 2021a).

The annual mean significant wave height in the vicinity of the Garrow infrastructure ranges from 1.51 m to 1.80 m (Marine Scotland, 2021a).

4.1.6 Meteorology

Winds in this region of the SNS are generally from between south and north-west. The prevailing winds in the region vary with the seasons. North-easterly winds and south-westerly winds are both common in winter and early summer. From July to September south-westerly winds dominate. Wind strengths are generally between Beaufort scale 1- 6 (1 – 11 m/s) in the summer months, with a greater proportion of strong to gale force winds of Beaufort scale 7 – 12 (14 – 32 m/s) in winter (UKHO, 2013).

4.2 Biological Environment

4.2.1 Plankton

The collective term plankton describes the plants (phytoplankton) and animals (zooplankton) that live freely in the water column and drift passively with the water currents. Plankton form the base of the food chain, therefore changes in the abundance and composition of the planktonic community can have impacts on higher consumers. Typically in the SNS a phytoplankton bloom occurs every spring, generally followed by a smaller peak in the autumn (DECC, 2016).

The SNS is characterised by shallow, well-mixed waters, which undergo large seasonal temperature variations (JNCC, 2004). The region is largely enclosed by land and as a result the marine environment is highly dynamic with considerable tidal mixing and nutrient-rich run-off from the land (eutrophication). Under these conditions, nutrient availability is fairly consistent throughout the year, therefore organisms with high nutrient uptake that thrive in dynamic waters, such as diatoms, are particularly successful (Leterme *et al.*, 2006). The phytoplankton community in the Regional Sea 2 area is dominated by the dinoflagellate genus *Tripos (T. fusus, T. furca, T. lineatus)* along with higher numbers of the diatom, *Chaetoceros* (subgenera *Hyalpchaete* and *Phaeoceros*) than are typically found in the northern North Sea. From November to May when mixing is at its greatest, diatoms comprise a greater proportion of the phytoplankton community than dinoflagellates (DECC, 2016).

The zooplankton community is dominated by copepods including *Calanus helgolandicus* and *C. finmarchicus* as well as *Paracalanus* spp., *Pseudocalanus* spp., *Acartia* spp., *Temora* spp. and cladorcerans such as *Evadne* spp. There has been a marked decrease in copepod abundance in the

SNS, which has been linked to changes in global weather phenomena (DECC, 2016). However, the planktonic assemblage in the vicinity of the Garrow infrastructure is not considered unusual.

4.2.2 Seabed Communities

4.2.2.1 Habitat Classification

Data from the EMODnet broad-scale seabed habitat map for Europe (EUSeaMap2), indicates that the following European Nature Information System (EUNIS) habitat classifications are predicted to be present within the vicinity of the Garrow infrastructure (EMODnet, 2021):

- **A5.25: Circalittoral Fine Sand** – Characterised by a range of echinoderms including the pea urchin *Echinocyamus pusillus*, polychaetes and bivalves. This habitat is generally more stable than infralittoral fine sand and subsequently supports a more diverse faunal assemblage;
- **A5.26: Circalittoral Muddy Sand** – Characterised by a variety of polychaetes, bivalves (*Abra alba* and *Nucula nitidosa*) and echinoderms (*Amphiura* spp., *Ophiura* spp. and *Astropecten irregularis*). These circalittoral habitats tend to be more stable than their infralittoral counterparts and as such support a richer infaunal community;
- **A5.27: Deep Circalittoral Sand** – Very little data is available on these habits however they are likely to be more stable than their shallower counterparts and characterised by a diverse range of polychaetes, amphipods, bivalves and echinoderms.

A benthic survey has previously been carried out in Block 43/26 in September 1991 for the Ravenspurn North Platform, located approximately 27 km south south west from the Garrow NUI. The results of the survey indicated that the most abundant species were the sea urchin *Echinocyamus pusillus,* the annelid *Ophelia limacina,* juvenile catworms (*Nephyts* sp), copepods, and juvenile *brittle stars* (*Amphiura* sp.) (UK Benthos, 2018).

In addition, numerous surveys have been undertaken in the Dogger Bank SAC, an extensive sandbank feature located approximately 31 km north-east of the Garrow NUI. These have identified that seabed fauna on the sandbank is dominated by robust short-lived organisms including the heart urchin *Echinocardium cordatum*, the bivalve *F. fabula* and a number of polychaetes including *L. conchilega* and *O. fusiformis* (DECC, 2016). These species are widely found in clean sandy sediments in the North Sea (DECC, 2016). Mobile fauna identified across the Dogger Bank includes the masked crab (*Corystes cassivelaunus*) and the hermit crab (*Pagurus bernhardus*) and well as a number of flatfish species (Gardline, 2011).

The seabed observed at Garrow during 2022 pre-decommissioning survey was largely homogeneous. The main sediment type observed from photographic data was sandy mud or muddy sand, with varying proportions of shell fragments. This sediment type has been classified as the habitat classification 'Faunal communities in Atlantic offshore circalittoral sand' (MD521) (Fugro, 2022b).

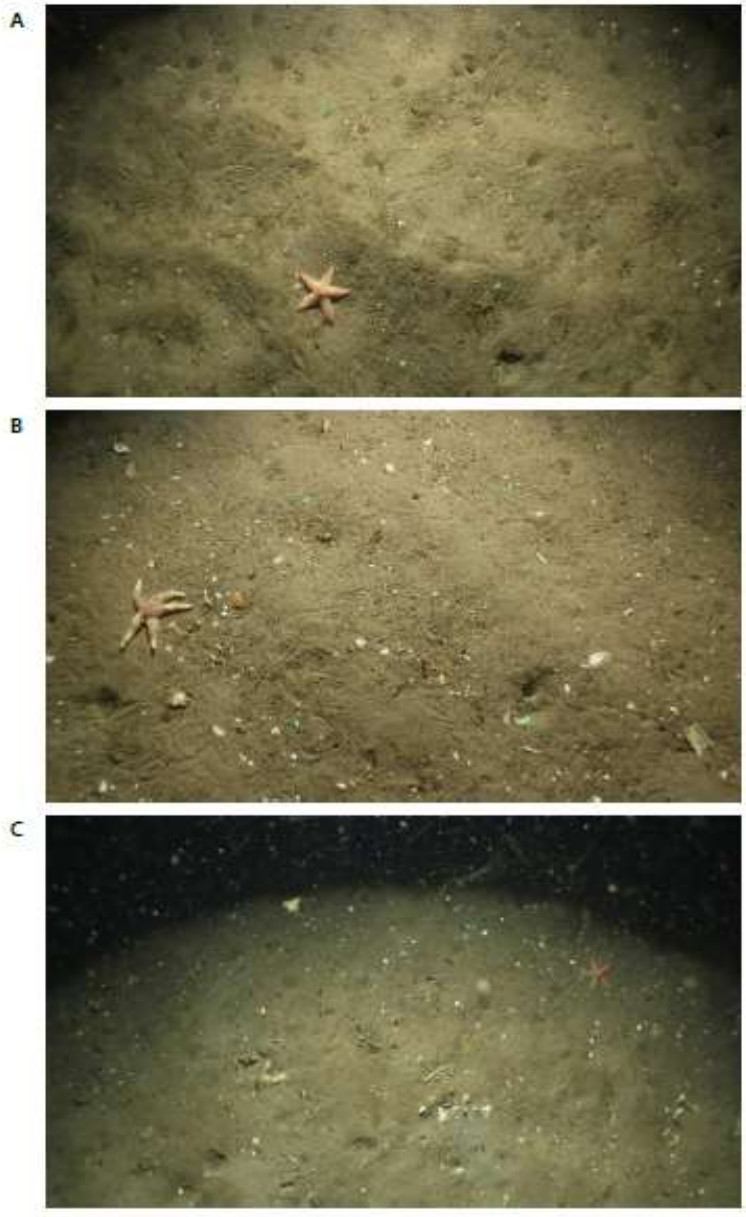
The habitat classification 'Faunal communities of Atlantic offshore circalittoral sand' (MD521) is described by habitats mostly comprising of fine sands or non-cohesive muddy sands. This habitat is thought to be stable and characterised by echinoderms, amphipods, bivalves and polychaetes (EEA, 2022). The habitat classification was assigned along all drop-down camera stations. Characterising taxa included the starfish *Astropecten irregularis*, *Asterias rubens*, and *Luidia sarsii*, and hermit crabs (Paguridae). Faunal tracks, tubes, and burrows were also present. Figure 4.2 presents example seabed photographs of the habitat classification (Fugro, 2022b).

The habitat classification 'Faunal communities of Atlantic offshore circalittoral sand' (MD521) is contained within the broadscale habitat 'Subtidal sand' and within the Habitat of Principal Importance (HPI) and Habitat of Conservation Importance (HOCI) 'Subtidal sands and gravels' (JNCC, 2018).

No other Annex I habitats or Annex II species, OSPAR threatened and/or declining species and habitats, UK Biodiversity Action Plan priority habitats and species or Features of Conservation

Interest (FOCI) (OSPAR, 2008; Biodiversity Reporting and Information Group [BRIG], 2011; JNCC, 2014; JNCC, 2018; JNCC, 2019c; JNCC, 2019d) were observed within the survey area.

Figure 4.2. Seabed photographs of 'Atlantic offshore circalittoral sand (MD521) at the Garrow Field



4.2.2.2 Macrofaunal Analysis

Seabed sediments provide support, protection, and the food source for many macrofaunal species. The sediment macrofauna, most of which are infaunal (living within the sediment), are therefore particularly vulnerable to external influences that alter the sediments' physical, chemical or biological nature. Such infaunal animals are largely sedentary and are thus unable to avoid unfavourable conditions.

Analysis of sediment macrofauna from the 2022 pre-decommissioning survey found that the macrofaunal community was relatively homogenous across the survey area. The data comprised 85 benthic taxa, of which 36 (42.4 %) were annelids, 19 (22.4 %), were arthropods, 19 (22.4 %) were molluscs, 4 (4.7 %) were echinoderms and 7 (8.2 %) were other phyla (specifically cnidarians, enteropneusts, platyhelminths, nemerteans, phoronids and chordates). A total of 962 individuals were identified, of which 431 (44.8 %) were annelids, 106 (11.0 %) were echinoderms, 99 (10.3 %) were molluscs 72 (7.5 %) were arthropods and 254 (26.4 %) were other phyla (Fugro, 2022a).

Annelids, specifically *Spiophanes bombyx* agg., were the most abundant and diverse taxa, present at 100% of stations, comprising 42.4% taxa with a mean station abundance of 31 individuals per 0.2 m^2. Arthropods (e.g. *Urothoe elegans*), were the second most abundant and diverse taxa, followed by molluscs (e.g. *Phaxas pellucidus*). Echinoderms (e.g. *Echinocyamus pusillus* and *Amphiura filiformis*) were generally the least diverse phyla comprising ≤ 12.5 % of the proportion of taxa at each station. Other phyla (e.g. Nemertea and *Phoronis sp.*) were also present (Fugro, 2022a).

Taxa frequently reported in sands such as *Echinocyamus pusillus* and *Ophelia* sp. were recorded within the top ten abundant taxa. The top ten most abundant taxa were present at all stations, with the exception of *Phaxas pellucidus*, Owenia and *Amphiura filiformis* which were present at six of the seven stations and *Ophelia borealis*, present at four of the seven stations. This indicates a high degree of similarity in macrofaunal community across the survey area. Small variations were observed (e.g. *O. borealis* was notably more abundant than dominant due to its presence in a limited number of stations); however, the results suggest that the taxa and abundance were evenly distributed across the survey area with some small-scale variation (Fugro, 2022a).

Historical data, Ossian-Darach, 2019 (OEUK, 2021a), and Airidh, 2008 (OEUK, 2021b), also showed annelids to be within the top ten most abundant taxa. The annelid *Paramphinome jeffreysii* was the most abundant species in both the 2019 and 2008 studies, but although recorded within the current Garrow survey it was not within the ten most abundant taxa. *Paramphinome jeffreysii* are known to be favourable of hydrocarbon contamination and intolerant of heavy metals and may be described as indicator species (Hiscock et al., 2005). *Spiophanes bombyx,* the most abundant taxa in the 2022 Garrow study, is intolerant of hydrocarbon contamination (Hiscock et al., 2005). THC in the current survey was low (refer to Section 4.1.3) suggesting minimal contamination. Of note, Ossian-Darach (2019) and Airidh (2008) were processed over a 0.5 mm sieve, potentially resulting in the differences in the numbers of individuals and number of taxa observed when compared to the current survey.

Differences observed in the macrofaunal community at Garrow were largely due to small scale variability in the abundance of the most dominant taxa across all clusters. The taxa encountered in the current survey were considered representative of a background SNS community.

4.2.3 Fish

4.2.3.1 Spawning and Nursery Grounds

Fish are separated into pelagic and demersal species, as follows:

- Pelagic species occur in shoals swimming in mid-levels of the water, typically making extensive seasonal movements or migrations between sea areas. Pelagic species include herring (*Clupea harengus*), mackerel (*Scomber scombrus*), blue whiting (*Micromesistius poutassou*) and sprat (*Sprattus sprattus*);

- Demersal species live on or near the seabed and include haddock (*Melanogrammus aeglefinus*), cod (*Gadus morhua*), plaice (*Pleuronectes platessa*), sandeel (*Ammodytidae* spp.), sole (*Microstomus kitt*) and whiting (*Merlangius merlangus*).

The international Council for the Exploration of the Seas (ICES) standardise the division of sea areas for the statistical analysis. The Garrow infrastructure is located in ICES Rectangle 37F0 and 37F1. Species that spawn within ICES Rectangle 37F0 and 37F1 include cod, herring, lemon sole, mackerel, *Nephrops*, plaice (high intensity spawning ground), sandeel (high intensity spawning ground), sole (*Solea solea*), sprat and whiting (Table 4.6; Coull *et al*., 1998; Ellis *et al.,* 2012).

Species that use the waters within Rectangles 37F0 and 37F1 as nursery grounds include anglerfish (white monkfish) (*Lophius piscatorius*), blue whiting, cod, European hake (*Merluccius merluccius*), herring, horse mackerel (*Trachurus trachurus*), lemon sole, ling (*Molva molva*), mackerel, sandeels, sprat, spurdog (*Squalus acanthias*) and whiting (Table 4.6; Coull *et al*., 1998; Ellis *et al.,* 2012).

Table 4.6. Fish Spawning and Nursery Species within ICES Rectangles 37F0 and 37F1 (Coull et al., 1998; Ellis et al., 2012)

Species	J	F	M	A	M	J	J	A	S	O	N	D
Anglerfish[1]	N	N	N	N	N	N	N	N	N	N	N	N
Blue whiting	N	N	N	N	N	N	N	N	N	N	N	N
Cod	N	N	N	N	N	N	N	N	N	N	N	N
European hake	N	N	N	N	N	N	N	N	N	N	N	N
Herring	N	N	N	N	N	N	N	N	N	N	N	N
Horse mackerel[2]	N	N	N	N	N	N	N	N	N	N	N	N
Lemon sole	N	N	N	N	N	N	N	N	N	N	N	N
Ling	N	N	N	N	N	N	N	N	N	N	N	N
Mackerel	N	N	N	N	N	N	N	N	N	N	N	N
Nephrops	N	N	N	N	N	N	N	N	N	N	N	N
Plaice												
Sandeels	N	N	N	N	N	N	N	N	N	N	N	N
Sole												
Sprat	N	N	N	N	N	N	N	N	N	N	N	N
Spurdog[3]	N	N	N	N	N	N	N	N	N	N	N	N
Whiting	N	N	N	N	N	N	N	N	N	N	N	N

Spawning | Peak Spawning | N Nursery | N High Intensity Nursery

[1] Insufficient data available on spawning grounds
[2] Horse mackerel appear to be widespread and with no spatially discrete nursery grounds (*Ellis et al., 2012*)
[3] Viviparous species (gravid females can be found all year) (*Ellis et al., 2012*)

In addition, data outputs from Aires *et al.* (2014) provide a guide to the most likely locations for aggregations of fish during their first year. Age 0 group fish are defined as fish in the first year of their lives and can also be classified as juvenile. The Garrow infrastructure is located in an area of moderate probability of 0 group fish for whiting, sprat, horse mackerel, herring and haddock, and a low probability of 0 group fish for sole, plaice, Norway pout (*Trisopterus esmarkii*), mackerel, hake, cod, blue whiting and anglerfish (Aires *et al.*, 2014).

All the species mentioned above are listed as UK BAP priority marine species, with the exception of haddock, lemon sole, *Nephrops* and sprat (JNCC, 2007). Cod is also on the OSPAR List of

Threatened and/or Declining Species and Habitats (OSPAR, 2014). In addition, cod, horse mackerel, haddock and spiny dogfish and tope shark are listed as 'Vulnerable' globally on the International Union for the Conservation of Nature (IUCN) Red List of Threatened Species, with spiny dogfish also listed as 'Endangered' in Europe. All other species are listed as 'Least Concern', aside from sole which is listed as 'Data Deficient' (IUCN, 2021).

4.2.3.2 Elasmobranchs

Elasmobranchs encompass species of sharks, skates and rays. These species differ from other fish by having a skeletal structure made out of cartilage as opposed to bone. They typically have a slow growth rate and low fecundity, leaving their populations vulnerable to over-fishing, habitat degradation and pollution events however, their distribution is wide throughout the world's oceans (Baxter *et al.*, 2011).

A survey of the distribution of elasmobranch species were recorded throughout the North Sea and surrounding waters. Species which have been recorded in the SNS at various times throughout the year, and may therefore be present in the vicinity of the proposed Garrow infrastructure, are listed in Table 4.7 (Ellis *et al.*, 2004; IUCN, 2021).

Table 4.7. Elasmobranch Species Likely to be found in the Vicinity of the Proposed Decommissioning Work (Ellis et al., 2004; IUCN, 2021)

Common name	Latin name	Depth range (in metres)	Global IUCN Status [1]	European IUCN Status [1]
Blonde skate	*Raja brachyura*	10 – 900	Near Threatened	Near Threatened
Common smooth-hound	*Mustelus mustelus*	5 – 350	Endangered	Vulnerable
Thorny skate / Starry ray	*Amblyraja radiata*	18 – 1400	Vulnerable	Least Concern
Smallspotted catshark	*Scyliorhinus canicula*	< 400	Least Concern	Least Concern
Spiny dogfish	*Squalus acanthias*	15 – 528	Vulnerable	Endangered
Spotted skate	*Raja montagui*	< 530	Least Concern	Least Concern
Starry smooth-hound	*Mustelus asterias*	0 – 100	Near Threatened	Near Threatened
Thornback skate	*Raja clavata*	10 – 300	Near Threatened	Near Threatened
Tope shark	*Galeorhinus galeus*	0 – 2000	Critically Endangered	Vulnerable
Undulate skate	*Raja undulata*	50 – 200	Endangered	Near Threatened

[1] Status as of December 2021

Of these species listed in the table above, blonde skate, common smooth-hound, thorny skate, spiny dogfish, starry smooth-hound, thornback skate and tope shark and undulate skate are of most concern due to their unfavourable conservation status (IUCN, 2021). In addition, spotted skate, thornback skate, and spiny dogfish are listed on the OSPAR List of Threatened and/or Declining Species and Habitats (OSPAR, 2014).

4.2.4 Seabirds

4.2.4.1 At-Sea Distribution

The offshore waters of the SNS are visited by seabirds, mainly for feeding purposes in and around the shallow sandbanks, although the number of seabirds in this region are generally lower compared to further north (DECC, 2016).

