# Leman 49/27J Jacket & Pipeline PL207 Decommissioning

## Environmental Appraisal Report

For Perenco UK Limited

200605-S-REP-0063

Consultation Version

October 2025

| | | | | | |
|---|---|---|---|---|---|
| 4 | 03/10/25 | OPRED comments included. Consultation Version issued. | EP | CF | OF |
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# ABBREVIATIONS

| Abbreviation | Description |
|---|---|
| As | Arsenic |
| AL | Assessment Level |
| Ba | Barium |
| BAC | Background Assessment Concentration |
| BAP | Biodiversity Action Plan |
| BDL | Below Detection Limit |
| BEIS | Department for Business, Energy & Industrial Strategy |
| BGT | Bacton Gas Terminal |
| boepd | Barrels Of Oil Equivalent Per Day |
| Cd | Cadmium |
| Cefas | Centre For Fisheries and Aquaculture Science |
| $CH_4$ | Methane |
| cm | Centimetres |
| CO | Carbon monoxide |
| $CO_2$ | Carbon dioxide |
| $CO_2e$ | Carbon dioxide equivalent |
| CoP | Cessation of Production |
| CPI | Carbon Preference Index |
| Cr | Chromium |
| Cu | Copper |
| CV | Coefficient of Variation |
| dB | Decibels |
| DDC | Drop-down Camera |
| DESNZ | The Department for Energy Security and Net Zero |
| DP | Decommissioning Programme |
| e.g. | For Example |
| E | East |
| EA | Environmental Appraisal |
| EBS | Environmental Baseline Survey |
| EC | European Council |
| EEC | European Economic Council |
| EF | Emission Factor |
| EIA | Environmental Impact Assessment |
| EMS | Environmental Management System |
| ENVID | Environmental Impacts Identification |
| ERL | Effects Range Low |

| Abbreviation | Description |
|---|---|
| ERM | Effect Range Median |
| EU | European Union |
| EUNIS | European Nature Information System |
| GHG | Greenhouse Gas |
| GWP | Global Warming Potential |
| HCS | Hydrocarbon Safe |
| Hg | Mercury |
| HMW | Heavy Molecular weight |
| HLV | Heavy Lift Vessel |
| hrs | Hours |
| HRA | Habitat Risk Assessment |
| HSE | Health and Safety Executive |
| HSSE | Health, Safety, Security and Environment |
| i.e. | That is |
| ICES | International Council for the Exploration of the Sea |
| ISO | International Organisation for Standardisation |
| IUCN | International Union for the Conservation of Nature |
| JNCC | Joint Nature Conservation Committee |
| kg | Kilogram |
| kW/m | Kilowatt/metre |
| km | Kilometre |
| LAT | Lowest Astronomical Tide |
| LMW | Light Molecular Weight |
| m | Metre |
| MCAA | Marine and Coastal Access Act |
| MCZ | Marine Conservation Zones |
| mg | Milligram |
| mm | Millimetre |
| MMMU | Marine Mammal Management Units |
| MMO | Marine Management Organisation |
| MFE | Mass Flow Excavators |
| MPA | Marine Protected Area |
| MSV | Multi-Service Vessel |
| N | North |
| $N_2O$ | Nitrous oxide |
| ND | No Data |
| Ni | Nickel |

| Abbreviation | Description |
|---|---|
| $NO_x$ | Nitrogen oxides |
| nm | Nautical miles |
| NORM | Naturally Occurring Radioactive Material |
| NSTA | North Sea Transition Authority |
| OEUK | Offshore Energies UK |
| OPEP | Oil Pollution Emergency Plan |
| OPRED | Offshore Petroleum Regulator for the Environment and Decommissioning |
| OSPAR | Oslo Paris Agreement |
| PAH | Polycyclic Aromatic Hydrocarbons |
| Pb | Lead |
| PEL | Probable Effects Level |
| PL | Pipeline |
| POMS | PUK Operating Management System |
| ppm | Parts per million |
| ppt | Parts per thousand |
| PUK | Perenco UK Limited |
| RAT | Rope Access Technician |
| ROV | Remotely Operated Vehicle |
| S | South |
| SAC | Special Area of Conservation |
| SCANS | Small Cetacean Abundance of the North Sea |
| SD | Standard Deviation |
| SE | Standard Error |
| SEMS | Safety and Environmental Management System |
| SNS | Southern North Sea |
| SOPEP | Shipboard Oil Pollution Emergency Plan |
| SOSI | Seabird Oil Sensitivity Index |
| $SO_2$ | Sulphur dioxide |
| SPA | Special Protection Area |
| spp | Species |
| SSS | Side Scan Sonar |
| TBa | Barium by Fusion |
| te | Tonne (UK) |
| TEL | Threshold Effects Level |
| THC | Total Hydrocarbon Content |
| TOC | Total Organic Carbon |
| UK | United Kingdom |

| Abbreviation | Description |
|---|---|
| UKCS | United Kingdom Continental Shelf |
| UKOOA | United Kingdom Offshore Operators Association |
| VOC | Volatile Organic Compound |
| W | West |
| Zn | Zinc |
| µm | Micrometre |
| µPa | Micro Pscal |
| $^2$ | Square |
| $^3$ | Cubic |
| " | Inch |
| °C | Degree Celsius |
| £ | Pound sterling |
| % | Percentage |
| > | Greater than |
| < | Less than |
| & | And |
| ° | Degree |

# HOLDS

| Section | Hold | |
|---|---|---|
| 3 | 1 | Provide stakeholder responses |
| | | |
| | | |

# EXECUTIVE SUMMARY

In accordance with the Petroleum Act 1998, Perenco UK Limited (PUK) is applying to the Offshore Petroleum Regulator for Environment and Decommissioning (OPRED) to obtain approval for the decommissioning of the Leman 27J jacket and Pipeline (PL) 207 including the riser section that is attached to the Leman 27J jacket and the rest of the pipeline that terminates at the tee junction on PL206.