The abundance, distribution and assemblage of seabird species varies seasonally. Between December and March, large numbers of auks; guillemot (*Uria aalge*) and razorbill (*Alca torda*), are present in the offshore waters of the SNS and around Flamborough Head, located approximately 72 km to the west of the Garrow platform. Large numbers of terns are present in the area during April and May and in coastal waters in August. The breeding season for most seabird species begins in April and continues through to June. During this and during the annual moult in July, most species are found in coastal waters and forage closer to their colonies (DECC, 2016).

The coastline in this region of the SNS encompasses a number of areas suitable for cliff nesting seabirds as well as important habitats for wintering and passage waterbirds (DECC, 2016). Based on the mean maximum foraging ranges taken from Woodward *et al*., 2019, species which are likely to be present from coastal SPAs including the Flamborough and Filey Coast SPA (located approximately 70 km to the west of Garrow) include kittiwake (*Rissa tridactyla*) (156.1±144.5 km), guillemot (73.2±80.5 km), gannet (*Morus bassanus*) (315.2±194.2 km) and razorbill (88.7±75.9 km) (Woodward *et al.,* 2019).

The European Seabirds at Sea (ESAS) database is the most complete and longstanding dataset detailing the distribution of seabirds at sea, compiling a range of boat and transect data over a period of 29 years. The data indicates that the Garrow infrastructure is not within a hotspot area, defined as an important area of high seabird density at sea. The predicted at-sea seabird density in the blocks of interest are shown in Table 4.8, with the data indicating a density of less than 33 seabirds per km^2 during the breeding season (March – September) and less than 28 seabirds per km^2 in winter (November – March). The most abundant species present are guillemot in the breeding season, fulmar (*Fulmarus glacialis*) and herring gull (*Larus argentatus*) over winter, and guillemot during the post breeding dispersal period (JNCC, 2019; Kober *et al.*, 2010).

Table 4.8. Predicted At-Sea Seabird Density in the Blocks 42/25, 43/21 and 43/22 (number of individuals per km^2) (JNCC, 2019; Kober et al., 2010)

Species	Season	Predicted Density in the Blocks of Interest [1]												Predicted Density Range Across UK Waters [1]
		J	F	M	A	M	J	J	A	S	O	N	D	
Fulmar	Breeding			1.6										0 – 582.6
	Winter	10.0							10.0					0 – 239.2
Sooty shearwater	Winter							< 0.01						0 - 16.3
Manx shearwater	Breeding					< 0.01								0 - 190.2
Gannet	Breeding					0.2								0 - 110.5
	Winter	1.2									1.2			0 - 24.9
Arctic skua	Breeding					0.2								0 - 2.4
	Other									< 0.01				0 - 1.1
Great skua	Breeding					< 0.01								0 - 1.6
	Winter	0.2								0.2				0 - 4.3
Kittiwake	Breeding					8.6								0 - 185.0
	Winter	5.6									5.6			0 - 306.8
Black-headed gull	Breeding				0.3									0 - 12.0
Little gull	Other								0.1					0 - 5.2
Great black-backed gull	Breeding				< 0.01									0 - 4.8
	Winter	2.0								2.0				0 - 19.5
Common gull	Breeding					0.2								0 - 2.6
	Winter	0.4								0.4				0 - 39.9
Lesser black-backed gull	Breeding					0.1								0 - 351.7
	Winter	< 0.01								< 0.01				0 - 368.8
Herring gull	Winter	9.1								9.1				0 - 101.9
Arctic tern	Breeding					1.5								0 - 31.2
Guillemot	Breeding					20.8								0 - 713.4
	Winter	4.4									4.4			0 - 62.7
	Other								12.9					0 - 254.8
Razorbill	Breeding					2.1								0 - 22.0
	Winter	0.3									0.3			0 - 15.8
	Other								0.3					0 - 64.6
Little auk	Winter	3.4										3.4		0 - 13.4
Atlantic Puffin	Breeding				1.4									0 - 162.4
	Winter	0.5							0.5					0 - 0.14

Key (Number of individuals per km^2)

	10.0 - ≤ 25.0		1.0 - < 10.0		0.01 - < 1.0		< 0.01		No Occurrence

[1] The predicted at-sea seabird density for each seabird species/season was calculated from ESAS transect data using the spatial interpolation technique Poisson kriging (Kober *et al.,* 2010).

Of the species listed in Table 4.8, the global and European populations of kittiwake are listed as Vulnerable on the IUCN Red List, and the global and European populations of razorbill and sooty shearwater (*Ardenna grisea*) are listed as Near Threatened. Atlantic puffin is listed as Vulnerable globally and fulmar is listed as Least Concern globally, although both species are listed as Endangered in Europe. Globally, herring gull (*Larus argentatus*), and guillemot are of Least Concern, however their European populations are Near Threatened. The global and European populations of Manx shearwater, gannet, storm petrel, pomarine skua (*Stercorarius pomarinus*), arctic skua (*Stercorarius parasiticus*), great skua (*Stercorarus skua*), great black-backed gull (*Larus marinus*), common gull (*Larus canus*), lesser black-backed gull, common tern (*Sterna hirundo*) and little auk (*Alle alle*) are of Least Concern (IUCN, 2021).

4.2.4.2 Nesting Seabirds on the Garrow Platform

Part 3 of the Conservation of Offshore Marine Habitats & Species Regulations 2017, and in particular regulation 40, gives protection to wild birds, their eggs and nests in UK offshore waters. The presence of wild birds on the Garrow platform may therefore affect the timing of the proposed decommissioning activities.

To date, evidence suggests that black-legged kittiwakes are the predominant bird species exploiting nesting opportunities on offshore installations in the SNS (typically those in lighthouse mode prior to dismantlement). Although most kittiwake colonies are located on sheer cliffs, the species is known to nest on man-made structures such as offshore oil and gas installations (JNCC, 2021). Colony size can vary from less than ten pairs to tens of thousands, with individuals returning to the same colony over multiple years. The nearest major colony to the Garrow platform is the Flamborough and Filey Coast SPA, which supported 45,504 apparently occupied nests in 2017 (JNCC, 2017), located approximately70 km to the west of the Garrow platform.

The global and European populations of kittiwake are listed as Vulnerable on the IUCN Red List. Kittiwake is also on the OSPAR List of Threatened and/or Declining Species and Habitats and Red listed in Birds of Conservation Concern 4. Of note is that from 2000 to 2019, the UK population of kittiwake has declined by 25% (JNCC, 2021a).

The phenology of nesting kittiwakes has been summarised in Table 4.9, although timings can vary from year to year due to factors such as lack of food. During the breeding season, kittiwakes feed mainly on small pelagic shoaling fish, particularly sandeels, but also scavenge for offal and discards around fishing boats (JNCC, 2021b). The first breeding does not usually occur until the age of 4 to 5 years, with birds laying 1 to 3 eggs per season (Del Hoyo *et al*., 1996; Cramp and Simmons, 1983).

Table 4.9. Phenology of Kittiwakes (Coulson et al., 2011; Hatch et al., 2020; JNCC, 2021b; Keogan et al., 2018)

Behaviour	Approx. Date Range	Observations
First Arrival	February to April	-
Nest Building	End of April – Mid May	Nests are normally built 1-3 weeks before appearance of first eggs.
Egg Laying	May	At Flamborough & Filey Coast SPA egg laying normally occurs in early to mid May. Incubation is normally around one month.
Hatching	Mid to late June	-
Fledging	Late July – September	Peak in mid-August, with chicks leaving colony ca. 10 days after first flight.

In June 2021, a third party on behalf of WPRL as previous field operator, investigated if breeding kittiwake were present on the Garrow platform. An ornithological survey was carried out to coincide with kittiwake main attendance at their colonies during the UK breeding season using methodologies in line with current JNCC and OPRED guidelines (JNCC, 2021b; Walsh *et al.,* 1995). The survey was undertaken in optimal weather conditions which did not limit the ability to identify

bird species. The survey involved an aerial survey using an aircraft which orbited the Garrow platform at a distance of 500 m to capture video imagery of the whole platform, with imagery captured directly opposite and slightly above the platform, in line with guidelines for survey methods at offshore installations (Thompson, 2021). Additionally, a thermal video stream was collected alongside the video to aid the location of birds. The video imagery was analysed by ornithologists to independently locate, identify and count the birds present on the platform. Additionally, a boat based survey was conducted from the upper deck of a vessel in which binoculars were used and images were taken using a DSLR camera. The vessel moved slowly around the Garrow platform at a distance of 100 to 500 m. The surveyors aimed to view the section of the platform from directly opposite on each side and different vantage points were used to achieve optimum viewing positions.

The survey recorded 48 individuals on breeding ledges (defined as ledges of an appropriate size which could potentially support breeding birds) and 30 potential occupied sites on the Garrow platform where birds were observed (which could potentially represent young birds recently recruiting into the colony) (see Figure 4.3). However, during this survey no breeding pairs of kittiwake or trace nests were observed. The total number of birds present on the Garrow structure (located in the wider area, excluding breeding ledges) was 33, these individuals were located on the north-east and north-west sides of the platform and the helideck. A feeding flock consisting of 38 individuals was recorded in the wider area surrounding the platform (Orsted, 2021). Additionally, great black-backed gull, herring gull, and lesser greater black-backed gull were present on the Garrow platform, however, there was no evidence of breeding (Orsted, 2021).

Figure 4.3. Seabirds Present on and in the Vicinity of the Garrow NUI (Orsted, 2021)

A further visual survey was undertaken on 11 June 2022 when the platform was visited by a maintenance team. All areas / levels of the platform were surveyed, including the underdeck. A number of birds were observed roosting on the platform, including 200+ kittiwakes, 150+ herring gulls and one razorbill (Figure 4.4). No nests were recorded and the kittiwake were not in pairs.

Since June 2022, a number of other visual surveys of the platform have taken place as follows:

- March 2023 - recorded 6 x herring gull, although no breeding pairs or nests were observed.

- February 2023 – recorded 3 x herring gulls and no nests.
- September 2022 – recorded 40 x herring gull and no nests.
- August 2022 – recorded 200 x gulls, 100 x kittiwakes, 2 x sparrow hawks, 1 x kestrel, but no nests.

Figure 4.4. Seabirds Present on and in the Vicinity of the Garrow NUI on 11 June 2022

4.2.4.3 Seabird Sensitivity to Oiling

Seabird sensitivity to oiling varies considerably throughout the year and is dependent on a variety of factors, including time spent on the water, total biogeographical population, reliance on the marine environment and potential rate of population recovery (DECC, 2016). The Seabird Oil Sensitivity Index (SOSI) (Webb *et al.*, 2016) combines seabird data collected between 1995 and 2015 and individual seabird species index values to create a single measure of seabird sensitivity to oil pollution. The SOSI score for each UKCS Block can be ranked into sensitivity categories, from 1 (extremely high sensitivity) to 5 (low sensitivity). An assessment of the median SOSI scores in the vicinity of the blocks of interest varies from low to extremely high throughout the year (see Table 4.10).

Table 4.10. Assessment of Seabird Oil Sensitivity Index (SOSI) Scores for UKCS 42/25, 43/21 and 43/22, and the Surrounding Area (Webb *et al.*, 2016)

Block	J	F	M	A	M	J	J	A	S	O	N	D
42/19	5	1	1	1	5	1	3	4	2	2	5	5
42/20	5	N	1	5	5	1	2	3	1	1	5	5
43/16	N	N	1	5	5	1	2	4	4	N	N	1
43/17	N	5	5	5	2	2	2	3	3	3	N	1

Block	J	F	M	A	M	J	J	A	S	O	N	D
43/18	1	5	5	5	2	2	2	2	3	3	1	1
42/24	5	2	2	2	4	1	3	3	3	3	5	5
42/25	**5**	**1**	**1**	**1**	**5**	**1**	**3**	**3**	**1**	**1**	**5**	**5**
43/21	**1**	**2**	**1**	**5**	**5**	**1**	**2**	**4**	**1**	**1**	**1**	**1**
43/22	**1**	**5**	**5**	**5**	**2**	**2**	**2**	**4**	**2**	**2**	**1**	**1**
43/23	1	5	5	5	2	2	2	3	2	2	1	1
42/29	5	2	1	1	4	1	3	3	3	3	5	4
42/30	2	2	2	2	5	1	3	3	2	2	3	3
43/26	1	2	1	1	5	1	2	3	1	1	1	1
43/27	1	3	5	1	1	2	1	3	1	1	1	1
43/28	1	5	5	5	3	3	1	4	1	1	1	1

Key: 1 = Extremely High; 2 = Very High; 3 = High; 4 = Medium; 5 = Low; 'N' = No Data.
SOSI sensitivity category in red and underlined indicates an indirect assessment of SOSI scores, in light of coverage gaps.
Rows in bold indicate the UKCS blocks within which the proposed decommissioning activity will be taking place.

4.2.5 Marine Mammals

4.2.5.1 Cetaceans

Cetacean abundance in the SNS is relatively low compared to the northern and central North Sea, with the exception of harbour porpoise (*Phocoena phocoena*). Ten species of cetacean have been sighted in the SNS, however only the harbour porpoise and the white-beaked dolphin (*Lagenorhynchus albirostris*) are considered to be regularly occurring. Minke whale (*Balaenoptera acutorostrata*) is a frequent seasonal visitor, whilst bottlenose dolphin (*Tursiops truncatus*) and white-sided dolphin (*Lagenorhynchus acutus*) are considered uncommon visitors (DECC, 2016).

Harbour porpoise are found in persistently high densities year round at the inner Silver Pit, in summer at the north-western edge of Dogger Bank, and in winter in offshore areas east of Norfolk and east of the outer Thames estuary. The SNS SAC has been designated to protect these areas and the Garrow infrastructure lies within this SAC (refer to Section 4.5.6 for further details).

The relative abundance of the most common species of cetaceans in this area of the SNS can be derived from data obtained during the Small Cetacean Abundance of the North Sea (SCANS-III) aerial and ship-based surveys. This project identified the abundance of cetacean species within predefined sectors of the North Sea and North-East Atlantic. The Garrow infrastructure is located within SCANS-III Block O (Table 4.11) in which harbour porpoise, minke whale and white-beaked dolphin have been recorded (Hammond *et al.,* 2021). It should be noted that although density estimates are shown in Table 4.11, they are only an example of what densities could be encountered in the area due to the wide-scale nature of the SCANS-III survey and the fact the data was only collected in July 2016.

Table 4.11. Cetacean Abundance and Density Recorded in SCANS-III Aerial Survey Area Block O (Hammond et al., 2021)

Species	SCANS-III Block 'O'		Total (Aerial Survey Blocks)	
	Abundance	Density [1]	Abundance	Density [1]
Harbour porpoise	53,485	0.888	424,245	0.351
White-beaked dolphin	143	0.002	36,287	0.030

Minke whale	603	0.010	13,101	0.011

[1] Density is the number of individuals per km^2.

The UK Statutory Nature Conservation Bodies (SNCBs) have defined Management Units (MUs) for seven cetacean species (harbour porpoise, Risso's dolphin (*Grampus griseus*), common dolphin, bottlenose dolphin, white-beaked dolphin, white-sided dolphin, and minke whale) in UK waters in order to provide an understanding of the geographical range and abundance of marine mammal populations, and subpopulations, to aid conservation and management purposes. The MUs within which the Garrow infrastructure is located, along with the corresponding abundance of animals within these units, are listed in Table 4.12 below (IAMMWG, 2021).

Table 4.12. Estimates of Cetacean Abundance in the Relevant MMMUs (IAMMWG, 2021)

Species	Management Unit (MU)	Abundance in MU	Abundance in UK part of MU	Density[1]
Harbour porpoise	North Sea (678,206 km^2)	346,601	159,632	0.5
Bottlenose dolphin	Greater North Sea (639,886 km^2)	2,022	1,885	0.003
Risso's dolphin	Celtic and Greater North Seas (1,560,875 km^2)	12,262	8,687	0.007
Common dolphin		102,656	57,417	0.06
Minke whale		20,118	10,288	0.01
White-beaked dolphin		43,951	34,025	0.02
White-sided dolphin		18,128	12,293	0.01

[1] Density (individuals per km) was calculated using the total area of the MU and the abundance of animals within that MU.

It is evident that harbour porpoise is the most abundant species in the North Sea compared to other species identified in Table 4.12, despite its MU being smaller in area.

To provide a more localised indication of the seasonal distribution of cetaceans in the area of the Garrow infrastructure, data from the JNCC Atlas of Cetacean Distribution in north-west European Waters is shown in Table 4.13. This indicates that harbour porpoise, minke whale, pilot whale, white-beaked dolphin and white-sided dolphin have been observed within the area (Reid *et al.*, 2003).

Table 4.13 Cetacean Sightings in the Vicinity of the Garrow Infrastructure (Reid et al., 2003)

Species	J	F	M	A	M	J	J	A	S	O	N	D
Harbour porpoise												
Minke whale												
Pilot whale												
White-beaked dolphin												
White-sided dolphin												
Key (Number of individuals per hour of sightings effort)												
High (>100)	Medium (10 – 100)	Low (1 – 10)	V. Low (0.01 – 1)	No sightings								

It is important to note that the lack of recorded sightings does not necessarily preclude the presence of other species. In addition, the highly mobile nature of cetaceans means that species that are found within the area in general, such as harbour porpoise and white-beaked dolphin, may be present at other times of the year.

All cetaceans (whales, dolphins and porpoises) are protected under Annex IV of the Council Directive 92/43/EEC (also known as the Habitats Directive). In addition, harbour propose is also listed on the OSPAR List of Threatened and/or Declining Species (OSPAR, 2014) and under Annex II of the EC Habitats Directive. All of the species that may occur in the vicinity of the blocks of interest are listed as UK BAP priority species (JNCC, 2007), but are of least concern on the IUCN Red List (IUCN, 2021).

4.2.5.2 Pinnipeds

Two species of seals; grey seal (*Halichoerus grypus*) and the harbour (or common) seal (*Phoca vitulina*) are found along the English coast. Important numbers of grey and harbour seals are present off the east coast of England, particularly around The Wash where harbour seals forage over a wide area.

Grey and harbour seals are both listed under Annex II of the Habitats Directive, requiring the designation of SACs in order to protect these species. In addition, harbour and grey seals are protected under the Conservation of Seals Act 1970 and are listed as UK BAP priority marine species (JNCC, 2007).

Grey Seal

Grey seals are rare globally, and the UK hosts around 36% of the world population and 95% of the EU population. Several colonies exist on the east coast of England, including Donna Nook, Blakeney Point, Horsey, Flamborough Head and The Wash. A total of 8,677 grey seals were counted between Donna Nook and Dover in August 2019 (DECC, 2016; SCOS, 2020).

Grey seals forage in the open sea and return regularly to haul out on land where they rest, moult and breed. Grey seal foraging movements are on two geographical scales: long and distant trips from one haul-out site to another; and local repeated trips to discrete foraging areas (McConnell *et al.* 1999). Foraging areas can be up to 100 km offshore and connected to haul-out sites by prominent high-usage corridors (Jones *et al.*, 2016). The distribution of grey seals in the vicinity of the Garrow infrastructure is moderate (< 10 individual per 25 km^2) (Russell *et al.*, 2017). Densities at sea are lower during pupping and breeding season, which in south-east Britain occurs between August and September, and during the moulting season (February to March) (SCOS, 2020).

Harbour Seal

Around 32% of EU harbour seals are found in the UK. Their distribution on the east coast of the UK is restricted, concentrating in major estuaries including the Thames, The Wash and the Moray Firth. The south-east coast of England hosts several harbour seal colonies and haul-out sites, and total

count for the Southeast England management unit between 2016-2019 was 3,752. The largest colony in the UK is The Wash, with an estimated 2,415 individuals counted in 2019 (SCOS, 2020).