The Leman 27J is located in the United Kingdom Continental Shelf (UKCS) in Block 49/27, approximately 53km from the northeast of Bacton Gas Terminal (BGT), off the coast of East Anglia. The Leman field was discovered by Shell in 1965 and utilises 16 development platforms, of which 9 installations are now operated by PUK. The Leman 27J used to extract natural gas and condensate from the subsea reservoir and export it via a 16” pipeline (PL207), that joins a 20” subsea pipeline (PL206), to Leman 27A. Produced gas and condensate received at Leman 27A was then routed to Bacton Gas Terminal (BGT).

The Cessation of Production (CoP) documentation was submitted to the North Sea Transition Authority (NSTA) in November 2021. Approval for CoP was gained on 15th December 2021. The Leman 27J jacket will be decommissioned because no other viable opportunities were identified for the reuse of the jacket.

Pre-decommissioning geophysical and environmental surveys were conducted in 2023. The 27J wells were plugged and abandoned during the topside hydrocarbon safe (HCS) campaign in the autumn of 2024. The 27J pipeline (PL207) will be cut subsea, near the base of the jacket to remove the riser section and create the air gap between the riser and the rest of the pipeline system to facilitate the removal of the jacket structure. An additional cut will be made at the tee junction on PL206 and thereafter, the rest of PL207 will be removed from the seabed. Pipeline stabilisation features (grout bags) will also be removed from the seabed.

Leman PL206 and PL207 have been verified as HCS, isolated and physically air-gapped at the topside on the Leman 27J, 27H, and 27A platforms. The 27J topside was removed in November 2024 and the jacket is currently in the ‘Dismantlement Interval Phase’.

In line with legislation and regulatory guidance, this Environmental Appraisal (EA) report has been produced to support the Leman 27J Jacket & Pipeline Decommissioning Programme (DP) by assessing the potentially significant impacts associated with the preferred decommissioning option.

This EA report sets out to describe, in a proportionate manner, the potential environmental impacts of the proposed activities associated with the Leman jackets and PL207 decommissioning and to demonstrate the extent to which these will be mitigated and controlled to an acceptable level.

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# 1 INTRODUCTION

## 1.1 Purpose of Document

This EA report sets out to describe, in a proportionate manner, the potential environmental impacts of the proposed activities associated with the Leman jacket and pipeline decommissioning and to demonstrate the extent to which these will be mitigated and controlled to an acceptable level. The key components and structure of this report are laid out in Table 1-1.

**Table 1-1: EA structure**

| Section | Description |
|---|---|
| | Executive summary |
| **Section 1** | Introduction to the decommissioning project for the Leman 27J jacket and PL207, and a description of the EA report scope and structure. |
| **Section 2** | The regulatory context and guidance for undertaking a decommissioning EA. |
| **Section 3** | A summary of the stakeholder engagement process and activities carried out by PUK to date. |
| **Section 4** | An outline of the options considered for decommissioning, the decision-making process undergone by PUK to arrive at the selected decommissioning strategy and a description of the proposed decommissioning activities. |
| **Section 5** | A summary of the baseline sensitivities relevant to the activities taking place and the assessments that support this EA. |
| **Section 6** | A summary of the project Environmental Issues Identification process and findings. |
| **Section 7** | An outline of the EA method used, review of the potential impacts from the proposed decommissioning activities, and justification for scoping potential impacts in or out of assessment in this EA report. |
| **Section 8** | Assessment conclusions. |
| **Section 9** | Environmental management. |
| **Section 10** | References. |
| **Section 11** | Appendices. |

## 1.2 PUK Limited

PUK, a subsidiary of Perenco, is an independent oil and gas company operating in the UK, specialising in hydrocarbon exploration, development, and production.

Perenco operates in 13 countries across the globe, ranging from Northern Europe to Africa and from South America to Southeast Asia.

Perenco currently produces approximately 450,000 barrels of oil equivalent per day (BOEPD), of which 250,000 BOEPD is net to the company. The group is present in world-class exploration basins such as Brazil, Peru, northern Iraq, Australia, and the North Sea. While PUK's growth has been driven by acquisitions, the Group's strategy evolved rapidly towards increasing production and reserves, renewing licenses, and securing additional acreage for new exploration and development opportunities.

In the Southern North Sea (SNS) gas basin, PUK and other operators, manage 17 offshore fields own by PUK, along with associated pipelines and onshore processing facilities including the Bacton and Dimlington Terminals. PUK's gas production in the North Sea is around 72,000 boepd.