In general, the harbour seal tends to forage within 40 – 50 km of its haul out sites (SCOS, 2020). Tagging studies, however, have demonstrated that individuals from haul-out sites in The Wash forage for much greater distances than individuals from elsewhere in the UK (Sharples *et al.*, 2012), although given the distance offshore, the distribution of harbour seals in the vicinity of the Garrow infrastructure is low (< 1 individual per 25 km^2) (Russell *et al.*, 2017). Harbour seals spend more time ashore at haul-out sites from June to July during breeding and in August during moulting season, and thus densities at sea are lower during this time (SCOS, 2020).

Management Units

The UK SNCBs have defined MUs for grey and harbour seals in inshore UK waters in order to provide an understanding of their geographical range, and abundance of their populations and subpopulations, to aid conservation and management purposes. The proposed decommissioning work is not located within a MU for seals as these are specific to inshore waters (IAMMWG, 2013). However, it is noted that the seaward extent of these MUs is illustrative and not definitive, as seals will cross MU boundaries on a regular basis. Table 4.14 lists the seal count for the South East England MU, along with the corresponding abundance of animals within this unit.

Table 4.14. Marine Mammal Management Units for Pinnipeds in UK Waters (IAMMWG, 2013)

Species	Management Unit	Seal Count	Estimated Population Size [1]	Survey Year
Harbour seal	South East England	3,567	-	2011
Grey seal		3,103	10,350	2010, 2011

[1] An independent population estimate for grey seals was calculated using counts obtained during the 2007 and 2008 summer surveys (Lonergan *et al.*, 2010). This estimate was not available for harbour seals.

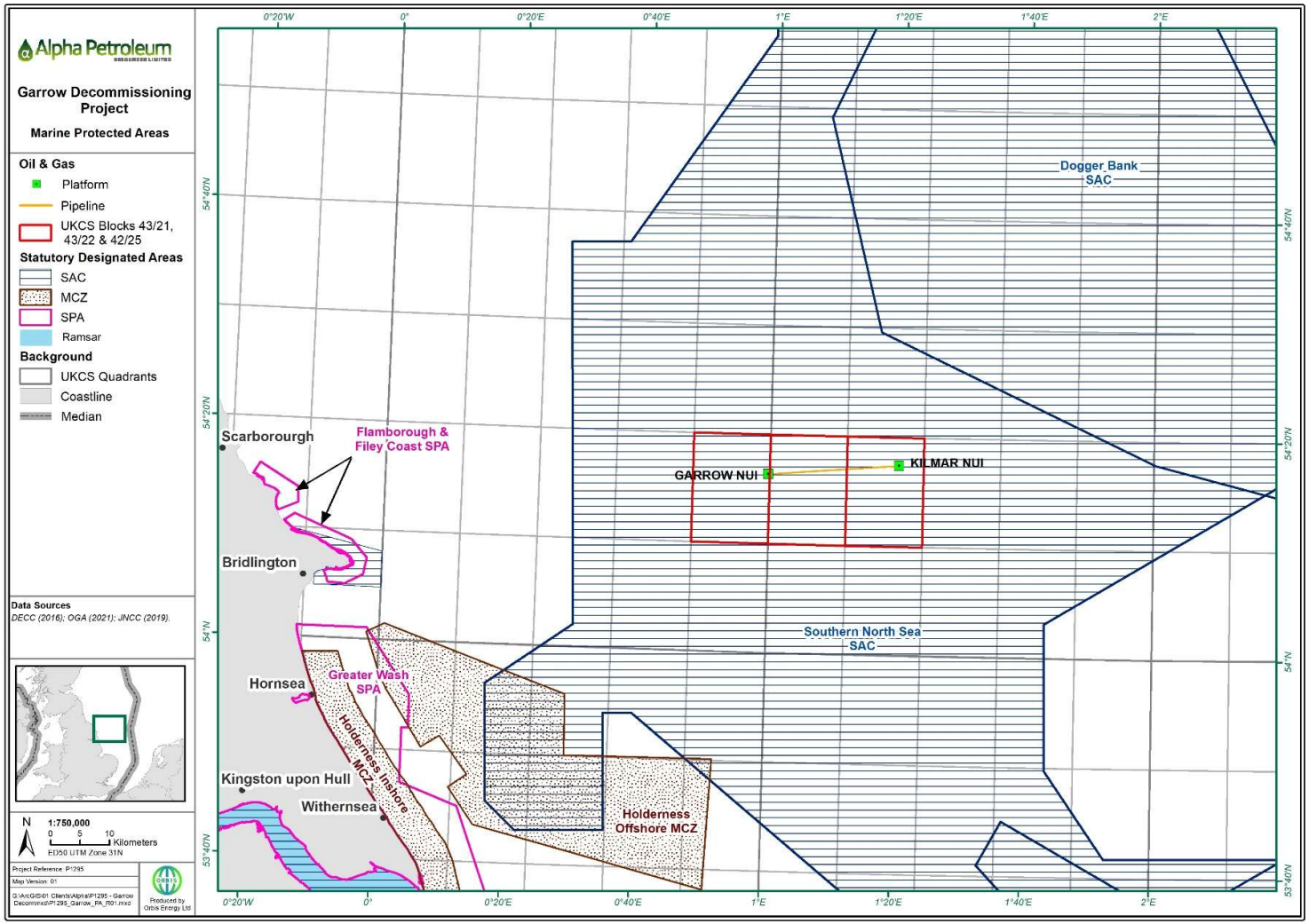
4.2.6 Marine Protected Areas

The Garrow infrastructure lies within the boundary of one marine protected area (MPA), the SNS SAC. There is one other MPAs located within 40 km of the proposed decommissioning work, the Dogger Bank SAC. In addition, the Greater Wash SPA, which lies along the adjacent coastline approximately 72km from the Garrow platform, has also been scoped into the assessment as vessels transiting through this site on the way to the Garrow location have the potential to disturb overwintering birds (red-throated diver and common scoter). Figure 4.5 shows the location of these MPAs in relation to the location of the proposed Garrow infrastructure and the qualifying features and site description are detailed in Table 4.15.

Table 4.15. Marine Protected Areas within 40 km of the Proposed Decommissioning Work

Site Name	Distance & Direction	Qualifying Features and Site Description
Southern North Sea SAC	All Garrow infrastructure is located within the boundary of the SAC	**Features:** Annex II species; Harbour porpoise (*Phocoena phocoena*) (1351). **Description:** The site has been identified as an area of importance for harbour porpoise, and supports 17.5% of the UK North Sea MU population. This site covers an area of 36,951 km^2. The majority of this site lies offshore, though it does extend into coastal areas of Norfolk and Suffolk. The northern two thirds of the site (within which the Garrow platform and abandoned well are located) are recognised as important for porpoises during the summer season (April – September), whilst the southern part supports persistently higher densities during the winter (October – March). **Conservation Objectives:** To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining Favourable Conservation Status for harbour porpoise in UK waters. In the context of natural change, this will be achieved by ensuring that: • Harbour porpoise is a viable component of the site; • There is no significant disturbance of the species; The condition of supporting habitats and processes, availability of prey is maintained.
Dogger Bank SAC	31 km NE from Garrow platform 20 km NE from Garrow pipelines and the Kilmar platform	**Features:** Annex I habitat; Sandbanks which are slightly covered by seawater all the time (1110). **Description:** The Dogger Bank is the largest single continuous expanse of shallow sandbank in UK waters, the southern area of the bank is covered by water seldom deeper than 20 m and extends within the SAC in UK waters down to 35–40 m deep. The site covers an area of 12,331 km^2. The site is an important location for the North Sea harbour porpoise population and as such, they are included as a non-qualifying feature. Grey and common seals are known to visit the bank and are also included as non-qualifying features at the site. Sediments range from fine sands containing many shell fragments on top of the bank to muddy sands at greater depths supporting invertebrate communities, characterised by polychaete worms, amphipods and small clams within the sediment, and hermit crabs, flatfish, starfish and brittlestars on the seabed. Sandeels are an important prey source at the bank, supporting fish, seabirds and cetaceans. **Conservation Objectives:** For the feature to be in favourable condition thus ensuring site integrity in the long term and contribution to Favourable Conservation Status of Annex I Sandbanks which are slightly covered by seawater all the time. This contribution would be achieved by maintaining or restoring, subject to natural change: • The extent and distribution of the qualifying habitat in the site; • The structure and function of the qualifying habitat in the site; • The supporting processes on which the qualifying habitat relies.
Greater Wash SPA	72 SW from Garrow platform	**Features:** Annex I bird species: Red throated diver (*Gavia stellata*), little gull (*Hydrocoloeus minutus*), little tern (*Sternula albifrons*), sandwich tern (*Sterna sandvicencis*), common tern (*Sternula albifrons*); and Migratory species: common scoter (*Melanitta nigra*). **Description:** The site is located predominantly in the coastal waters of the mid-SNS between the counties of Yorkshire and Suffolk, covering an area of 3,536km^2. This area supports the largest breeding populations of little terns within the UK SPA network by protecting important foraging areas, and supports the second largest aggregations of non-breeding red-throated diver and little gull. The SPA includes a range of marine habitats, including intertidal mudflats and sandflats, subtidal sandbanks and biogenic reef, including *Sabellaria* reefs and mussel beds. **Conservation Objectives:** The site's conservation objectives apply to the site and the individual species and/or assemblage of species for which the site has been classified (see above). The objectives are to ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring: • The extent and distribution of the habitats of the qualifying features; • The structure and function of the habitats of the qualifying features; • The supporting processes on which the habitats of the qualifying features rely; • The population of each of the qualifying features; and • The distribution of the qualifying features within the site.

Figure 4.5. Marine Protected Areas in the Vicinity of the Garrow Infrastructure



4.3 Human Environment

4.3.1 Commercial Fishing

The North Sea is one of the world's most important fishing grounds, and major UK and international fishing fleets operate in the SNS, including vessels from England, Scotland, Belgium, Holland, Denmark and France (DECC, 2009).

Fishing effort and landings are recorded by ICES Rectangle on a monthly and annual basis. As previously noted the Garrow infrastructure is located within ICES Rectangles 37F0 and 37F1. Fishing effort is relatively high in ICES Rectangle 37F0, within which the Garrow platform is located, with the mean annual fishing effort between 2016 and 2020 at 1,007 days (Figure 4.5). The windfarm activity (in particular Hornsea) has pushed fishing activity further north into the ICES rectangle 37F0 (near Garrow) over the last few years so the same static gear is now used in a smaller area.

Fishing effort is highest in March, May and September (Figure 4.7). The majority of fishing effort is from dredgers (27%), followed by traps and trawls (both 23%), and seine nets (18%). In ICES Rectangle 37F0, the mean annual fish landings (by weight) between 2016 and 2020 was 1,963 tonnes, with a mean value of £3,825,933 (Figures 4.8 and 4.9). Landings by weight and value peak in October. Landings data demonstrate that catches (by weight) are largely composed of shellfish (70%), followed by pelagic species (25%), and demersal species (5%) and the most commonly caught species are crabs, herring and scallops (Marine Scotland, 2021b).

Fishing effort within ICES Rectangle 37F1 is relatively low, with an average of 167 days fished per year between 2016 and 2020 (Figure 4.6). Fishing effort is highest in July and August (Figure 4.7). The mean annual fish landings (by weight) between 2016 and 2020 was 466 tonnes, with a mean value of £810,518 (Figures 4.8 and 4.9). Landings data demonstrate that catches (by weight) are largely composed of shellfish (63%), followed by demersal species (37%) and the most frequently caught species are crabs, *Nephrops* and plaice. (Marine Scotland, 2021b).

Table 4.16 provides a summary of UK Fleet landings over a five year period (2016-2020). There has been a general declining trend from 2016 to 2020 in ICES rectangle 37F1 and an increasing trend with a recent decline in ICES Rectangle 37F0 (MMO, 2021).

Figure 4.6. Total Fishing Effort (Days Fished) between 2016 and 2020 within ICES Rectangles 37F0 and 37F1 (Marine Scotland, 2021b)

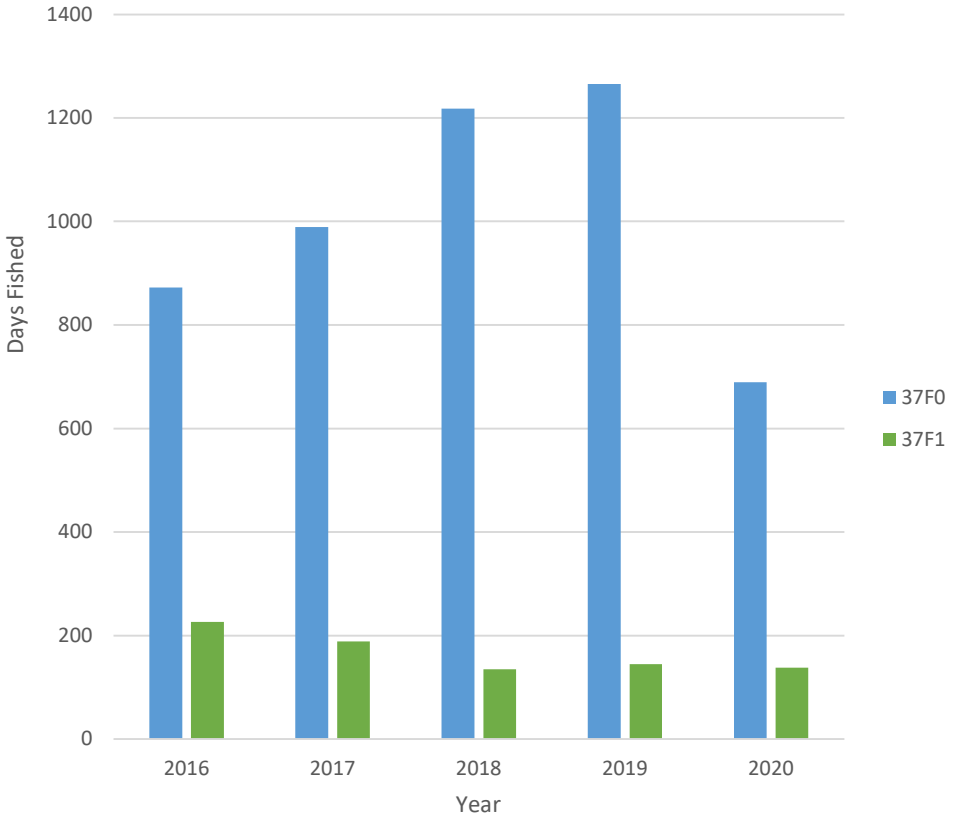


Figure 4.7. Total Fishing Effort (Days Fished) by month between 2016 and 2020 within ICES Rectangles 37F0 and 37F1 (Marine Scotland, 2021b)

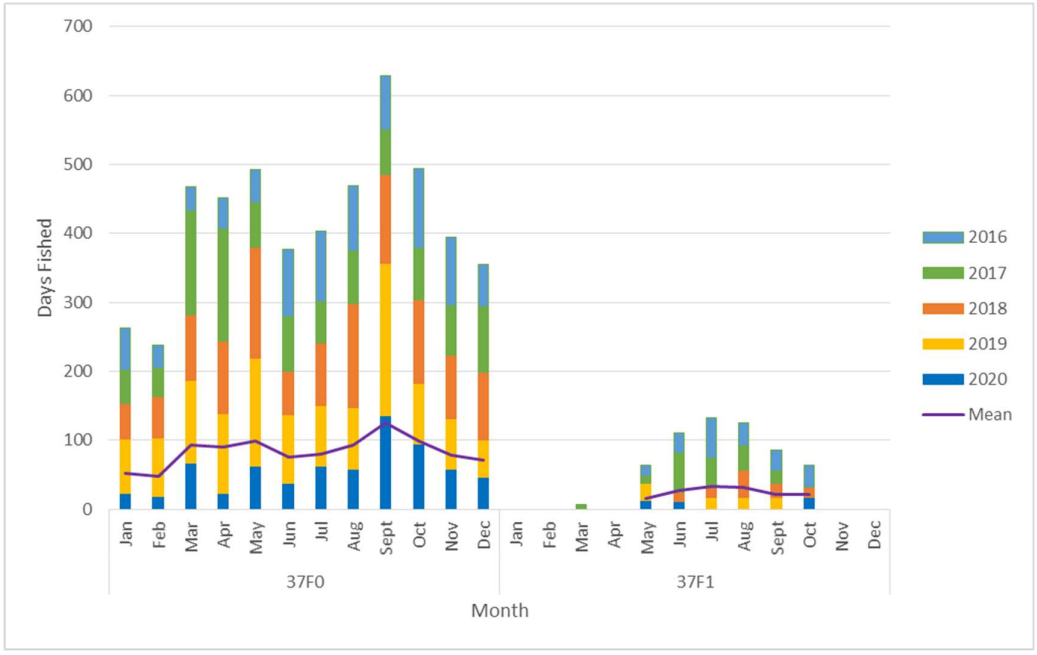


Figure 4.8. Total Annual Fishing Landings (tonnes) between 2016 and 2020 within ICES Rectangles 37F0 and 37F1 (Marine Scotland, 2021b)

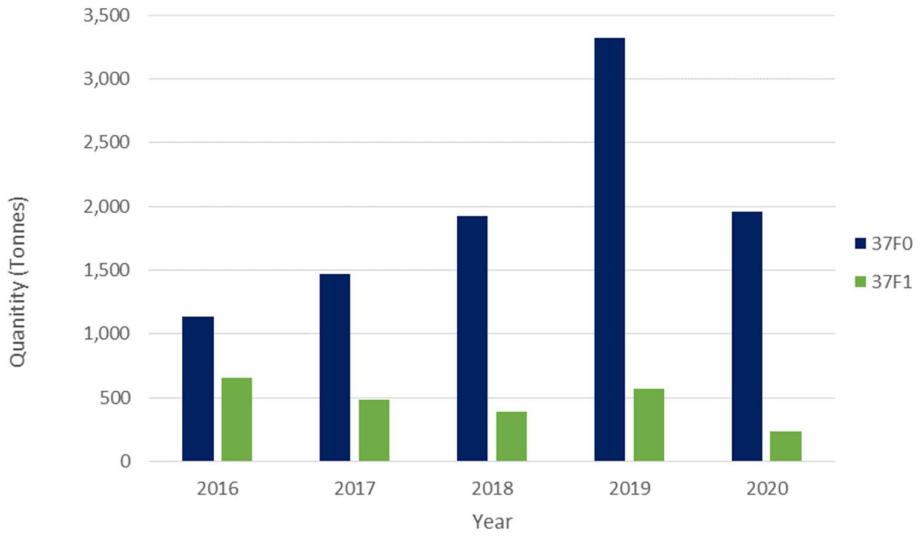


Figure 4.9. Total Annual Catch by Value (£) between 2016 and 2020 within ICES Rectangles 37F0 and 37F1 (Marine Scotland, 2021b)

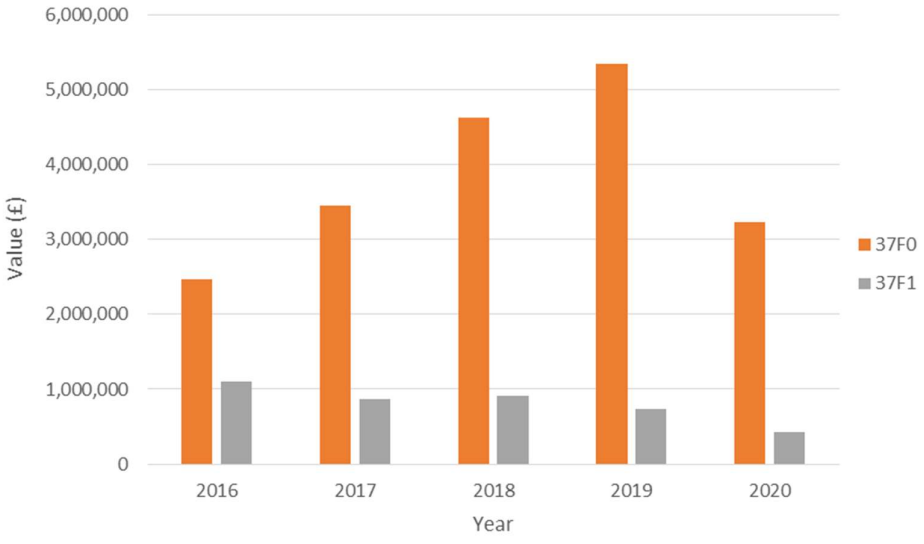


Table 4.16. UK Fleet Landings within ICES Rectangles 37F0 and 37F1 (MMO, 2021)

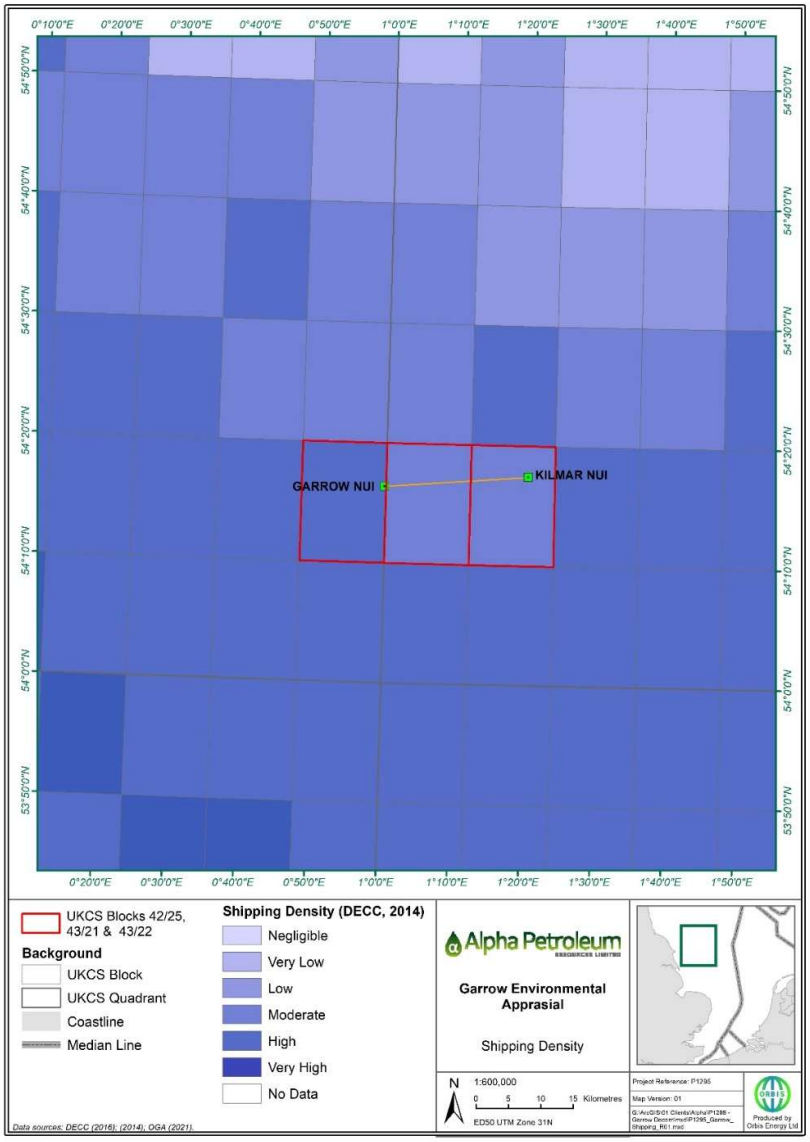
ICES Rectangle	Year	Landed Weight (tonnes)	Value (£)
37F0	2016	1,133	2,461,999
	2017	1,355	3,434,345
	2018	1,734	4,626,447
	2019	3,106	5,138,128

ICES Rectangle	Year	Landed Weight (tonnes)	Value (£)
	2020	1,887	3,154,487
37F1	2016	606	1,109,022
	2017	431	874,187
	2018	366	907,338
	2019	314	666,504
	2020	229	425,898

4.3.2 Shipping

The density of shipping traffic in the SNS is relatively high due to the presence of fishing vessels, some ferries between the UK and the rest of Europe, and cargo and offshore support vessels (DECC, 2016). Shipping activity is considered to be high within Block 42/25, moderate within Block 43/21 and Block 43/22 (DECC, 2014) (refer to Figure 4.10).

Figure 4.10. Shipping density in the vicinity of the Proposed Garrow Infrastructure (DECC, 2014)



4.3.3 Oil and Gas Activities

There is a high level of existing oil and gas activity in this region of the SNS, as illustrated in Figure 4.11. Facilities adjacent to the Garrow platform are listed in Table 4.17.

Table 4.17. Oil and Gas Infrastructure Adjacent to the Garrow Platform (NSTA, 2021)

Name	Distance/ Direction[1]	Operator	Status
Kilmar	22km East, 85°	Energean UK Ltd	Operational and shut-in
Trent	44km East, 85°	Perenco (UK) Limited	Operational
Johnston	29km South Southeast, 151°	Premier Oil E&P UK EU Limited	Operational
Ravenspurn	23km – 34 km South Southwest, 193°	Perenco (UK) Limited	Operational

Name	Distance/ Direction[1]	Operator	Status
Tolmount	51km Southwest,230°	Harbour Energy	Operational
Wollaston	41km Southwest, 245°	Perenco (UK) Limited	Operational
Breagh	51km Northwest, 345°	Ineos Oil &Gas UK	Operational
Whittle	34 km Southwest, 230°	Perenco (UK) Limited	Operational
Garrow Pipelines (PL2160 / PL2161)	Between Garrow and Kilmar	Energean UK Ltd	Dormant
Kilmar Pipelines (PL2162 / PL2163)	Between Kilmar and Trent	Energean UK Ltd	Dormant
Babbage	40km South,170°	NEO Energy	Operational
Cleeton	30 km Southwest, 200 °	Perenco (UK) Limited	Operational

[1] Measured from the Garrow platform

4.3.4 Telecommunication Subsea Cables

The disused 'UK-GERMANY 6 telecom cable (Operator: TAMPNET) is located 35 km north of the Garrow NUI (Figure 4.11) (KIS-ORCA, 2021).

4.3.5 Offshore Renewable Activities

The closest windfarm to the Garrow platform is the Hornsea Project Four (Operator: Ørsted) which is in the pre-planning stage, located approximately 7 km to the south east of the Garrow NUI. The operational Hornsea Project Two wind farm turbine area (Operator: Ørsted Hornsea) is located 40 km south east of the Garrow platform and 32 km to the south east of the Garrow pipelines and the operational windfarm is the Hornsea Project One (Operator: Ørsted), which is located approximately 44 from the Garrow pipelines at its nearest point (see Figure 4.12). The consented Dogger Bank export cable is located 27 km to the north of the Garrow NUI (Crown Estates, 2022).

UKCS Blocks 42/25, 43/21 and 43/22 lie within the Endurance Carbon Capture and Storage (CCS) licence which is owned by BP Exploration Operating Company Limited (Crown Estate, 2022). The Kilmar infrastructure additionally lies within a carbon storage licence area offered for application (SNS Area 1) (NSTA, 2023; Figure 4.12).

4.3.6 Offshore Aggregate and Dredging Areas

There are no aggregate or dredging areas within 40 km of the proposed Garrow infrastructure (MMO, 2022).

4.3.7 Military Activities

UKCS Blocks 42/25, 43/21 and 43/22 lie within a Ministry of Defence (MoD) Royal Airforce Practice and Exercise Area (PEXA) (DECC, 2016).

4.3.8 Wrecks

No protected wrecks or non-designated wrecks are located in the vicinity of the Garrow infrastructure (MMO, 2022).

Figure 4.11. Oil and Gas Infrastructure in the Vicinity of the Proposed Garrow Decommissioning Work

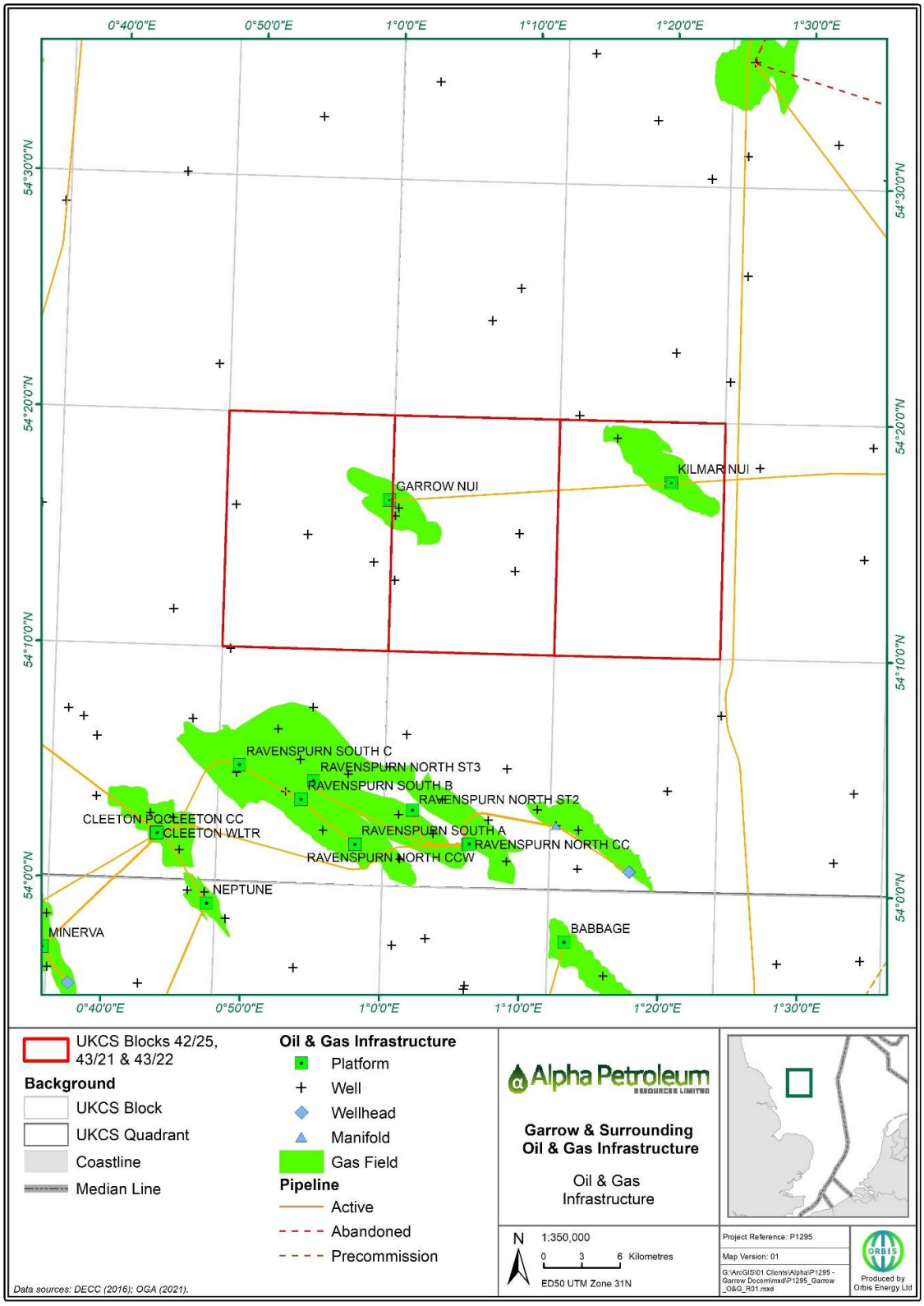
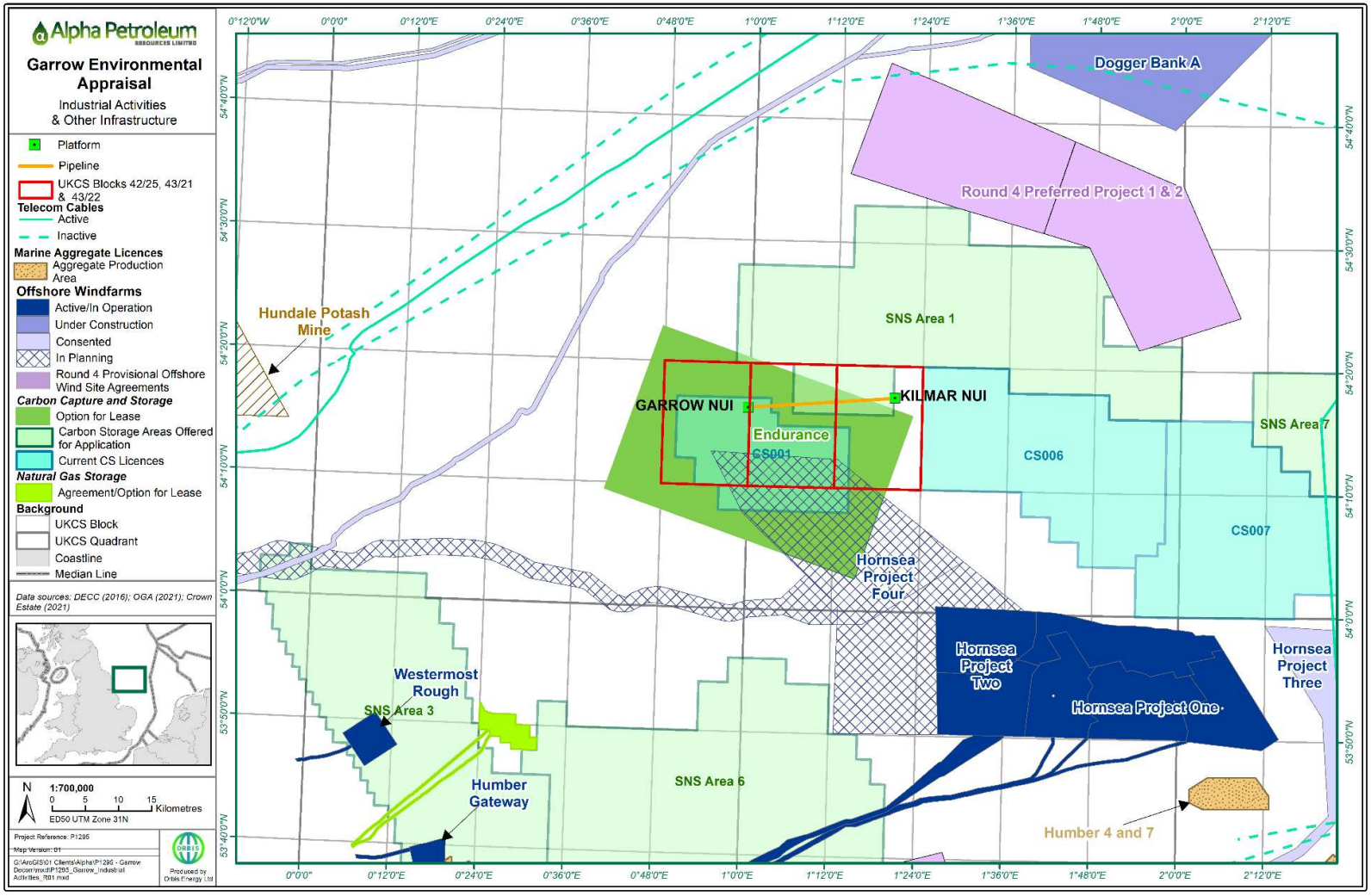


Figure 4.12. Offshore Renewable Energy and Industrial Activities in the Vicinity of the Garrow Infrastructure



5 Environmental Assessment Methodology

This section describes the process followed by EUL to identify and screen the relative significance of the potential environmental impacts associated with the proposed Garrow decommissioning activities.

5.1 Stakeholder Engagement

Table 5.1 provides a summary of the key issues raised during the informal consultations which have been held to date and identifies where these issues have been considered in the EA report. Further details are provided in Section 5 of the combined Garrow DPs.

Table 5.1. Summary of Stakeholder Comments

Stakeholder	Summary of Comments	Addressed in EA Report
Joint Nature Conservation Committee (JNCC)	Stated that they see the Garrow decommissioning project as a potential net benefit project in terms of benthic impacts.	Section 6.2
	Would like to understand the frequency of pipeline surveys that will take place before and after decommissioning. WPRL confirmed that the Garrow route survey is planned in 2022 and will have further route surveys on completion of the decommissioning. The benefit and need for any further surveys after this are yet to be agreed with OPRED.	Section 3.6
	Had concerns about the camera drops along the pipeline and if there were enough. JNCC suggested that photos may be better than grab samples and will be available sooner. Suggest consider going for more photos. JNCC would like to see more details of the rock berms along the pipeline and what the fishing industry's opinions of them are.	Section 4.1
	Would like to see the survey data being used to avoid an overtrawl survey later on. Pointing out that OPRED are against overtrawl, whereas the fishing industry may argue for it.	See NFFO comments below
	JNCC would like include an assessment of the Greater Wash SPA. Suggesting to include the Red Throated Diver bird in the ES and considerations for observing best practise in that respect e.g. directing marine traffic to use the defined shipping lanes as much as possible to avoid disruption	Section 7.3
National Federation of Fishermen's Organisations (NFFO)	NFFO's view on non-intrusive post decom surveys is that they prefer full overtrawl trials with bottom gear only (no nets involved so no risk of damage to nets). This is not in agreement with JNCC's view and ongoing discussions with JNCC/OPRED are continuing. Some incidents of post decom snagging after non-intrusive surveys have been noted.	Section 3.6
	The windfarm activity (in particular Hornsea) has pushed fishing activity further north into the ICES rectangle 37F0 (near Garrow) over the last few years so the same static gear is now used in a smaller area.	Section 4.6.1
Northern Irish Fish Producer's Organisation Limited and SFF	SFF and NiFPO have been consulted and are content given the geographical location of Garrow to let NFFO consult with regards to any fishing interaction with the decommissioning activities.	N/A
Global Marine Group	GMG have confirmed there are no cables within 50km of the decommissioning works.	N/A

5.2 Environmental Impact Identification

In order to identify the potential environmental issues and impacts on the marine environment, which may arise from the proposed Garrow decommissioning activities (both from planned (routine) activities and unplanned (accidental) events), the WPRL decommissioning team as previous field operator, has undertaken a preliminary scoping exercise.

The activities (or aspects) identified during this exercise are summarised in the receptor based activity and events matrix in Table 5.2. An initial high-level assessment of the aspects identified has been undertaken against the significance criteria defined in Section 5.3 to determine whether there is the potential for any of the impacts to result in significant effects on the environment. Impacts are defined as changes to the environment as a direct result of an activity or event and can be either positive or adverse. Effects are defined as the consequences of those impacts upon receptors.

As a final decision on the removal methods associated with the Garrow DPs will be made following an engineering feasibility and commercial tendering process (refer to Section 2), the worse-case scenario in terms of the potential environmental impact has been considered in all instances.

The scoping exercise identified that the following sources of impact could potentially result in significant effects:

- Physical presence;
- Seabed disturbance;
- Underwater noise.

A comprehensive assessment has therefore been undertaken for these aspects, using the significance criteria defined in Section 5.3, the results of which are documented in Section 6. The potential for significant cumulative, in-combination and transboundary impacts has also been assessed in Section 6.

For the following sources of impact, it was considered that none of the resulting effects are likely to be significant:

- Energy use and atmospheric emissions;
- Waste management;
- Marine discharges;
- Accidental events.

These aspects have therefore been scoped out from detailed assessment, as justified in Section 5.4.