PUK operates under a Safety and Environmental Management System (SEMS) which is certified to conform to the International Organisation for Standardisation (ISO) 14001 for environmental management systems (EMS). SEMS provides the framework for PUK to achieve safe and reliable operations and ensures compliance with PUK's Health, Safety, Security and Environment (HSSE) Policy. Further detail on PUK's SEMS is provided in Section 9.

# 2 POLICY & REGULATORY CONTEXT

The decommissioning of offshore oil and gas installations and pipelines on the UKCS is principally governed through the Petroleum Act 1998 and is amended by the Energy Act 2008.

The United Kingdom (UK) international obligations in relation to decommissioning is principally governed by the 1992 Convention for the Protection of the Marine Environment of the Northeast Atlantic (Oslo-Paris Agreement (OSPAR) convention). Agreement in relation to the offshore decommissioning regime was reached at a meeting of the OSPAR commission in 1998 (OSPAR Decision 98/3). As a result, OPRED guidance in relation to offshore decommissioning is aligned.

The primary objection of OSPAR decision 98/3 remains to prevent the dumping of offshore installations at sea, with the default position of full removal. The decision however, allows the granting of derogations to leave all or part of a structure in place, subject to a Comparative Assessment process and regulatory approval.

In the context of marine planning and being located in the English offshore waters of the SNS, the pipelines fall within the area of the East Marine Plans [47]. These plans were developed to help ensure sustainable development of the UK marine area; The broad aims and policies outlined in the Marine plan have therefore been considered in this EA report.

The primary guidance for offshore decommissioning [7] details the need for an EA to be submitted in support of the DP. The guidance sets out a framework for the required environmental inputs and deliverables throughout the approval process. It now describes a proportionate EA process that culminates in a streamlined EA report rather than a lengthy Environmental Statement as would be required under the Environmental Impact Assessment (EIA) Directive (Directive 2011/92/EU as amended by Directive 2014/52/EU) [22].

## 2.1 Field and Infrastructure Description

The Leman 27J is located in the UKCS in Block 49/27 (see Figure 2), approximately 53km northeast of BGT, off the coast of East Anglia. Its coordinates are: Latitude: 01' 54.9164" North (N) and Longitude: 13' 04.2255" East (E).

The Leman field was discovered by Shell in 1965. The 49/27 block was then tested and appraised by Amoco in 1966 with production coming online in 1968. Leman field utilises 16 development platforms, of which 9 installations are now operated by PUK, as shown in Figure 1. The Leman 27J wells (49/27-J1,49/27-J2, 49/27-J3, 49/27-J4 and 49/27-J5) were developed between September 1983 to February 1984, with production starting in July 1984.

The Leman 27J (Licence Number: P16) used to extract natural gas and condensate from the subsea reservoir and export it via the 16” PL207, which joins the 20” PL206, to Leman 27A. Produced gas and condensate received at Leman 27A was then routed to BGT via a 30” PL 23.

CoP documentation was submitted to the NSTA in November 2021. Approval for CoP was gained on 15th December 2021. The Leman 27J jacket will be decommissioned because no other viable opportunities were identified for the reuse of the jacket.

Pre-decommissioning geophysical and environmental surveys were conducted in 2023. The 27J wells were plugged and abandoned during the topside HCS campaign.

in the autumn of 2024. The 27J topside was removed in November 2024 and the jacket is currently in the ‘Dismantlement Interval Phase’.

Both PL206 and PL207 have been verified as HCS following seawater flushing. PL207 was isolated and physically air-gapped at the topside on the Leman 27J platform.

PL207 will be cut subsea, near the base of the jacket and at the tee junction on PL206. The cut near the base of the jacket will create the air gap between the riser and the rest of the pipeline system to facilitate the removal of the jacket structure. The seabed laid section of PL207 will be removed from the seabed after the jacket removal campaign. The riser section will be removed with the jacket.

The 27J jacket and PL207 are located within the boundary of the North Norfolk Sandbanks and Saturn Reef Special Area of Conservation (SAC) and the Southern North Sea SAC protected areas.

**Figure 1: Overview of Leman field layout**

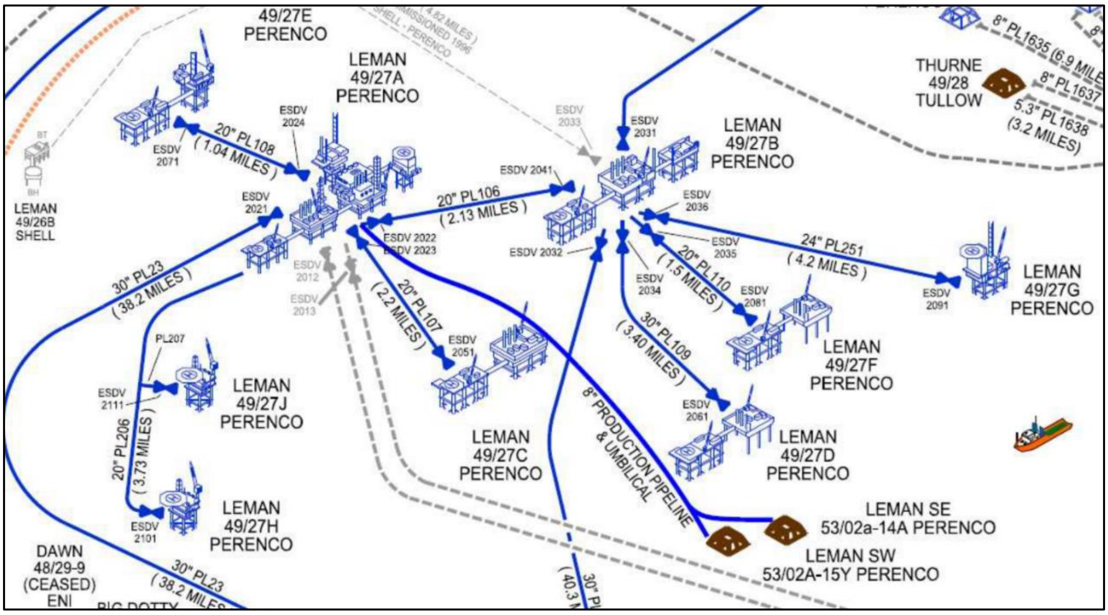
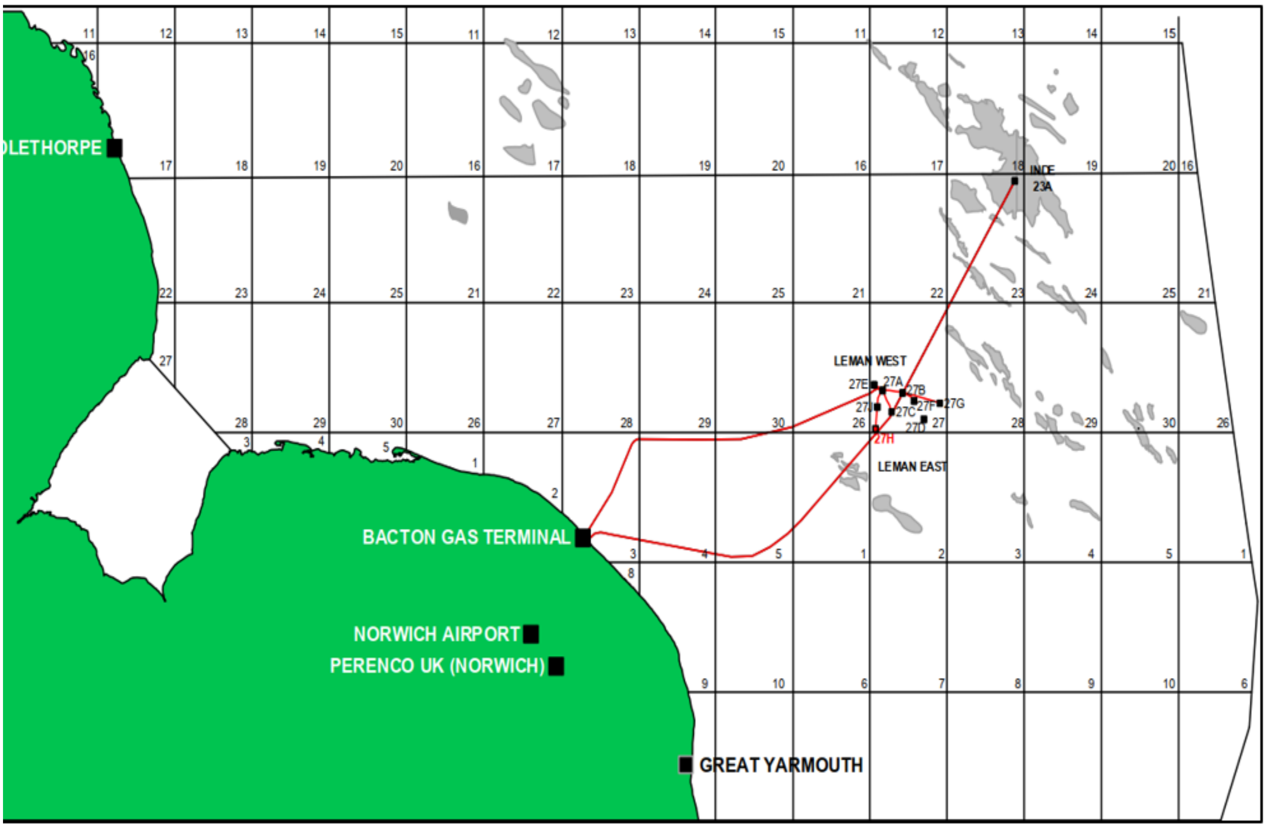


**Figure 2: Leman field location within SNS**



# 3 CONSULTEE RESPONSES

Table 3-1 provides details of stakeholder responses (**HOLD 1**).

**Table 3-1: Consultee Responses**

| **Who** | **Comment** | **Response** |
|---|---|---|
| **1. Stakeholder Consultations** | | |
| Joint Nature Conservation Committee (JNCC) | | |
| Health and Safety Executive | | |
| Environment Agency | | |
| Ministry of Defence | | |
| Centre for Environment, Fisheries and Aquaculture Science (Cefas) | | |
| **2. Public** | | |
| | | |
| **3. Statutory Consultations** | | |
| National Federation of Fishermen's Organisations | | |
| Scottish Fishermen's Federation | | |
| Northern Ireland Fish Producers Organisation | | |
| Global Marine Group | | |
| NSTA | | Perenco UK Limited has consulted with NSTA under S29(2A) of the Petroleum Act |

# 4 DECOMMISSIONING ACTIVITIES & PARAMETERS

This section details the infrastructure being decommissioned and provides details on the selected decommissioning method and timings.