In addition, as the Garrow infrastructure is located within the SNS SAC (refer to Section 4.5.6), an assessment has been undertaken to determine whether there will be any likely significant effects on the conservation objectives of these MPAs as a result of the proposed Garrow decommissioning activities, either alone or in-combination with other plans or projects. This assessment is documented separately within Section 7.

Table 5.2. Impact Identification Matrix

Assessment Topic	Project Activity / Unplanned Event	Physical Receptors				Biological Receptors						Human Receptors										
		Seabed Sediments & Features	Water Quality	Air Quality	Climate	Plankton	Benthic Communities	Fish & Shellfish	Seabirds	Marine Mammals	Marine Protected Areas	Shipping	Commercial Fisheries	Oil & Gas Activity	Subsea Cables	Renewable Energy Activity	Cultural Heritage	Military Activity	Disposal, Dredging & Aggregate Activity	Seascape	Tourism & Leisure	Population & Human Health
Physical Presence	- Presence of vessels on location and transiting to / from site								A			A	A									
	- Removal of Garrow platform (topside and jacket) and associated 500m safety zone								A		P	P	P									
	- Legacy of infrastructure decommissioned in situ										A		A									
	- Contingency rock dump to mitigate scour										A		A									
Seabed Disturbance	- Anchoring of LV	A	A				A	A			A											
	- Footprint of jack-up vessel	A	A				A	A			A											
	- Internal dredging and cutting of piles and removal of jacket	A	A				A	A			A											
	- Cutting of pipeline ends and removal of surface laid pipeline sections / tie-in spools	A	A				A	A			A											
	- Removal / redeployment of mattresses and gravel bags	A	A				A	A			A											
	- Leaving in situ of rock dump along the pipelines	A					A	A			A											
	- Contingency rock dump to mitigate scour	A					A	A			A											
	- Use of propellers / DP thrusters on vessels							A		A	A		A									

Assessment Topic	Project Activity / Unplanned Event	Physical Receptors				Biological Receptors						Human Receptors										
		Seabed Sediments & Features	Water Quality	Air Quality	Climate	Plankton	Benthic Communities	Fish & Shellfish	Seabirds	Marine Mammals	Marine Protected Areas	Shipping	Commercial Fisheries	Oil & Gas Activity	Subsea Cables	Renewable Energy Activity	Cultural Heritage	Military Activity	Disposal, Dredging & Aggregate Activity	Seascape	Tourism & Leisure	Population & Human Health
Underwater Noise Emissions	- Use of underwater cutting tools and ROVs							A		A	A		A									
	- Use of geophysical equipment (MBES & SSS) during post decommissioning survey							A		A	A		A									
Energy Use & Atmospheric Emissions	- Power generation on vessels			A	A																	
	- Recycling of materials returned to shore and loss of materials left in situ for future use			A	A																	
Marine Discharges	- Routine vessel discharges to sea		A			A		A	A		A											
	- Potential for introduction of alien species (from ballast water)		A			A		A	A		A											
	- Discharge of residual amounts of chemicals/condensate during pipeline cutting operations		A				A	A			A											
	- Release overtime of contaminants contained within the pipeline material		A				A	A			A											
Waste Management	- Onshore disposal of waste transferred to shore																			A		A
	- Marine growth removal (offshore)	A	A				A	A														
Accidental Events	- Vessel collision (loss of diesel inventory)	A	A			A	A	A	A	A	A	A	A									
	- Dropped objects	A	A				A				A		A									
	- Leak of hydraulic fluid from cutting equipment	A	A			A	A	A	A	A	A		A									

Assessment Topic	Project Activity / Unplanned Event	Physical Receptors				Biological Receptors						Human Receptors										
		Seabed Sediments & Features	Water Quality	Air Quality	Climate	Plankton	Benthic Communities	Fish & Shellfish	Seabirds	Marine Mammals	Marine Protected Areas	Shipping	Commercial Fisheries	Oil & Gas Activity	Subsea Cables	Renewable Energy Activity	Cultural Heritage	Military Activity	Disposal, Dredging & Aggregate Activity	Seascape	Tourism & Leisure	Population & Human Health
Key:																						

	Potentially significant effects (aspects scoped in for further assessment)		No potential for significant effects (aspects scoped out from assessment, see Section 5.4)	**A**	Adverse effect	**P**	Positive effect		No interaction

5.3 Evaluation of Significance Criteria

5.3.1 Planned Activities

For planned activities, the significance of environmental effects has been evaluated by considering the sensitivity of the receptor affected in combination with the magnitude of impact that is likely to arise.

Sensitivity is a function of the value of the receptor (a measure of its importance, rarity and worth), its capacity to accommodate change when a pressure is applied (resistance or tolerance), and its subsequent recoverability (resilience). The criteria presented in Table 5.3 has been used as a guide to determine the sensitivity of receptors.

Table 5.3: Determining Sensitivity

		Resistance and Resilience			
		Very High	*High*	*Medium*	*Low*
Value	*Low*	Low	Low	Medium	Medium
	Medium	Low	Medium	Medium	High
	High	Low	Medium	High	Very High
	Very High	Medium	High	Very High	Very High

Definitions:

Resistance and Resilience	
Very High:	Highly adaptive and resilient to pressure. High recoverability in the short-term.
High:	Some tolerance / capacity to accommodate pressure. High recoverability in the medium-term.
Medium:	Limited tolerance / capacity to accommodate pressure. Recoverability is slow and/or costly.
Low:	Very limited or no tolerance / capacity to accommodate pressure. Recovery is unlikely or not possible.
Value	
Very High:	Very high value and/or of international importance.
High:	High value and/or of national importance.
Medium:	Moderate value and/or of regional importance.
Low:	Low value and/or of local importance.

The **magnitude of impact** considers the characteristics of the change that is likely to arise (e.g. a function of the spatial extent, duration, reversibility and likelihood of occurrence of the impact) and can be adverse or positive. The criteria presented in Table 5.4 has been used as a guide to define the magnitude of impact.

Table 5.4: Determining Magnitude of Impact

Magnitude	Definition
Substantial	Permanent or long-term (>5 years) change in baseline environmental conditions, which is certain to occur. Impact may be one-off, intermittent or continuous and/or experienced over a very wide area (i.e. international and/or transboundary in nature). Impact is likely to result in environmental quality standards or threshold criteria being routinely exceeded.
Major	Medium to long-term (1 – 5 years), reversible change in baseline environmental conditions, which is likely to occur. Impact may be one-off, intermittent or continuous and/or experienced over a wide area (i.e. national in scale). Impact could result in one-off exceedance of environmental quality standards or threshold criteria.
Moderate	Short to medium-term (< 1 year), temporary change in baseline environmental conditions, which is likely to occur. Impact may be one-off, intermittent or continuous and/or regional in scale (i.e. beyond the area surrounding the Project site to the wider region). Impact is unlikely to result in exceedance of environmental quality standards or threshold criteria.
Minor	Short-term (< 1 week), temporary change in baseline environmental conditions, which could possibly occur. Impact may be one-off, intermittent and/or localised in scale, limited to the area surrounding the proposed Project site. Impact would not result in exceedance of environmental quality standards or threshold criteria.
Negligible	Immeasurable or undetectable changes (i.e. within the range of normal natural variation).

The overall **significance** of an effect has been determined by cross referencing the sensitivity of the receptor with the magnitude of impact, using the matrix shown in Table 5.5.

Table 5.5: Significance Evaluation Matrix (Planned Activities)

		Magnitude of Impact				
		Negligible	**Minor**	**Moderate**	**Major**	**Substantial**
Receptor Sensitivity	**Low**	Negligible	Minor	Minor	Minor	Minor / Moderate[1]
	Medium	Negligible	Minor	Minor	Moderate	Moderate / Major[1]
	High	Negligible	Minor	Moderate	Major	Major
	Very High	Negligible	Minor / Moderate[1]	Moderate / Major[1]	Major	Major

[1] The choice of significance level is based upon professional judgement and has been justified in the assessment text.

In the context of this assessment, effects classed as **Major** or **Moderate** are considered to be significant and therefore mitigation measures are required to be identified in order to prevent, reduce or offset adverse significant effects or enhance positive effects. The overall significance of the effect is then re-evaluated, taking the mitigation measures into consideration, to determine the residual effect utilising the methodology outlined above.

Effects classed as **Minor** are not considered to be significant and are usually controlled through good industry practice.

Effects classed as **Negligible** are also not considered to be significant.

5.3.2 Unplanned Events

For unplanned events, such as accidental hydrocarbon releases, significance has been determined using a risk assessment approach, where the likelihood (probability) of the unplanned event occurring is considered against the consequence (significance of effect) if the event was to occur.

The **consequence (significance of effect)** has been determined using the methodology for planned events as described in Section 5.3.1 above. The likelihood of an unplanned event occurring has been determined using the criteria presented in Table 5.6 as a guide.

Table 5.6: Determining Likelihood of Occurrence

Likelihood	Definition
Extremely Rare	Event is extremely unlikely to occur during the Project, given good industry practice. Frequency of event: 1×10^{-4}.
Rare	Event is very unlikely to occur during the Project, given good industry practice. Frequency of event: 1×10^{-3}.
Unlikely	Event is unlikely to occur during the Project, given good industry practice. Frequency of event: 1×10^{-2}.
Possible	Event could occur during the Project, based on industry data. Frequency of event: 1×10^{-1}.
Likely	Event is likely to occur at least once during the Project. Frequency of event: > 1

A risk category (low, medium or high) has then been assigned to the unplanned event using the matrix shown in Table 5.7.

Table 5.7: Significance Evaluation Matrix (Unplanned Events)

		Consequence (Significance of Effect) [1]			
		Negligible	Minor	Moderate	Major
Likelihood of Event	Extremely Rare	LOW	LOW	MEDIUM	MEDIUM
	Rare	LOW	LOW	MEDIUM	MEDIUM
	Unlikely	LOW	LOW	MEDIUM	HIGH
	Possible	LOW	MEDIUM	MEDIUM	HIGH
	Likely	LOW	MEDIUM	HIGH	HIGH

In the context of this assessment, **High** risk events are considered to be significant and are unacceptable.

Medium risk events are also considered to be significant, unless it can be demonstrated that the risk has been reduced to as low as reasonably practicable (ALARP) through mitigation measures and good industry practice.

Low risk events are not considered to be significant, but should still be controlled through good industry practice.

5.4 Aspects Scoped Out From Detailed Assessment

5.4.1 Energy Use and Atmospheric Emissions

Atmospheric emissions will be produced during the proposed Garrow decommissioning activities as a result of the fuel consumed by offshore vessels, diesel-powered equipment and generators.

The main environmental effects of the emission of gases to the atmosphere are:

- Direct or indirect contribution to global warming (CO, CO_2, CH_4 and N_2O); and
- Contribution to photochemical pollutant formation and local air pollution (particulates, NOx, SO_2, VOCs).

Estimated emissions from the proposed decommissioning activities are summarised in Table 5.8.

Table 5.8. Estimated Atmospheric Emissions from Garrow Decommissioning Activities

Activity [1]	Emissions (tonnes) [2]							
	CO_2	CO	NO_X	N_2O	SO_2	CH_4	VOC	CO_2e
Topside Removal & P&A Operations	4,035.20	19.80	74.90	0.28	5.04	0.23	2.52	4,124
Jacket Removal	2,016.00	9.89	37.42	0.14	2.52	0.11	1.26	2,060
Decommissioning of Pipelines and Stabilisation Material	940.80	4.62	17.46	0.06	1.18	0.05	0.59	961
Total:	**6,992.00**	**34.31**	**129.78**	**0.48**	**8.74**	**0.39**	**4.37**	**7,145**

[1] See assumptions relating to vessel types, timings and fuel consumption detailed in Section 3.
[2] Emissions factors from DECC (2008).

It is predicted that the atmospheric emissions generated will result in localised and short term impacts on air quality, with prevailing metocean conditions expected to lead to the rapid dispersion and dilution of the emissions.

The contribution to UKCS and global atmospheric emissions will be negligible. To place this in context, the estimated CO_2e emissions predicted to be generated by the proposed Garrow decommissioning operations equate to approximately 0.04% of the total UK offshore CO_2e emissions in 2020 (17.06 Mt CO2e tonnes; OEUK, 2021c) and 0.002% of the UK net total CO_2e emissions in 2020 (414.1 Mt CO2e; DESNZ, 2021).

To minimise the emissions generated, EUL will look to reduce vessel time in the field as far as practicable and will make use of vessel synergies where possible. In addition, EUL's contractor selection process will aim to ensure that the engines, generators and other combustion plant on the vessels to be used during the proposed decommissioning activities are maintained and correctly operated to ensure that they work as efficiently as possible.

EUL has therefore concluded that impacts arising from energy use and atmospheric emissions do not warrant further assessment.

5.4.2 Marine Discharges

Routine discharges to sea from the vessels used during the proposed decommissioning activities (e.g. the discharge of food waste, bilge water and grey water) has the potential to cause short-term, localised organic enrichment of the water column and an increase in biological oxygen demand. This could contribute to a minor increase in plankton and attract fish to the area. However, food waste will be macerated to increase the rate of dispersion and biodegradation at sea and waste water will be treated appropriately before being discharged to sea, in accordance with the requirements of the MARPOL convention.

Ballast water discharges will be in accordance with the International Maritime Organisation Ballast Water Management Convention, including a ballast water plan and log book.

During pipeline cutting operations there may be a small release of any residual chemicals / condensate remaining within the pipelines. However, as stated in Section 3.4.1, as part of the preparatory work the export pipeline and chemical injection pipeline will be flushed and depressurised. It is anticipated that agreed cleanliness criteria will be aligned with accepted industry thresholds for discharge of oil in produced water, under The Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005 (as amended), which is 30 mg/l or less. As such, any release of chemicals / condensate will be minimal and is anticipated to dissipate before it reaches the surface with no long-term persistence expected.

In addition, as the pipelines will be decommissioned in situ they will degrade overtime and contaminants contained within the pipeline material (e.g. coating) may be released. Any releases are expected to occur in very small quantities and over a long period of time. Additionally, since the pipelines are fully trenched and buried, the pathway for contaminant releases will be limited. Given the small quantities of contaminants expected to be released and the long-term degradation of the pipeline left in situ, no significant effects on the marine environment are predicted.

Given the above, EUL has therefore concluded that impacts arising from marine discharges do not warrant further assessment.

5.4.3 Waste Management

The impacts of waste management are largely onshore and therefore outside the scope of this EA report; however, EUL will ensure the principles of the Waste Management Hierarchy are followed during the proposed decommissioning activities, focusing on the reuse and recycling of wastes where possible, that licensed waste contractors are used and a project Waste Management Plan is in place to ensure compliance with relevant waste regulations. In addition, good housekeeping standards will be maintained on board all vessels.

Any waste disposed of outside of the UK will be in accordance with the Transfrontier Shipment of Waste Regulations 2007.

The presence of NORM is not expected, but if encountered EUL will ensure appropriate Radioactive Substance Regulation (RSR) permits are in place and conditions that dictate the management and control of radioactive waste are met.

Marine growth will be removed by high pressure cleaning offshore, only where necessary and practicable. The detached marine growth will fall to the seabed or be dispersed by currents and will degrade naturally. There may be a temporary increase in turbidity, nutrient enhancement and an increase in biological oxygen demand in the vicinity of the release, but any effects will be localised and transient given the dispersive environment that exists offshore (OEUK, 2013). The majority of marine growth will be removed onshore at a dismantling yard, with appropriate odour control implemented through an odour management plan.

On this basis, ARPL has concluded that no further assessment of waste management is necessary.

5.4.4 Accidental Events

5.4.4.1 Accidental Release of Hydrocarbons

Prior to the proposed decommissioning activities commencing, the Garrow facilities will be made hydrocarbon free. As such, the source of a worst case accidental release of hydrocarbons to sea will be from the loss of diesel inventory from a vessel in the unlikely event of a collision. Of the types of vessels which may be utilised during the proposed decommissioning activities, the LV typically has the largest fuel inventory. This could be in the region of 500 to 800 m^3 of diesel, although the LV's fuel inventory is likely to be split between a number of separate fuel tanks, significantly reducing the potential of an instantaneous release of the full inventory.

The Tors Offshore OPEP contains modelling of an instantaneous release of 800 m^3 of diesel from a vessel at the Garrow platform and indicates that the probability of a diesel release beaching on the UK coastline is highest in Spring (up to 20%), with the shortest arrival time after 2.7 days on the Yorkshire and The Humber coastline. The maximum mass accumulated onshore across all beaching locations in any one season is 192 m^3 after 15 days. However, diesel is a light oil, containing a large percentage of light and volatile compounds. Once spilt diesel is likely to remain on the sea surface and be subject to high rates of evaporation. It also has a low asphaltene content which prevents emulsification. A release of diesel is therefore not expected to persist in the marine environment for a prolonged period of time. The modelling predicts that a release of diesel at the Garrow location will not cross into international waters.

An approved OPEP will be in place for the proposed Garrow decommissioning activities, as required by the Merchant Shipping (Oil Pollution Preparedness, Response and Co-Operation Convention) Regulations 1998 (as amended). In addition, the risk of collision is low as the majority of vessels required for the proposed decommissioning activities will be present on location within the existing 500m safety exclusion zone surrounding the Garrow platform minimising the risk of a collision. This zone is clearly marked on navigation charts and has been in place for a number of years. Notifications will also be made to regular users of the area via Notices to Mariners, NAVTEX/NAVAREA warnings and Kingfisher bulletins. Any spills from vessels in transit and working outside of existing 500m zones are covered by separate Shipboard Oil Pollution Emergency Plans (SOPEPs).

Considering the above, EUL has concluded that the potential impacts from an accidental release of hydrocarbons during the proposed decommissioning activities do not require further assessment.

5.4.4.2 Dropped Objects

The potential for dropped objects to occur is most likely to arise from lifting operations. However, dropped object procedures are industry-standard and will be employed throughout the proposed operations. All unplanned losses in the marine environment will be attempted to be remediated, and notifications to other mariners will be sent out. Post-decommissioning debris clearance surveys will aid in the identification of any dropped objects should they occur. As such, ARPL has concluded that impacts from unplanned loss of materials to the sea do not require further assessment.

5.4.4.3 Leak of Hydraulic Fluid from Cutting Equipment

The proposed Garrow decommissioning activities require the use of subsea hydraulic cutting tools and ROVs that could fail and result in a release of a small number of litres of hydraulic fluid into the marine environment. However, in the event this did occur, it is anticipated that the hydraulic fluid would be rapidly dispersed in the marine environment given the highly dynamic nature of the area.

To minimise the risk of a release, appropriate maintenance and pre-use checks on hydraulic equipment and ROVs will be undertaken. In addition, where possible equipment with automatic hydraulic shut-off will be used to minimise the volume of fluid released in the event of a hydraulic line failure. ARPL has therefore concluded that impacts from a leak of hydraulic fluid do not require further assessment.

6 Environmental Assessment

This section documents the detailed assessment undertaken for those impacts that were identified in the scoping exercise as potentially resulting in significant effects.

6.1 Physical Presence

6.1.1 Potential Impacts to Other Sea Users

The vessels required for the removal of the platform will be present on location within the existing 500 m safety exclusion zone surrounding the Garrow platform. An existing 500 m safety exclusion zone also surrounds the Kilmar platform. These zones are clearly marked on navigation charts and have been in place for a number of years. If an anchored LV is used to remove the platform, the anchor lines are likely to extend outside the exclusion zone, although this should not present a significant hazard to shipping or fishing vessels as they are unlikely to transit immediately adjacent to an existing exclusion zone. In addition, once the Garrow platform has been removed, the 500 m safety exclusion zone surrounding the platform will be withdrawn. This will result in a positive impact as an area of circa 0.79 km^2 will be made available to other sea users.