## 4.1 Relevant Infrastructure Inside DP/EA scope

The Leman 27J jacket and PL207 are located within the UKCS block 49/27a in the SNS (Figure 2).

Table 4-1 provides details on the infrastructure relevant to the Leman 27J Jacket & Pipeline DP and EA. The pipeline, which is approximately 45m in length (excluding the riser), is elevated above the seabed by supporting grout bags. It is PUK's intention to remove these grout bags as part of this DP so that they do not present a snagging hazard. If these grout bags are not recoverable, i.e., they have degraded to the point that they cannot be picked up, the PUK will engage OPRED to discuss alternative options.

**Table 4-1: Leman 27J jacket subject to the DP/EA**

| Jacket no. | Water depth | Material | Legs no. | Piles | Weight Note1 | Status |
|---|---|---|---|---|---|---|
| 27J | 41.8 m | Fixed legs steel | 4 | 4 | 1,124 te | The jacket is currently in the 'Dismantlement Interval Phase', with the riser, and subsea PL207 section attached to the jacket. |

**NOTE 1**: Total weight inventory includes jacket, piles and marine growth.
Pile weights: 281te (left in situ once cut -3m below the seabed).

**Table 4-2: Leman 27J pipeline subject to the DP/EA**

| PL no. | Service | Size | Length | Pipeline route | Material | Status |
|---|---|---|---|---|---|---|
| PL207 | Gas Export | 16" | 89.7 m | From the riser open cut-end near the top of the jacket to the tee junction on PL206 | Steel with coal tar enamel and reinforced concrete coating | Subsea PL is elevated above the seabed supported by grout bags Flushed clean, filled with seawater and made HCS |

## 4.2 Relevant Infrastructure Outside the DP/EA Scope

### 4.2.1 Pipelines and Stabilisation Material

The 16" Leman PL207 that joins the 20" subsea PL206 is 89.7 m in length, including the riser section. PL207 will be cut and removed from the seabed.

PL207 has been verified as HCS following seawater flushing to concentrations of less than 30 parts per million (ppm) oil in water. It was isolated and physically air-gapped at the topside on the Leman 27J platform.

A detailed review of the stabilisation material adjacent to Leman 27J jacket confirms that there are no concrete mattresses over PL207.

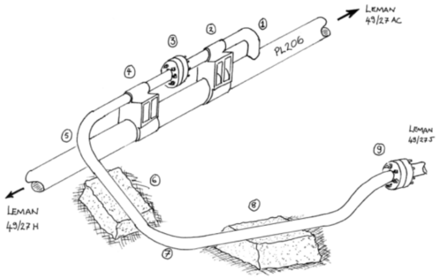
The pipeline is free spanning in this area, supported by grout bags as shown in Figure 3 and Figure 5. The grout bags are estimated to be about one tonne each and be approximately 1 $m^2$ at their base on the seabed. As such, the pipeline can be lifted from the seabed without any seabed excavation. The grout bags will also be removed so they cannot pose a snagging hazard.

**Figure 3: PL207 Drawing [54]**

**Perenco UK 2016 GVI – Riser Datasheet**

PERENCO

| Datasheet Ref. | Leman 49/27 J PL207 16" Riser | Dive No. | 2006/1006 |
|---|---|---|---|
| Vessel | SV Noordhoek Pathfinder | Date | 26/09/2016 |
| Images | | Time | 04:50 UTC |
| Anomalies | 2 | Page | 2 |




| Index | Bolts Secure Y/N | Damage Y/N | Liner Present Y/N | CP Value | Stab/ Prox | Comment |
|---|---|---|---|---|---|---|
| 1 | | N | | | | PL206 20" x 16" Tee |
| 2 | Y | N | | -645<br>-650 | Stab | Tee support clamp: Good Support |
| 3 | | N | | -1045<br>-1043 | Stab | PL207-PL206 Tie-In Flange: Outboard<br>PL207-PL206 Tie-In Flange: Inboard |
| 4 | Y | N | | -643<br>-630 | Stab | Spool support clamp: Good Support |
| 5 | | N | | -1054 | Prox | 90° Horizontal Bend |
| 6 | Y | N | | -1053 | Prox | Grout bag: Good Support |
| 7 | | N | | -1055 | Prox | 45° Horizontal Bend |
| 8 | Y | N | | -1049 | Prox | Grout bag: Good Support |
| 9 | Y | N | | -1046<br>-1050 | Stab | Riser flange: Inboard<br>Riser flange: Outboard |

| Data Recorder | Bradley Moxon-Holt | ROV Sup. | Derek Marshal |
|---|---|---|---|
| Insp. Coordinator | Mike van Wijk | Client Rep | Steve Weatherly |

**Figure 4: PL207 tee intersection with PL206 [54]**


Image shows Index 1 in Figure 3.

**Figure 5: PL207 supported on grout bag [54]**


Image shows Index 6 in Figure 3.

### 4.2.2 Topside and Wells

The 27J topside was removed in November 2024 and the jacket is currently in the 'Dismantlement Interval Phase'. The 27J wells were plugged and abandoned during the topside HCS campaign in the autumn of 2024.

## 4.3 Decommissioning Activities and Methodology

PUK has assessed options for extending the producing life of the Leman 27J jacket, but a suitable relocation or reuse for the jacket as a whole has not yet been identified. At present, dismantling of the Leman jacket at an onshore disposal facility is considered the most likely disposal option. Those materials deemed suitable for recycling will be recovered at an appropriate recycling facility.

### 4.3.1 Preparatory Works

Decommissioning of the Leman jacket 27J installation and pipeline are anticipated to commence from quarter (Q)2 2026. Preparatory work has been carried out in order to enable the proposed decommissioning activities.

CoP documentation was submitted to the NSTA in November 2021. Approval for CoP was gained on 15th December 2021.

The 27J topside was removed in November 2024 as a part of an independent decommissioning campaign, and the jacket is currently in the 'Dismantlement Interval Phase'.

PL207 and PL206 have been flushed clean, rendered HCS and PL207 remains attached to the 27J jacket. PL207 has been left filled with filtered seawater cut above water just below the cellar deck elevation.

Additionally, a pre-decommissioning survey [60, 61] was completed inside the Leman 27J 500m safety zone in 2022.

### 4.3.2 Pipeline Cutting and Removal

Prior to the decommissioning of the Leman jacket and pipeline, PUK will conduct a pipeline cutting campaign to facilitate Leman jacket and pipeline removal.

A total of two subsea cuts, shown in Figure 6, will be performed on PL207. PL207 will be cut and air-gapped at the tee junction on PL206 (-44.8m Lowest Astronomical Tide (LAT)). PL207 will also be cut on the seabed near the base of the Leman 27J jacket (-46.6m LAT). This will create an air gap between the riser and the rest of the pipeline system to facilitate the removal of the jacket structure.

The pipeline is free spanning in this area, supported by grout bags as shown in Figure 3 and Figure 5. The grout bags are estimated to be about one tonne and be approximately 1 $m^2$ at their base on the seabed. As such, the pipeline can be lifted from the seabed without any seabed excavation. The grout bags will also be removed so they cannot pose a snagging hazard.

PL207 is expected to be cut and removed using a vessel with dynamic positioning, and as such, no anchoring will be required for this activity.

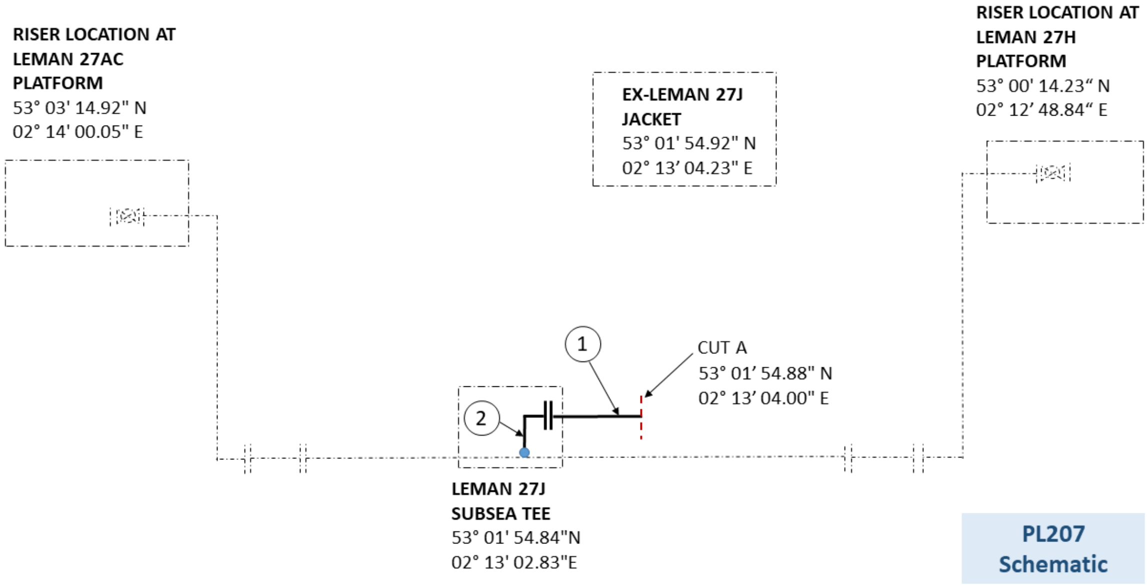



**Figure 6: Diagram showing proposed cuts to PL207. Cut A at PL207 riser. Cut B at 27J Subsea Tee.**

### 4.3.3 Jacket Decommissioning Overview

A single lift removal option using a suitable Heavy Lifting Vessel (HLV) and transportation ashore for cleaning, break up and recycling is considered the most likely removal methodology.

The leg piles will be cut to a target depth of at least 3m below the mean seabed level to ensure that any remains are unlikely to become uncovered. The means of cutting will be an industry standard technique such as diamond wire, oxyacetylene, or high-pressure abrasive water jet cutting.

PUK will investigate the opportunities to perform deeper internal cuts of the piles, subject to surveys to verify the piles are free of internal blockages. However, if this proves unfeasible it would be necessary to excavate the seabed around the piles to enable external cutting. Where required, cleaning will be carried out at the dismantling site for recycling, as appropriate.

The riser section attached to the jacket will be removed with the jacket. Following jacket and riser removal, the rest of PL207 and supporting grout bags will be removed from the seabed.