The potential for significant impacts to other sea users is therefore limited to the risk of fishing gear snagging on infrastructure that is being decommissioned in situ, particularly in the event free spans were to develop along the route of the pipelines. The sensitivity of commercial fishing to snagging is considered to be **Medium** in the vicinity of the Garrow infrastructure. The receptor has a medium value as fishing effort varies from low to relatively high compared to the wider region and, due to the potential significance of the threat associated with snagging, resistance and resilience is medium. The magnitude of the impact is considered to be **Moderate** as snagging can result in damage to fishing gear, loss of fishing time/access, and risks to crew health and safety.

To minimise the risk of snagging, EUL is proposing to remove any exposed subsea infrastructure (surface laid spools and pipeline sections and their associated mattress protection). Mattresses will be redeployed and deposited over the cut ends of the pipelines to prevent a possible snagging point, if the cut ends cannot easily be covered using the existing rock dump. If used, these mattresses will be flush with the seabed and overtrawlable. The majority of the pipelines are currently buried to a depth well in excess of 0.6 m and no pipeline exposures have been seen in any of the operational surveys undertaken since the lines were installed. In a flooded condition (as would be the decommissioned left in situ state) both pipelines are significantly negatively buoyant and so no upward movement of the pipelines would be expected. The likelihood of free spans developing or the stabilisation material decommissioned in situ becoming a snagging hazard is therefore considered to be **Extremely Rare**.

In the event that contingency rock dump is required to mitigate scour either prior to or during the rig/JUWB decommissioning works, once the rig/JUBW has departed the location, the profile of the rock adjacent to the spudcan locations will allow fishing nets to trawl over the rock unobstructed. Suitably graded rock will be used to minimise the risk of snagging fishing gear.

Given the above, the risk to commercial fishing from the legacy of the Garrow infrastructure decommissioned in situ is therefore predicted to be **Low**.

6.1.2 Mitigation Measures

EUL will adopt the following measures to ensure the impacts to other sea users from the physical presence of the decommissioning vessels and legacy of infrastructure decommissioned in situ are minimised:

- Where required, Consent to Locate permits will be in place, existing collision risk management plans will be reviewed and notifications of the proposed decommissioning activities will be made to regular users of the area via Notices to Mariners, NAVTEX/NAVAREA warnings and Kingfisher bulletins;

- If the jacket is removed in a separate campaign to the topside, a solar navaid / foghorn will be installed to warn other sea users of its presence;
- Details of any infrastructure decommissioned in situ will be publicised through Notices to Mariners and marked on navigation and fisheries charts;
- A post-decommissioning survey will be undertaken around the Garrow platform 500m radius and a (minimum) 100m corridor (50m either side) along the route of the Garrow pipelines where decommissioning activities have taken place to identify and recover any oil and gas seabed debris and confirm the seabed has no trawling obstructions;
- A post-decommissioning monitoring programme covering the pipelines and associated stabilisation features remaining in situ will be agreed with OPRED.

6.1.3 Residual Effects

Residual effects on other sea users (commercial fishing and shipping) resulting from the physical presence of vessels on location at Garrow and transiting to / from site are **Negligible** and not significant, particularly given the short duration of the proposed decommissioning activities and the operational control measures which will be in place. In addition, removal of the Garrow platform and associated 500 m safety exclusion zone will result in positive effects as the area will become available to other sea users again.

The risk to commercial fishing from the legacy of the Garrow pipelines and stabilisation material decommissioned in situ and contingency rock dump is predicted to be **Low**, but ALARP as the generation of snagging risks such as free spans is very unlikely, considering historic data, the burial depth of the pipelines and the mitigation measures that will be in place.

6.1.4 Potential Impacts to Seabirds

The physical presence of vessels associated with the decommissioning activities may potentially cause displacement and/or other behavioural responses in seabirds foraging in the vicinity of the Garrow infrastructure. However, given the temporary and short term presence of the decommissioning vessels and in the context of other vessel activity in the area, significant disturbance or displacement of foraging seabirds from the area is unlikely. Considering the availability of alternative habitat in the surrounding area, no significant impacts on foraging seabirds are therefore predicted.

EUL is aware, however, that the physical presence of the Garrow platform, particularly if it enters a Lighthouse Mode phase, has the potential to provide nesting habitat to breeding seabirds, which forage in the SNS. Black-legged kittiwake have been recorded on breeding ledges of the platform in June 2021, although no breeding pairs of kittiwake or trace nests were observed (see Section 4.5.4). However, the presence of nesting kittiwake during the breeding season (April to September) in future years cannot be ruled out.

The removal of the Garrow topside therefore has the potential to result in significant impacts to seabirds nesting on the platform, if present in future years, through disturbance by operational movement and noise. Once the chicks start hatching in June they are particularly vulnerable to human disturbance that may spook them from the nest, resulting in them falling or being pushed to sea.

All wild birds are protected under the Wild Birds Directive, which is transposed for the UK offshore area by The Conservation of Offshore Marine Habitats and Species Regulations 2017. Under Part 3 (40) of the 2017 Regulations it is an offence to deliberately:

- Capture, injure, or kill any wild bird;
- Take, damage or destroy the nest of any wild bird while that nest is in use or being built; or
- Take or destroy an egg of any wild bird.

The sensitivity of nesting birds on the Garrow platform is considered to be **Very High**. Due to the conservation status of kittiwake, nesting birds have a very high value and their tolerance to

accommodate pressure is limited with a medium resistance and resilience. The magnitude of any disturbance is considered to be **Moderate** with nesting potentially abandoned for the year/season or chicks being spooked from the nest. Effects on nesting birds from the removal of the Garrow platform, if their presence is recorded during the breeding bird season, are therefore predicted to be **Moderate** and significant before mitigation measures are applied.

6.1.5 Mitigation Measures

The following measures will be put in place during the Garrow decommissioning activities to ensure any adverse effects on nesting seabirds are mitigated:

- Installation of nesting bird deterrents will be considered when the preparatory work is being undertaken to discourage birds from nesting on the platform, if it enters the Lighthouse Mode phase;
- EUL will continue to check for the presence of nesting birds on scheduled routine visits to the Garrow platform, noting there is not a history of nesting birds on the platform. If the topside is to be removed during the breeding season, data will be reviewed to confirm the absence of nesting birds and, if considered necessary, the platform will be checked by a qualified ornithologist prior to removal. If nesting birds are observed, OPRED will be consulted to ascertain if it is possible for a Wild Birds Licence to be granted to allow the works to go ahead;
- If any other decommissioning activity (e.g. preparatory works) is to be undertaken on the topside during the breeding season, the platform will be checked for nesting birds prior to commencing work. OPRED will be informed of the results and, if necessary, a Wild Birds Licence applied for. In the event nesting birds are observed, EUL currently propose to erect signage in the area advising offshore personnel of the nests and personnel will be briefed on instructions to minimise possible disturbance to the juveniles and attending adults. The nests will also be monitored on a daily basis to record bird presence and activity.

6.1.6 Residual Effects

Given the proposed mitigation measures, coupled with the fact that nesting birds have previously not been recorded on the Garrow platform, residual effects on nesting birds from the removal of the Garrow platform are predicted to be **Negligible** and not significant.

6.2 Seabed Disturbance

6.2.1 Quantification of Seabed Disturbance

The following Garrow decommissioning activities have been identified as sources of potential seabed disturbance:

- LV anchoring and anchor line scour for removal of the topside and jacket;
- Contingency rock dump to mitigate scour either prior to or during the rig/JUWB decommissioning works;
- Footprint of jack-up vessel used to P&A the platform wells;
- Removal of the jacket following internal dredging and cutting of piles;

Cutting of pipeline ends, removal of surface laid pipeline sections / tie-in spools, including mattresses and gravel bags at the approaches to the Garrow and Kilmar platforms and possible redeployment of mattresses to protect the cut ends of the pipelines (a single Mattress at each cut end may remain to prevent a snagging hazard if the cut end is exposed and not easily covered by the existing rock dump. The mattresses will be moved, the pipelines cut, and any remaining mat will be level with seabed and overtrawlable).Table 6.1 provides an estimate of the total area of seabed likely to be disturbed by the above listed decommissioning activities, which equates to ca. 79,129 m^2 (0.079 km^2).

Of this total 63,129 m^2 (0.06 km^2) will result in a temporary disturbance and 16,000 m^2 (0.016 km^2) will result in a permanent disturbance, namely as a result of the rock dump to mitigate scour. In addition, there will be a legacy impact from the existing rock dump along the pipelines which will be decommissioned in situ, as well as any mattresses redeployed to cover the cut pipeline ends, if required. The area of seabed currently covered by rock dump is ca. 1,280 m^2 (0.001 km^2), based on an assumed width of 160 m by 8 m. The redeployment of stabilisation material, if required, is likely to impact an area of ca. 48 m^2 (< 0.00005 km^2), on the assumption one (6 m x 4m) mattress is left at the Garrow end and one (6 m x 4 m) mattress is left at the Kilmar end.

Of note is that there are no accumulations of historic drill cuttings associated with the Garrow wells as these have been dispersed by the energetic currents of the area.

Table 6.1. Estimated Area of Seabed Disturbed from Garrow Decommissioning Activities

Activity	Description of Impact	Estimated Area Impacted	
		(m^2)	(km^2)
Use of an anchor moored LV to remove topside and jacket	Although selection of a LV is still to be made, it is assumed that the LV will have eight anchors (ca. 4 m by 4 m in dimension) and associated anchor chain/cable (each extending up to 1,200 m from the LV). Each anchor chain/cable will have a 600 m length section in contact with the seabed, which will be subject to lateral movement of ca. 5 m. This equates to an impact area of 16 m^2 per anchor and 3,000 m^2 per anchor chain/cable. As a worst case, it is assumed the topside and jacket will be removed separately and therefore the estimated area of impact accounts for disturbance from two anchored LVs.	48,256	0.0483
Use of jack-up vessel to P&A the platform wells[1]	Although selection of a jack-up vessel is still to be made, it is assumed that the vessel will have four spud cans, each of which has a radius of 7 m, impacting an area of 154 m^2, equating to 616 m^2 for all four. It is assumed that the vessel will be jacked down on the seabed at the Garrow platform. In addition, the vessel may also need to deploy anchors to assist in final positioning. As a worst case, it is assumed that four anchors (ca. 4m by 4m in dimension) and associated chain/cable (each extending 600m from the vessel, with the entire length laid on the seabed and subject to a lateral movement of ca. 5 m) will disturb the seabed. This equates to an impact area of 16 m^2 per anchor and 3,000 m^2 per anchor chain/cable. Once the vessel is in position, the anchors (including the wires and chains) will be recovered for the duration of the P&A operations. It is not considered that there will be a need to deposit stabilisation material around the spud cans, due to the underlying clay layer and the fact it has not previously been required at the Garrow location.	12,680	0.0126
Contingency rock dump to mitigate scour either prior to or during the rig/JUWB decommissioning works	As a worst case contingency scenario against scour either prior to or during the rig/JUWB decommissioning works a total of up to 85,000 tonnes of rock could be required to be placed over an area of 16,000 m^2 adjacent to the existing jacket legs to prevent sinkage of the rig/JUWB legs into the seabed.	16,000	0.016
Removal of the jacket following internal dredging and cutting of piles	The piles will be dredged to remove the soil inside the jacket skirts to a depth of ca. 4 m below the seabed to provide access for the abrasive cutting tool. As no dredging is planned around the exterior of the jacket, disturbance to the seabed will primarily occur when the jacket is lifted from the seabed and will be within close proximity to the existing physical footprint of the jacket (23 m by 23 m). To facilitate the release of the jacket from the seabed, it is estimated that an area of ca. 729 m^2 will be disturbed during removal operations, based on a contingency buffer of 2 m around the jacket footprint. All the abrasive material will be deposited in the hole and not the surrounding area. Once the jacket has been removed, the piles cut at least 3 m below the seabed will result in depressions, but these are expected to be temporary and will refill with natural backfill given the highly dynamic nature of the area.	729	0.0007

Activity	Description of Impact	Estimated Area Impacted	
		(m^2)	(km^2)
Cutting of pipeline ends, removal of surface laid pipeline sections / tie-in spools, including mattresses and gravel bags at the approaches to the Garrow and Kilmar platforms and redeployment of mattresses to protect the cut ends of the pipelines (if required)	The Garrow and Kilmar riser to pipeline spool sections will be cut (using either shear cutting or diamond wire cutting tools) to allow recovery of the Garrow jacket and isolate the pipeline from the Kilmar platform. Mattresses and gravel bags will be removed to allow access to cut the surface laid pipeline/spool sections. These sections will then be removed using a vessel crane. In total it is assumed that the length of pipeline / tie-in spool pieces to be removed is ~70 m at Garrow and ~85 m at Kilmar. Based on the mattress size (6 m x 4 m) and a contingency buffer of 2 m around each mattress to account for potential disturbance during their removal, it is estimated that an area of ca. 1,464 m^2 will be disturbed. The removal of the pipeline / tie-in spool pieces underneath the mattresses and the redeployment of mattresses to protect the cut ends of the pipelines, if required, will not result in additional seabed disturbance.	1,464	0.0015
	Total Area of Seabed Impacted:	**79,129**	**0.079**

[1] Although the P&A operations will be consented via appropriate environmental permits and consents under the OPRED PETS UK Energy Portal, for completeness the area of seabed disturbed by the jack-up vessel has been accounted for in the above table.

6.2.2 Potential Impacts to Seabed Communities

Seabed disturbance will result in direct physical effects on benthic fauna, which may include mortality as a result of physical trauma and smothering by resuspension and settlement of natural seabed sediments.

Physical disturbance of the seabed resulting from the removal of infrastructure from the seabed, temporarily placing materials and equipment on the seabed and anchoring of the LV is likely to cause displacement or mortality of benthic species, such as sessile organisms, that are unable to move out of the impacted area. However, species in highly dynamic, tidally-influenced areas such as those found in the shallow waters of the SNS, are generally tolerant of physical disturbance (DOER, 2000). With the exception of the legacy impact from the stabilisation material decommissioned in situ and the permanent impact arising as a result of the contingent rock dump to mitigate scour, the proposed Garrow decommissioning activities are transient and, as such, it is expected that recovery of affected areas of seabed will be relatively rapid once the activities have been completed. Recolonisation of the affected areas is anticipated to take place in a number of ways; including mobile species moving in from the edges of the area, juvenile recruitment from plankton or from burrowing species digging back to the surface. The majority of seabed species recorded from the area are known, or believed to have, short lifespans (a few years or less) and relatively high reproductive rates, indicating the potential for rapid population recovery, such that any effects will be temporary. Species with opportunistic life strategies, are likely to recolonize the disturbed areas first (Tillin, 2016). For example, *Spiophanes bombyx*, the most abundant taxa recorded in the 2022 Garrow study, has a short life span, high dispersal potential and high reproductive rate (Niermann et al., 1990).

The proposed decommissioning activities will also lead to an increase in turbidity through sediment resuspension resulting in smothering of sensitive benthic species. As previously noted, the Garrow platform is located within a highly dynamic area with strong near-seabed currents and highly mobile sediments (DECC, 2016). The fauna found here are therefore robust infauna that are adapted to frequent disturbances and natural fluctuations in sediment loading and resuspension. Where sedimentation does impact negatively on benthic species, consequences are likely to be short-lived as most of the smaller sedentary species (such as polychaete worms) have short lifecycles and recruitment of new individuals from outside of the disturbed area will be rapid (Tillin and Tyler-Walters, 2014).

Retrieval of mattresses and gravel bags at the approaches to the Garrow and Kilmar platforms will result in hard / coarse substratum habitats being replaced by sediment habitats, more typical of this area of the SNS. As a result, there will be localised changes in benthic communities from epifaunal species that can colonise hard substrata to those that favour of soft sandy sediments.

Given the above, the sensitivity of seabed communities to seabed disturbance in the vicinity of the Garrow location is considered to be **Medium**, with a very high value due to some species being of international importance and very high resistance and resilience. The majority of seabed species recorded from the area are known to have short lifespans (a few years or less) and relatively high reproductive rates, indicating the potential for rapid population recovery. The magnitude of impact is considered to be **Minor**, due to the localised and temporary nature of the predicted impacts and the relatively small area of seabed disturbed (ca. 0.06 km^2). Therefore, physical effects on seabed communities due to seabed disturbance are predicted to be **Minor** and not significant.

In addition to the temporary impacts assessed above, there will be a legacy impact from the stabilisation material which will be decommissioned in situ, including the redeployment of any material required to protect the cut ends of the pipelines, if required. There will also be a permanent impact in the event rock dump is required to be deposited on the seabed to mitigate scour. The sensitivity of seabed communities in the vicinity of the Garrow location to the legacy / permanent impact is considered to be **Very High**, with a very high value due to some species being of international importance and low resistance and resilience, given that the changes will be permanent. It is estimated that this will permanently disturb an area of ca 0.017 km^2. Although the hard substrate will permanently change the habitat type and associated fauna present, the

scale of the impact is **Negligible** considering the very large extent of sandy seabed available in the SNS. Effects on seabed communities are therefore predicted to be **Negligible**.

In all cases, the scale of changes to the seabed and its fauna are such that effects on higher trophic levels (e.g. fish and marine mammals), and any related effect on species of commercial interest are **Negligible**.

6.2.3 Mitigation Measures

The following measures will be adopted to ensure that seabed disturbance and its impacts are minimised:

- Jacket legs will be cut internally, to avoid seabed disturbance from external excavation;
- Where vessels are required to hold position for only short duration, dynamic positioning (DP) vessels will be used in favour of moored vessels;
- No new mattresses or gravel bags will be placed on the seabed.
- If required for spudcan support, rock will be carefully placed over the designated areas of the seabed by the use of a fall pipe system. This will control the profile of the rock covering and ensure accurate placement of the rock on the seabed within the planned footprint with minimal spread over adjacent sediment, minimising seabed disturbance.

6.2.4 Residual Effects

Based on the nature of the seabed habitats and species present in the vicinity of the Garrow infrastructure, the comparatively small area of seabed that will be impacted by the proposed decommissioning activities (ca. 0.06 km^2 will be temporary disturbed and ca. 0.017 km^2 will be subject to a permanent loss of habitat from the stabilisation material decommissioned in situ and the contingent rock dump), residual effects on seabed communities are predicted to be **Minor** to **Negligible** and not significant.

6.3 Underwater Noise Emissions

The potential effects of underwater noise emissions on marine organisms depends on the characteristics of the sound (e.g. type, intensity, spectra, duration), the physical characteristics of the environment in which sound propagates, the acoustic sensitivity of the receiver, and their interaction in space and time.

Marine fauna use sound for navigation, communication and prey detection (NMFS, 2016; Southall *et al*., 2007; Richardson *et al.,* 1995). Therefore, the introduction of anthropogenic underwater sound has the potential to impact on marine animals if it interferes with the animal's ability to use and receive sound. Potential effects range from masking biological communication and causing small behavioural reactions, to chronic disturbance, injury and mortality (OSPAR, 2009c).

The most sensitive marine fauna to underwater noise are fish and marine mammals. A range of fish species use the Garrow area for nursery and/or spawning grounds at different times of the year including anglerfish, blue whiting, cod, hake, herring, horse mackerel, lemon sole, ling, mackerel, *Nephrops*, plaice, sandeel, sole, sprat, spurdog, and whiting (Coull *et al.*, 1998 and Ellis *et al.,* 2012). Harbour porpoise, minke whale, pilot whale, white-beaked dolphin and white-sided dolphin are marine mammals that have been observed or identified as most likely to be present in the Garrow area (see Section 4.5.5).