The installation will be removed as a complete unit by an HLV and transported to shore.

As a result, the following EA has been prepared based on the preferred decommissioning option described above.

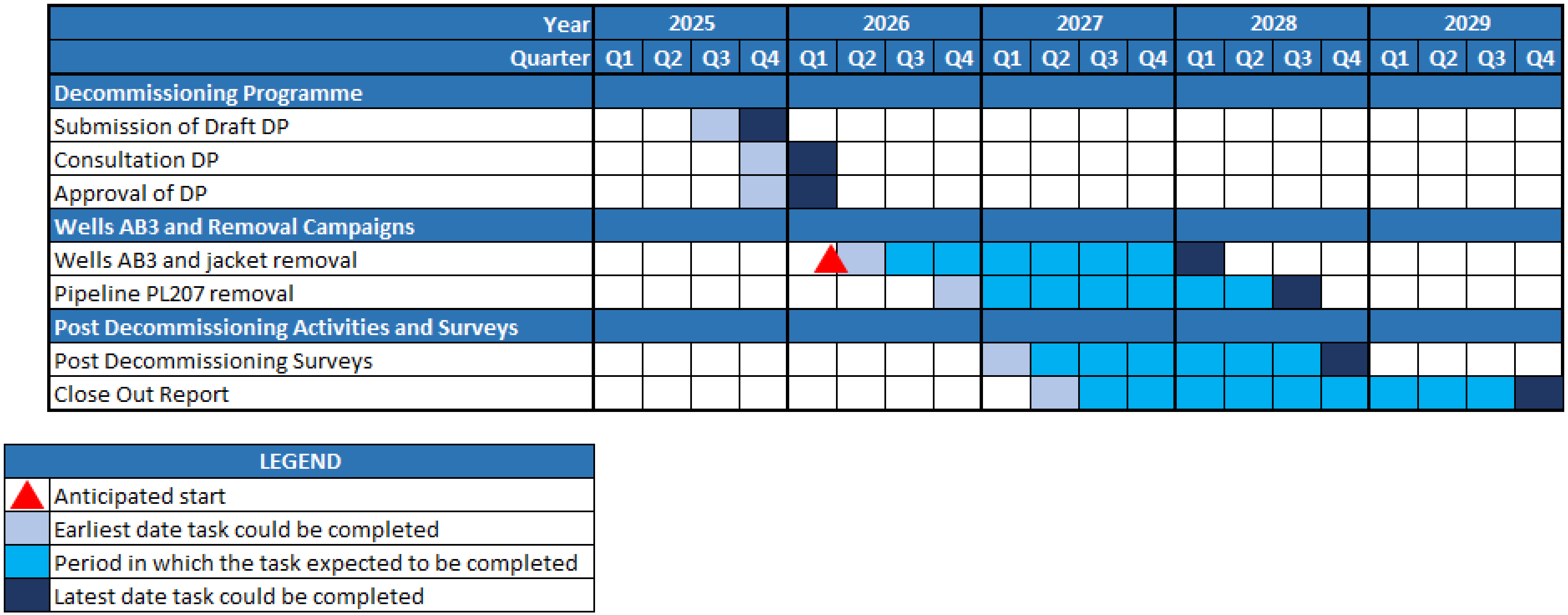
A high-level description of this removal option is presented below, although the exact cutting points and removal method are subject to detailed engineering and commercial tendering.

- Mobilisation of equipment and personnel to HLV.
- Transit of vessel to Leman Field.
- Arrive at 500m exclusion zone and complete pre-entry checks.
- Move into position next to the jacket.

- Launch a Remotely Operated Vehicle (ROV) to inspect the jacket.
- Connect rigging to grillage which the solar Aids to Navigation are placed on with Rope Access Technician (RAT) (if required) and hang off rigging to the vessel deck.
- Connect rigging to the main crane.
- Lift grillage and solar Aids to Navigation from the jacket.
- Connect rigging to Jacket pad-eyes with RAT and hang off rigging to the vessel deck.
- Remove soil plug from pile annulus and complete pile cuts.
- Cut riser at the base of the jacket.
- Connect rigging to the main crane.
- Lift the Jacket to the deck of the vessel and seafasten in place.
- Execute as-left survey/debris removal with ROV.
- Complete safety checks in preparation for leaving the field and moving out of 500m exclusion zone.
- Transport the jacket to a disposal yard for onshore disposal and recycling.

### 4.3.4 Schedule

**Table 4-3: Schedule of Leman 27J jacket and pipeline decommissioning activities**



# 5 ENVIRONMENTAL AND SOCIETAL BASELINE

## 5.1 Introduction

As part of the EA process, it is important that the main physical, biological and societal sensitivities of the receiving environment are well understood. As such, this section describes the main characteristics of the physical and biological environment, identifies the other users of the sea present in and around the Leman development, and highlights any key sensitivities therein.

This environmental baseline description draws upon a number of data sources including published papers on scientific research in the area, industry wide surveys (for example (e.g.) the OSEA3 and OSEA4 programmes) and site-specific investigations commissioned as part of the exploration and development processes and pre-decommissioning survey work carried out at the Leman 27J jacket.