6.3.1 Sources of Underwater Noise Emissions

The potential sources of underwater noise from the Garrow decommissioning activities have been identified as:

- Vessel operations (e.g. use of propellers / DP thrusters);
- Use of underwater cutting tools and ROVs;

- Use of geophysical equipment during post decommissioning survey.

6.3.1.1 Vessel Operations

The Garrow decommissioning activities will mobilise a variety of vessels, including the LV, jack-up rig, DSV / MSV, AHV, barge and tugs. Large vessels (greater than 100 m length, such as the LV) have sound pressure levels within the range of 180-190 dB re 1 µPa, whilst most support vessels, assuming a medium-size ship (50 – 100 m in length), have sound pressure levels within the range of 165-180 dB re 1 µPa (OSPAR, 2009c). The highest sound levels are expected from short-term energy-demanding activities, for example when using DP thrusters to position vessels on location (Genesis, 2011). The majority of the acoustic energy from vessels is below 1 kHz, typically within the 50-300 Hz range, although cavitation from propellers produces sounds at frequencies of between 1 kHz and 125 kHz (Genesis 2011; Hermannsen *et al.* 2014).

6.3.1.2 Underwater Cutting Tools and ROVs

It is proposed that mechanical (shear or diamond wire) cutters will be used to server the Garrow pipelines, an abrasive cutting tool system will be used to internally cut the jacket piles. However, underwater noise emissions from cutting tools are unlikely to result in sufficient levels of noise to cause significant disturbance to marine fauna (DECC, 2016). As the tool use episodes will be intermittent and of short duration, it is predicted that the noise generated will not be greater than that arising from vessel operations and therefore no additional impacts beyond that estimated from the noise arising from vessel operations are predicted to occur. The ROVs will also not generate noise above that of the mother vessels supporting them. This aspect has therefore been scoped out of detailed assessment.

6.3.1.3 Geophysical Survey Equipment

The post decommissioning survey is likely to utilise a combination of multi-beam echo sounder (MBES) and side scan sonar (SSS), as well as an Ultra Short Baseline (USBL) beacon system to confirm positioning of the underwater survey equipment. On the whole, these are highly directional sources with expected low levels of horizontal sound propagation. The use of this equipment in shallow waters is unlikely to cause injury or significant disturbance to marine fauna as the equipment tends to operate within frequency ranges that are outside the hearing range of most sensitive species (Turnpenny and Nedwell, 1994; JNCC, 2010). As such, no potentially significant impacts on sensitive marine fauna are predicted from the underwater noise emissions generated during the post decommissioning survey and therefore this aspect has been scoped out of detailed assessment.

6.3.2 Potential Impacts to Fish

The sensitivity to noise differs among fish species, especially according to the anatomy of the swimbladder and its proximity to the inner ear. Species known to have a high-sensitivity to noise include herring and sprat and species known to have a medium-sensitivity to noise include gadoids, such as cod, haddock and whiting. All these species may be present within the vicinity of the Garrow location. In contrast, those species lacking a swim bladder altogether such as elasmobranchs (sharks and rays) and flatfish such as plaice and sole tend to be of relatively low auditory sensitivity.

Juvenile and larval fish, in their first year of life, are the most sensitive to environmental stressors, particularly anthropogenic noise (Aires *et al.,* 2014). Physiological damage is of particular concern for fish eggs and larvae, since unlike adult fish they are unable to move away from a noise source and are therefore at greater risk of mortality (Turnpenny & Nedwell, 1994). However, there is no direct evidence of mortality or potential mortal injury to fish from ship noise and no data available on injury to eggs and larvae (Popper *et al.,* 2014).

It is acknowledged that displacement is of particular concern for demersal spawning species, such as herring and sandeels, as these species are more restricted by habitat type, requiring a specific type of substrate on which to lay their eggs. However, although both species spawn over the Garrow location, the area which would be impacted represents only a small proportion of the

spawning grounds available for these species in the SNS. In addition, this area of the SNS has a relatively high volume of vessel traffic and, as such, it is anticipated that the additional underwater noise generated by the proposed Garrow decommissioning activities is likely to be insignificant.

Given the above, the sensitivity of fish to underwater noise emissions from the proposed decommissioning activities is considered to be **Low**, with a high value due to fish being of national importance and very high resistance and resilience as fish have capacity to accommodate the pressure, with high recoverability in the short term. The magnitude of impact is predicted to be **Minor** as there is no potential for injury and any displacement from the area will be localised and temporary. Effects on fish from underwater noise emissions are therefore predicted to be **Minor** and not significant.

6.3.3 Potential Impacts to Marine Mammals

Not all marine mammal species have equal hearing capabilities, in terms of absolute hearing sensitivity and the frequency band of hearing and, consequently, vulnerability to impact from underwater noise differs between species (NOAA, 2018). Table 6.2 presents the marine mammal species that could be present within the vicinity of the Garrow location by their functional hearing group and associated estimated hearing range, as classified by Southall *et al.* 2019. It can be seen that odontocetes (toothed whales, dolphins and porpoises) have a wider hearing frequency range compared to mysticetes (baleen whales).

Table 6.2. Functional Marine Mammal Hearing Groups (Southall et al., 2019)

Hearing Group	Estimated Hearing Range	Species
Low-frequency cetaceans	7 Hz – 35 kHz	Minke whale, pilot whale
High-frequency cetaceans	150 Hz – 160 kHz	White-beaked dolphin, common dolphin and white-sided dolphin
Very high-frequency cetaceans	275 Hz - 160 kHz	Harbour porpoise
Phocid carnivores in water	50 Hz – 86 kHz	Harbour seal, grey seal

When marine mammals are exposed to intense sound, an elevated hearing threshold may occur, known as a threshold shift. If the hearing threshold returns to the pre-exposure level after a period of time, the threshold shift is known as a temporary threshold shift (TTS). If the threshold does not return to the pre-exposure level, it is known as a permanent threshold shift (PTS) (Finneran *et al.,* 2000; Southall *et al.,* 2007). Both TTS and PTS arise as a result of physiological changes to the auditory systems of marine mammals. The PTS and TTS onset thresholds for each of the functional marine mammal hearing groups are provided in Table 6.3.

Table 6.3. Non-Impulsive PTS and TTS Onset Thresholds for Marine Mammals (Southall et al. 2019)

Hearing Group	PTS Criteria - Weighted SEL_{cum} (dB re 1 μPa^2s)	TTS Criteria - Weighted SEL_{cum} (dB re 1 μPa^2s)
Low-frequency cetaceans	199	179
High-frequency cetaceans	198	178
Very high-frequency cetaceans	173	153
Phocid carnivores in water	201	181

None of the noise sources associated with the proposed decommissioning activities will exceed any of the PTS / TTS thresholds, with the SEL from vessels in the region of 150 dB re 1 µPa. It is therefore concluded that marine mammals will not be injured or experience a temporary, recoverable reduction in hearing sensitivity as a result of the proposed Garrow decommissioning activities.

However, there is still a possibility of behavioural disturbance. Due to the complexity and variability of marine mammal behavioural responses, guidance regarding the effects of anthropogenic sound

on marine mammal behaviour is still being developed. In the absence of detailed behavioural disturbance in Southall *et al.* 2019, criteria of 120 dB re 1 µPa (unweighted SPL_{RMS}), which is applicable to all marine mammal hearing groups for behavioural disturbance from non-impulsive noise (NOAA, 2013), has been used in this assessment.

In order to determine the impact range within which marine mammals may exhibit behavioural changes, a simple sound propagation model has been used based on the equation by Richardson et al. (1995), which assumes spherical spreading as shown below:

$$\text{Transmission Loss} = 20\text{Log}(R/R_0)\ \text{dB}$$

R_0 = the reference range, usually 1 metre; R = the distance from the reference range.

This method provides a conservative estimate of sound propagation with distance as it struggles to extrapolate sound attenuation in the near field (within tens of metres of the noise source), due to interference between sound waves and reverberation. It therefore generally overestimates transmission of sound from the source, but in this instance is considered sufficient to examine a 'worst-case' scenario for behavioural impacts on marine mammals. Table 6.4 presents the predicted impact range within which marine mammals may exhibit behavioural changes as a result of the proposed Garrow decommissioning activities.

Table 6.4. Maximum Behavioural Impact Range to Marine Mammals (NOOA, 2013)

Hearing Group	Behavioural Criteria – unweighted SPL_{RMS} (dB re 1 µPa)	Noise Source (dB re 1 µPa)	Maximum Predicted Impact Range
Marine Mammals	120	190	3,163 m

It can be seen from Table 6.4 that behavioural responses may be elicited ca. 3 km from the noise source, although for the reasons provided above the distance quoted is conservative.

To determine the magnitude of impact in terms of the actual number of animals impacted, it is possible to calculate the number of animals likely to experience some sort of behavioural impact using the density and estimates from the MMMUs (IAMMWG, 2021) as shown in Table 6.5. In addition, density data from Russell *et al.,* 2017 has been used for harbour seal and grey seal.

Table 6.5. Estimated Number of Marine Mammals Potentially Experiencing Behavioural Disturbance During the Garrow Decommissioning Activities

Species	Estimated Density in the Area (animals / km²)	Estimated Number of Animals that May Experience Behavioural Disturbance [3]	% of Reference Population Disturbed [4]
Harbour porpoise [1]	0.5	16	0.004
White-beaked dolphin [1]	0.02	< 1	0.002
Minke whale [1]	0.01	< 1	0.004
White-sided dolphin [1]	0.01	< 1	0.005
Common dolphin [1]	0.06	< 2	0.001
Bottlenose dolphin [1]	0.003	< 1	0.5
Risso's dolphin [1]	0.007	< 1	0.008
Harbour seal [2]	0.04	<2	N/A
Grey seal [2]	0.4	13	0.125

[1] Source: IAMMWG (2021) – MMMU data
[2] Source: Russell *et al.,* (2017)
[3] Calculated as the estimated density x behavioural onset area
[4] Based on MMMU abundance data (IAMMWG, 2021)

It can be seen from Table 6.5 that only a relatively low number of individual animals are likely to exhibit some form of change in behaviour for the period in which they encounter noise from the proposed decommissioning activities and the percentage of reference population disturbed is very small.

All species of cetaceans are classified as European Protected Species (EPS), listed on Annex IV of the EU Habitats Directive, which is transposed into UK law in UK offshore waters through The Conservation of Offshore Marine Habitats and Species Regulations 2017 (OMR). It is an offence under the OMR to deliberately disturb, injure or kill a species designated as an EPS. The likelihood of an offence being committed is highly dependent on the temporal characteristics of the activity (JNCC, 2010). A disturbance offence is more likely where an activity causes persistent (sustained and chronic) noise in an area for long periods of time. For most cetacean populations in the UK, disturbance in terms of OMR is unlikely to result from single, short-term operations (JNCC, 2010). Considering the noise sources associated with the proposed Garrow decommissioning activities and the fact that only a low number of individuals are likely to experience behavioural disturbance, with no cetaceans are predicted to be injured, it is not considered that the proposed decommissioning activities would constitute an offence under OMR.

In conclusion, the sensitivity of marine mammals to underwater noise emissions from the proposed decommissioning activities is considered to be **Medium** with a very high value as marine mammals are of international importance and very high resistance and resilience. Reported responses of behavioural disturbance to marine mammals from vessel noise include avoidance, changes in swimming speed, direction and surfacing patterns, alteration of the intensity and frequency of calls (Erbe *et al.* 2019). Harbour porpoises and minke whales have been shown to respond to vessels by moving away from them, while some other species, such as common dolphins, have shown attraction (Palka & Hammond 2001). The magnitude of impact is considered to be **Minor** as while there is potential for some behavioural disturbance, the area of potential disturbance will be localised and any impacts will be temporary. Effects on marine mammals from underwater noise emissions are therefore predicted to be **Minor** and not significant, particularly relative to the underwater noise generated by existing levels of vessel traffic in the wider SNS area.

It is also acknowledged that during the proposed decommissioning activities there is the potential for indirect effects on marine mammals due to changes in prey (fish) species distribution and/or abundance. However, as discussed in Section 6.3.2, impacts to fish from underwater noise

emissions will be temporary and in a localised area, in close proximity to the source. As such, any impacts to marine mammals due to changes in prey resources are not predicted to be significant.

6.3.4 Mitigation Measures

The following measures will be implemented for the Garrow decommissioning activities to ensure that any adverse effects on noise-sensitive receptors are mitigated:

- Operations will be planned to reduce vessel movements and minimise the overall duration of the project.
- Where vessels are required to hold position for extended durations (months rather than days), jack-up or moored vessel will be used in favour of DP vessels.
- Internal cutting techniques will be utilised where possible, which do not produce any significant noise emissions.
- Where internal cuts are not possible, external cuts will be via mechanical methods as they produce significantly less noise than of abrasive methods.

6.3.5 Residual Effects

In summary, there is no evidence to suggest that the underwater noise emissions generated during the proposed Garrow decommissioning activities would result in injury or significant disturbance to marine fauna. Residual effects are therefore predicted to be **Minor** and not significant.

6.4 Cumulative and In-combination Impacts

Cumulative impacts may arise from incremental changes caused by other past, present or reasonably foreseeable projects/ proposals together with the proposed Garrow decommissioning activities.

There are no aggregate areas within the vicinity of the Garrow platform, however, there are a large number of existing oil and gas developments adjacent to the Garrow platform. Apart from the Kilmar platform, which Garrow is tied back to, the nearest surface infrastructures are the Ravenspurn platforms, operated by Perenco (UK) Limited, located approximately 23 km to the south southwest (see Section 4.6.3).

In addition, there are a number of offshore wind farm developments in the vicinity of the Garrow platform (see Section 4.6.5), the closest operational wind farm is the Hornsea Project Two wind farm turbine area (Operator: Ørsted Hornsea), located 32 km to the south east of the Garrow pipelines. The Hornsea Project One (operated by Ørsted) is located approximately 44 km south east of the Garrow pipelines. Ørsted is also planning to develop Hornsea Project Four; the proposed wind farm turbine area for which is located approximately 7 km south east of the Garrow platform. An application for a Development Consent Order (DCO) for this wind farm was accepted by the Planning Inspectorate in October 2021 and is currently in the pre-examination stage.

However, given the limited area of seabed disturbed by the proposed Garrow decommissioning activities, coupled with the distance between the Garrow infrastructure and the developments listed above, no significant cumulative effects on seabed habitats and species are predicted.

The emissions and discharges from the developments listed above in conjunction with the proposed Garrow decommissioning activities are also not expected to result in any significant cumulative effects on marine receptors. Atmospheric emissions are predicted to rapidly disperse. In addition, the underwater noise emissions generated by the proposed Garrow decommissioning activities is predicted to be insignificant against the noise produced by the existing vessel traffic in this area of the SNS. As such, any emissions and discharges from the proposed Garrow decommissioning activities are unlikely to significantly overlap with emissions and discharges from other activities in the area and therefore no significant cumulative effects on marine receptors are predicted.

In addition to cumulative impacts, in-combination impacts may arise from different activities within the Garrow decommissioning project resulting in several impacts on the same receptor or where different receptors are adversely effected to the detriment of the entire ecosystem. An example of this in the marine environment would be marine fauna, such as fish, experiencing habitat loss from both seabed disturbance and underwater noise emissions. Water quality may also be adversely impacted by an increase in turbidity through sediment resuspension during seabed disturbance activities, as well as routine marine discharges from vessels. However, given the localised nature of any impacts and the fact the majority will be temporary nature, no significant environmental effects are predicted as a result of in-combination impacts.

6.5 Transboundary Impacts

The Garrow platform is located approximately 115 km south west of the UK / Netherlands median line and the Kilmar platform is located approximately 94 km south west of the UK / Netherlands median line. However, any impacts arising from emissions, discharges and seabed disturbance generated as a result of the proposed Garrow decommissioning activities are predicted to be highly localised and are therefore not expected to result in any significant transboundary impacts.

As discussed in Section 5.4.4.1 modelling predicts that a worst case release of diesel from the Garrow location will not cross into international waters. Once spilt diesel is likely to remain on the sea surface and be subject to high rates of evaporation. It also has a low asphaltene content which prevents emulsification. A release of diesel is therefore not expected to persist in the marine environment for a prolonged period of time. In the unlikely event an unplanned release of hydrocarbons does enter Dutch waters during the proposed Garrow decommissioning activities, it may be necessary to implement the Bonn Agreement. This Agreement is the main counter-pollution multi-state agreement for dealing with marine pollution that may affect states that border the North Sea and English Channel (Belgium, Denmark, France, Germany, Ireland, Netherlands, Norway, Sweden and the UK). It requires member states to provide early notification if hydrocarbons may affect the interests of another party and mutual assistance in the event of a spill. EUL will therefore ensure the Maritime and Coastguard Agency (and OPRED) is immediately informed once they have any indication that an accidental release of hydrocarbons from the proposed Garrow decommissioning activities will encroach into Dutch waters. In the event any waste from the Garrow decommissioning activities is disposed of outside of the UK, EUL will ensure regulations governing transfrontier shipment of waste are complied with.

7 Potential Impacts to Marine Protected Areas

EUL has identified that the SNS SAC, is potentially at risk of being adversely impacted by the proposed Garrow decommissioning activities. In addition, the Greater Wash SPA, which lies along the adjacent coastline approximately 72km from the Garrow platform, has been scoped into the assessment as vessels could be transiting through this site on the way to the Garrow location. This section therefore assesses whether the potential impacts from the proposed decommissioning activities, either alone or in-combination with other plans or projects, may cause likely significant effects to the qualifying features of the SAC and SPA, thereby affecting the integrity of the site. It should be noted that the Dogger Bank SAC, designated for the protection of the Annex I sandbanks which are slightly covered by seawater all the time, has been screened out of this assessment given that it is located approximately 31km to the north-east of the platform.

7.1 Southern North Sea SAC

7.1.1 Qualifying Features and Conservation Objectives

The SNS SAC is designated for the protection of Annex II species harbour porpoise. The site covers an area of 36,951 km^2 and supports an estimated 17.5 % of the UK North Sea MU population of harbour porpoises. The northern two thirds of the site, covering an area of 27,000 km^2, is recognised as important for harbour porpoises during the summer season (April – September), whilst the southern part, covering an area of 12,687 km^2 as there is some overlap with the northern part, supports persistently higher densities during the winter (October – March) (JNCC & NE, 2019).

The conservation objectives of the SNS SAC are to ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining favourable conservation status (FCS) for harbour porpoise in UK waters. In the context of natural change, this will be achieved by ensuring that:

- Harbour porpoise is a viable component of the site;
- There is no significant disturbance of the species; and
- The condition of supporting habitats and processes, and the availability of prey is maintained.

7.1.2 Potential Impacts

The Garrow infrastructure is located within the northern part of the SAC.

As noted in Section 6.3, the underwater noise emissions generated during the proposed Garrow decommissioning activities are not predicted to result in injury to harbour porpoise but do have the potential to cause disturbance out to a distance of ca. of 3,163 m from the noise source, equivalent to an area of ca. 31 km^2, with impacts primarily due to vessel noise. This equates to ca. 0.08% of the SNS SAC total area and ca. 0.2% of the 'summer' area. It has been calculated that up to 16 individuals may be temporarily disturbed within this area, which is equivalent to 0.004% of the harbour porpoise North Sea MU reference population. Given the low number of harbour porpoises which may be impacted, there is considered to be sufficient foraging habitat in the wider vicinity to accommodate any temporary displacement of harbour porpoise from the area whilst the decommissioning activities are ongoing.

In addition to impacts on harbour porpoise from noise, there is the potential for impacts to supporting habitats and processes relevant to harbour porpoises and their prey within the SAC. Harbour porpoise are strongly reliant on the availability of prey species due to their high energy demands, and are highly dependent on being able to access prey species year-round. However, it is assumed that any potential effects on harbour porpoise prey species from the underwater noise generated during the proposed decommissioning activities would be the same or less than those for harbour porpoise, i.e. if prey are disturbed from an area as a result of underwater noise, harbour porpoise will be disturbed from the same or greater area, therefore any changes to prey

availability would not affect harbour porpoise as they would already be disturbed from the same area.

In terms of the supporting habitats relevant to the prey of the harbour porpoise, fish species such as sandeels, herring, mackerel, cod and whiting that form part of the harbour porpoise diet and are present in the vicinity of the proposed decommissioning work. However, fish spawning and nursey grounds are not predicted to be significantly impacted by seabed disturbance activities resulting from the proposed decommissioning activities. The majority of disturbance to the seabed habitat that could affect the prey of the harbour porpoise or their prey within the SAC will be localised and temporary. It is estimated that the proposed decommissioning activities will temporary disturb an area of seabed totalling ca. 0.06 km^2 within the SAC, which equates to only ca. 0.0002% of the SNS SAC total area and ca. 0.0002% of the 'summer' area.

It is acknowledged that will be a permanent loss of ca. 0.017 km^2 of habitat within the SAC due to the decommissioning in situ of the protection material (rock) along the pipeline route. However, the area impacted is extremely small compared to the extent of habitat in the wider SNS SAC, approximately 0.00005% of the total area of the SAC. The loss of a relatively very small area of habitat that occurs widely within the SAC is not predicted to impact on harbour porpoise or their prey.

Given the above, it is therefore considered that the proposed Garrow decommissioning activities will not have a likely significant effect on harbour porpoise or supporting habitats and processes relevant to harbour porpoises and their prey.

7.1.3 In-Combination Effects

Guidance for assessing the significance of noise disturbance against Conservation Objectives of harbour porpoise SACs states that noise disturbance within an SAC from a plan/project, individually or in combination, is considered to be significant if it excludes harbour porpoises from more than (JNCC, 2020):

- 20% of the relevant area of the site in any given day, or
- An average of 10% of the relevant area of the site over a season.

EUL is aware that construction activities associated with a number of offshore wind farm projects could be ongoing within the SAC during the period when the proposed decommissioning work will be taking place (2023-2027), including:

- Hornsea Four offshore wind farm (status: pre-application) (summer area): construction could be ongoing during 2023-2027, located approximately 7 km from the Garrow platform;
- Dogger Bank Creyke Beck A and B Offshore Wind Farms (status: under construction) (summer area) construction could be ongoing during 2023-2024, located approximately 67 km and 79 km respectively from the Garrow platform;
- Norfolk Vanguard offshore wind farms (status: consented but subject to re-determination) (summer area): construction could be ongoing during 2024-late 2020s, located 171 km south of the Garrow platform;
- Norfolk Boreas offshore wind farm (status: in-planning) (summer area): construction could be ongoing during 2024-late 2020s, located 179 km south east of the Garrow platform;
- East Anglia Three offshore wind farm (status: consented) (summer and winter area): construction could be ongoing during 2023-2024, located approximately 205 km from the Garrow platform.

However, as any disturbance caused by the proposed Garrow decommissioning activities will result in a very small, temporary reduction in available habitat it is considered that this in-combination with the wind farm projects is unlikely to prevent the site from contributing in the best possible way to species FCS. In addition, this area of the SNS is subject to a relatively high volume of vessel traffic (refer to Section 4.6) and therefore it is anticipated that the additional underwater noise

generated by the proposed Garrow decommissioning activities is likely to be insignificant compared to the ambient noise level.

7.1.4 Conclusion

In summary, based on the predicted scale of impacts and proposed mitigation measures, along with evidence from existing studies of the likely potential effects on the qualifying features, it is concluded that the proposed Garrow decommissioning activities either alone or in-combination with other plans or projects will not have an adverse effect on the integrity of the SNS SAC.

7.2 Greater Wash SPA

7.2.1 Qualifying Features and Conservation Objectives

The Greater Wash SPA covers an area of 3,536 km^2 and lies along the east coast of England in the mid-SNS and extends between the counties of Yorkshire (to the north) and Suffolk (to the south). The site is classified for the protection of red-throated diver, common scoter and little gull during the non-breeding season, and for breeding Sandwich tern, common tern and little tern. This area supports the largest breeding populations of little terns within the UK SPA network by protecting important foraging areas, and supports the second largest aggregations of non-breeding red-throated diver and little gull.

The site's conservation objectives apply to the site and the individual species and/or assemblage of species for which the site has been classified. The objectives are to ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring:

- The extent and distribution of the habitats of the qualifying features;
- The structure and function of the habitats of the qualifying features;
- The supporting processes on which the habitats of the qualifying features rely;
- The population of each of the qualifying features; and
- The distribution of the qualifying features within the site.

7.2.1 Potential Impacts

As contracts are not yet in place for the proposed decommissioning work vessel mobilisation and demobilisation locations are unknown. Hull, Great Yarmouth and Lowestoft are all possible ports that could be utilised by the project, which would result in vessels transiting through the Greater Wash SPA to the Garrow location.

Of the bird species present within the SPA, common scoter and red-throated diver are vulnerable to disturbance by boats (Schwemmer *et al*., 2011), with common scoter flushing at distances of around 1,600 ± 777 m from approaching vessels and red-throated diver flushing at distances of about 750 ± 437 m (Fliessbach *et al.,* 2019). Large aggregations of these species are present within the SPA between November and March. In contrast, little gull are less sensitive to disturbance from shipping traffic (Leopold & Dijkman, 2010) and tern species are generally tolerant of vessel activity (Cook & Burton, 2010).

In the event that vessels do transit through the SPA during the overwintering period, based on evidence of vessel displacement, it is assumed that all red-throated diver within 2 km of a vessel could be displaced (Burt et *al*., 2017; Burger *et al.,* 2019) and all common scoter within 2.5 km of a vessel could be displaced (Fliessbach *et al.,* 2019). The total number of birds that could be displaced at any one point by a vessel transiting through the SPA is summarised in Table 7.1.

Table 7.1. Estimated Numbers of Red-Throated Diver and Common Scoter Potentially Disturbed at Any One Point Within the Greater Wash SPA during the Overwintering Period

Mob / Demob Port	Distance Through SPA[1]	Displacement Area at Any One Point[2]	Density of Birds Within SPA[3]	No. of Birds Disturbed at any One Point	% Population of SPA Disturbed at any One Point[4]
Red-throated Diver					
Hull	14 km	13 km^2	1.35 – 3.38 per km^2	18 - 44	1.3 – 3
Great Yarmouth	30 km	13 km^2	1.35 – 3.38 per km^2	18 – 44	1.3 – 3
Lowestoft	30 km	13 km^2	1.35 – 3.38 per km^2	18 - 44	1.3 – 3
Common Scoter					
Hull	14 km	20 km^2	0 – 0.7 per km^2	0 – 14	0 – 0.4
Great Yarmouth	30 km	20 km^2	0 – 0.7 per km^2	0 – 14	0 – 0.4
Lowestoft	30 km	20 km^2	0 – 0.7 per km^2	0 – 14	0 – 0.4

[1] Assumes a direct transit route through the SPA to the Garrow platform.
[2] Based on displacement distance of 2km for red-throated diver and 2.5km for common scoter along the entire route within the SPA.
[3] Based on maximum predicted density of red-throated diver within the SPA. Highest densities of common scoter are present offshore The Wash therefore density range reflects the likely distribution along the transit routes (Lawson *et al.,* 2016)
[4] Based on the following count data: 1,407 red-throated diver and 3,449 common scoter (NE, 2018)

It can be seen from Table 7.1 that red-throated diver are most at risk of disturbance if vessels were transiting to / from Hull, Great Yarmouth or Lowestoft. Therefore to minimise disturbance, EUL proposes to implement the following mitigation measures:

- Restricting, to the extent possible, vessel movements within the Greater Wash SPA to existing navigation routes when transiting to / from the Garrow location;
- Maintaining direct transit routes;
- Avoiding over-revving of engines;
- Briefing vessel crew on the purpose and implications of vessel management practices within the Greater Wash SPA.

Given the above, it is therefore considered that the proposed Garrow decommissioning activities will not have a likely significant effect on the distribution and population of red-throated diver within the SPA.

7.2.3 In-Combination Effects

It is recognised that this region of the SNS is already subject to high densities of vessel traffic, which could result in adverse impacts to red-throated diver within the SPA in-combination with the vessel traffic generated during the proposed Garrow decommissioning project. However, given the temporary nature of the project and the relatively short duration of the proposed operations, coupled with mitigation measures EUL propose to implement, significant in-combination effects are not predicted.

7.2.4 Conclusion

In summary, the proposed decommissioning activities will not significantly alter the extent, distribution, structure and function of the habitats of the qualifying bird species, the supporting processes on which these habitats rely, nor the population or distribution of the qualifying bird species. Therefore, in view of the conservation objectives of the SPA, no LSE on the Greater Wash SPA are predicted, as a result of the proposed decommissioning activities either alone or in-combination with other plans or projects.

8 Conclusions

The Garrow Field Installations DP and the Garrow Pipelines DP involves the removal of the Garrow platform (topside and jacket) and surface laid tie-in spools and pipeline sections, mattresses and gravel bags, with recovery to shore. The remaining buried pipelines will be left cleaned and decommissioned in situ, along with the associated rock stabilisation features. This EA report confirms that the Garrow DPs can be executed with no significant adverse effects on the marine environment.

An initial screening of the potential impacts to environmental and societal receptors from the proposed Garrow decommissioning activities concluded that the only aspects considered to be potentially significant and therefore requiring further assessment were physical presence, seabed disturbance and underwater noise. However, following further assessment and upon implementation of the identified mitigation measures, it is has been concluded that no significant residual effects are predicted to occur, with the majority of impacts being localised and temporary in nature.

Of note is that the Garrow infrastructure lies within the boundary of the SNS SAC, designated for the protection of harbour porpoises. However, the EA has concluded that there will not be any likely significant effects on the conservation objectives of the SAC as a result of the proposed Garrow decommissioning activities, either alone or in-combination with other plans or projects.

The mitigation measures identified to reduce any adverse environmental effects arising from the proposed decommissioning activities are summarised in Table 8.1. EUL operates under an integrated Safety and Environmental Management System (SEMS), certified to ISO 14001:2015, and has established contractor selection and management procedures. As a number of contractors will be involved in the detailed planning and execution of the proposed Garrow decommissioning activities, EUL will produce a SEMS interface document for the project to help ensure the measures listed in Table 8.1 are successfully implemented.

Table 8.1. Garrow Decommissioning Mitigation Measures

Physical Presence
• Where required, Consent to Locate permits will be in place, existing collision risk management plans will be reviewed and notifications of the proposed decommissioning activities will be made to regular users of the area via Notices to Mariners, NAVTEX/NAVAREA warnings and Kingfisher bulletins; • If the jacket is removed in a separate campaign to the topside, a solar navaid / foghorn will be installed to warn other sea users of its presence; • Details of any infrastructure decommissioned in situ will be publicised through Notices to Mariners and marked on navigation and fisheries charts; • A post-decommissioning monitoring programme covering the pipelines and associated stabilisation features remaining in situ will be agreed with OPRED, if necessary; • Installation of nesting bird deterrents will be considered when the preparatory work is being undertaken to discourage birds from nesting on the platform, if it enters the Lighthouse Mode phase; • EUL will continue to check for the presence of nesting birds on scheduled routine visits to the Garrow platform, noting there is not a history of nesting birds on the platform. If the topside is to be removed during the breeding season, data will be reviewed to confirm the absence of nesting birds and, if considered necessary, the platform will be checked by a qualified ornithologist prior to removal. If nesting birds are observed, OPRED will be consulted to ascertain if it is possible for a Wild Birds Licence to be granted to allow the works to go ahead; • If any other decommissioning activity (e.g. preparatory works) is to be undertaken on the topside during the breeding season, the platform will be checked for nesting birds prior to commencing work. OPRED will be informed of the results and, if necessary, a Wild Birds Licence applied for. In the event nesting birds are observed, EUL currently propose to erect signage in the area advising offshore personnel of the nests and personnel will be briefed on instructions to minimise possible disturbance to the juveniles and attending adults. The nests will also be monitored on a daily basis to record bird presence and activity.

- Restricting, to the extent possible, vessel movements within the Greater Wash SPA to existing navigation routes when transiting to / from the Garrow location, maintaining direct transit routes, avoiding over-revving of engines and briefing vessel crew on the purpose and implications of vessel management practices within the Greater Wash SPA.

Seabed Disturbance

- Jacket legs will be cut internally, to avoid seabed disturbance from external excavation;
- Where vessels are required to hold position for only short duration, DP vessels will be used in favour of moored vessels;
- No new mattresses or gravel bags will be placed on the seabed.
- If required for spudcan support, rock will be carefully placed over the designated areas of the seabed by the use of a fall pipe system. This will control the profile of the rock covering and ensure accurate placement of the rock on the seabed within the planned footprint with minimal spread over adjacent sediment, minimising seabed disturbance.

Underwater Noise Emissions

- Operations will be planned to reduce vessel movements and minimise the overall duration of the project.
- Where vessels are required to hold position for extended durations, jack-up or moored vessel will be used in favour of DP vessels.
- Internal cutting techniques will be utilised where possible, which do not produce any significant noise emissions.
- Where internal cuts are not possible, external cuts will be via mechanical methods as they produce significantly less noise than of abrasive methods.

Energy Use and Atmospheric Emissions

- EUL will look to reduce vessel time in the field as far as practicable and will make use of vessel synergies where possible;
- EUL's contractor selection process will aim to ensure that the engines, generators and other combustion plant on the vessels to be used during the proposed decommissioning activities are maintained and correctly operated to ensure that they work as efficiently as possible.

Marine Discharges

- Food waste will be macerated and waste water will be treated appropriately before being discharged to sea, in accordance with the requirements of the MARPOL convention;
- Ballast water discharges will be in accordance with the International Maritime Organisation Ballast Water Management Convention, including a ballast water plan and log book.

Waste Management

- EUL will ensure the principles of the Waste Management Hierarchy are followed during the proposed decommissioning activities, that licensed waste contractors are used and a project Waste Management Plan is in place to ensure compliance with relevant waste regulations;
- Any waste disposed of outside of the UK will be in accordance with the Transfrontier Shipment of Waste Regulations 2007;
- If NORM is not encountered, EUL will ensure appropriate Radioactive Substance Regulation permits are in place and conditions that dictate the management and control of radioactive waste are met.

Accidental Events

- An approved Oil Pollution Emergency Plan will be in place for the proposed Garrow decommissioning activities, as required by the Merchant Shipping (Oil Pollution Preparedness, Response and Co-Operation Convention) Regulations 1998 (as amended);
- All unplanned losses (dropped objects) in the marine environment will be attempted to be remediated, and notifications to other mariners will be sent out;
- Where possible equipment with automatic hydraulic shut-off will be used to minimise the volume of fluid released in the event of a hydraulic line failure.

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Appendix A: Marine Planning Objectives and Policies

Table A.1. Marine Planning Objectives and Policies Relevant to the Proposed Garrow Decommissioning Operations

Relevant Objectives	Associated Policies	Project Compliance
Economic Productivity - To promote the sustainable development of economically productive activities, taking account of spatial requirements of other activities of importance to the East marine plan areas.	EC1 - Proposals that provide economic productivity benefits which are additional to Gross Value Added currently generated by existing activities should be supported.	Production from Garrow has been in decline for a number of years and the field is now uneconomic. A CoP application has been submitted to the NSTA and EUL is seeking approval to decommission the Garrow infrastructure. EUL has explored alternative uses for the Garrow facilities, including the possibility for in situ re-use or redevelopment, however none were found viable.
Employment and Skill Levels - To support activities that create employment at all skill levels, taking account of the spatial and other requirements of activities in the East marine plan areas.	EC2 - Proposals that provide additional employment benefits should be supported, particularly where these benefits have the potential to meet employment needs in localities close to the marine plan areas.	Where possible the proposed decommissioning work will utilise local contractors.
Heritage Assets - To conserve heritage assets, nationally protected landscapes and ensure that decisions consider the seascape of the local area.	SOC2 - Proposals that may affect heritage assets should demonstrate, in order of preference: a) that they will not compromise or harm elements which contribute to the significance of the heritage asset; b) how, if there is compromise or harm to a heritage asset, this will be minimised; c) how, where compromise or harm to a heritage asset cannot be minimised it will be mitigated against, or; d) the public benefits for proceeding with the proposal if it is not possible to minimise or mitigate compromise or harm to the heritage asset. SOC3 - Proposals that may affect the terrestrial and marine character of an area should demonstrate, in order of preference: a) that they will not adversely impact the terrestrial and marine character of an area; b) how, if there are adverse impacts on the terrestrial and marine character of an area, they will minimise them;	The proposed decommissioning operations are not anticipated to have an impact on any heritage assets. There will be a beneficial impact to the seascape of the local area once the Garrow platform has been removed.

Relevant Objectives	Associated Policies	Project Compliance
	c) how, where these adverse impacts on the terrestrial and marine character of an area cannot be minimised they will be mitigated against; d) the case for proceeding with the proposal if it is not possible to minimise or mitigate the adverse impacts.	
Healthy Ecosystem - To have a healthy, resilient and adaptable marine ecosystem in the East marine plan areas.	ECO1 - Cumulative impacts affecting the ecosystem of the East marine plans and adjacent areas (marine, terrestrial) should be addressed in decision-making and plan implementation.	No significant cumulative impacts are predicted to occur. Refer to Section 6.4
	ECO2 - The risk of release of hazardous substances as a secondary effect due to any increased collision risk should be taken account of in proposals that require an authorisation.	In the unlikely event of an accidental release of hydrocarbons or chemicals the impact to the marine environment is not anticipated to be significant. Refer to Section 5.4.4.1.
Biodiversity - To protect, conserve and, where appropriate, recover biodiversity that is in or dependent upon the East marine plan areas.	BIO1 - Appropriate weight should be attached to biodiversity, reflecting the need to protect biodiversity as a whole, taking account of the best available evidence including on habitats and species that are protected or of conservation concern in the East marine plans and adjacent areas (marine, terrestrial).	The proposed decommissioning operations will not significantly impact biodiversity. Refer to Section 6.
Marine Protected Areas (MPAs) - To support the objectives of MPAs (and other designated sites around the coast that overlap, or are adjacent to the East marine plan areas), individually and as part of an ecologically coherent network.	MPA1 - Any impacts on the overall MPA network must be taken account of in strategic level measures and assessments, with due regard given to any current agreed advice on an ecologically coherent network	The proposed decommissioning operations will not pose a risk of adversely affecting (either directly or indirectly) the integrity of any MPA, either alone or in combination with other plans or projects. Refer to Section 7.
Governance - To ensure integration with other plans, and in the regulation and management of key activities and issues, in the East marine plans, and adjacent areas.	GOV2 - Opportunities for co-existence should be maximised wherever possible.	Residual effects on other sea users resulting from the physical presence of vessels on location at Garrow during the proposed decommissioning operations are predicted to be Negligible and not significant. In addition, removal of the Garrow platform and associated 500 m safety exclusion zone will result in positive effects as the area will become available to other sea users again. Refer to Section 6.1
	GOV3 - Proposals should demonstrate in order of preference: a) that they will avoid displacement of other existing or authorised (but yet to be implemented) activities; b) how, if there are adverse impacts resulting in displacement by the proposal, they will minimise them; c) how, if the adverse impacts resulting in displacement by the proposal, cannot be minimised, they will be mitigated against or; d) the case for proceeding with the proposal if it is not possible to minimise or mitigate the adverse impacts of displacement.	