### 5.1.1 Leman 27J Pre-decommissioning Surveys [60,61]

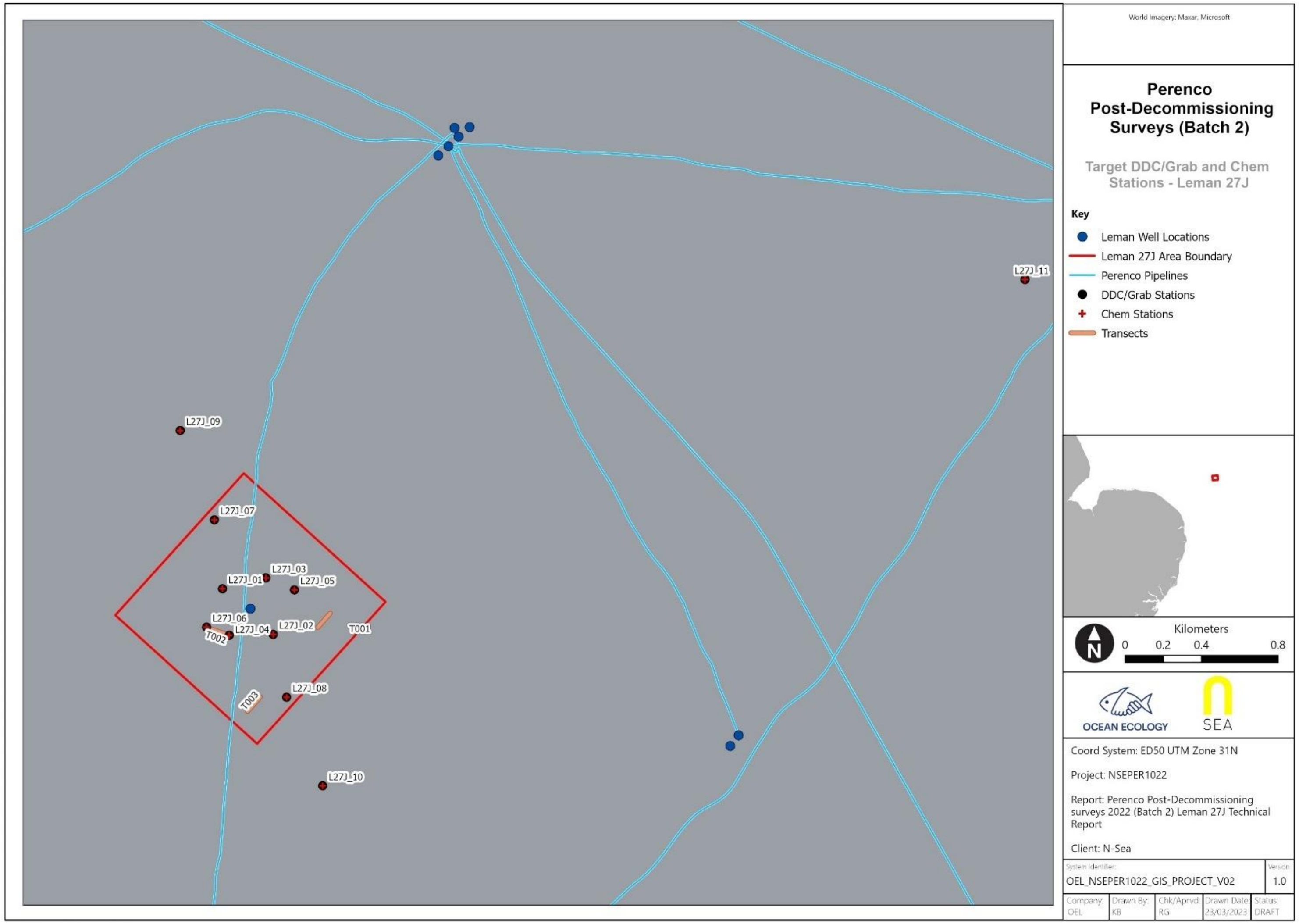
In 2022, PUK commissioned a pre-decommissioning seabed survey of the Leman 27J field.

The key objectives of the environmental benthic survey were to:

- Provide baseline data for sediment physico-chemical characteristics and macrobenthic composition.
- Provide a description of the seabed habitats based on sediment and imagery analysis.
- Identify and assess the status of species and habitats of conservation importance, including Annex I protected species and habitats (such as *Sabellaria spinulosa* biogenic reef or stony reef), and Annex V species of the Habitats Regulations, species listed under Schedule 5 of the Wildlife & Countryside Act, OSPAR species and habitats and designated features of the MPA network (e.g., SAC and Marine Conservation Zone (MCZ) features).
- Confirm the presence/absence of any epibenthic Invasive Non-Native Species, epibenthic species non-native to UK waters and epibenthic species non-native to the local habitat types (e.g., hard-substrate specialists in a wider sedimentary habitat).

Drop Down Camera and sediment sampling was carried out at 11 stations, and three transects, resulting in the acquisition of 167 still images, 18 videos and 30 sediment samples (see Figure 7). The imagery substantiated geophysical data observations, particularly in areas where the acoustic data presented high density of indentations, confirming the presence *of S. spinulosa* aggregations. In contrast, other areas were predominantly characterised by sand, often manifesting as ripples measuring less than 10cm in amplitude.

**Figure 7: Overview of target stations across the Leman 27J pre-decommissioning survey area**



### 5.1.2 N-Sea Decommissioning Seabed Surveys [54]

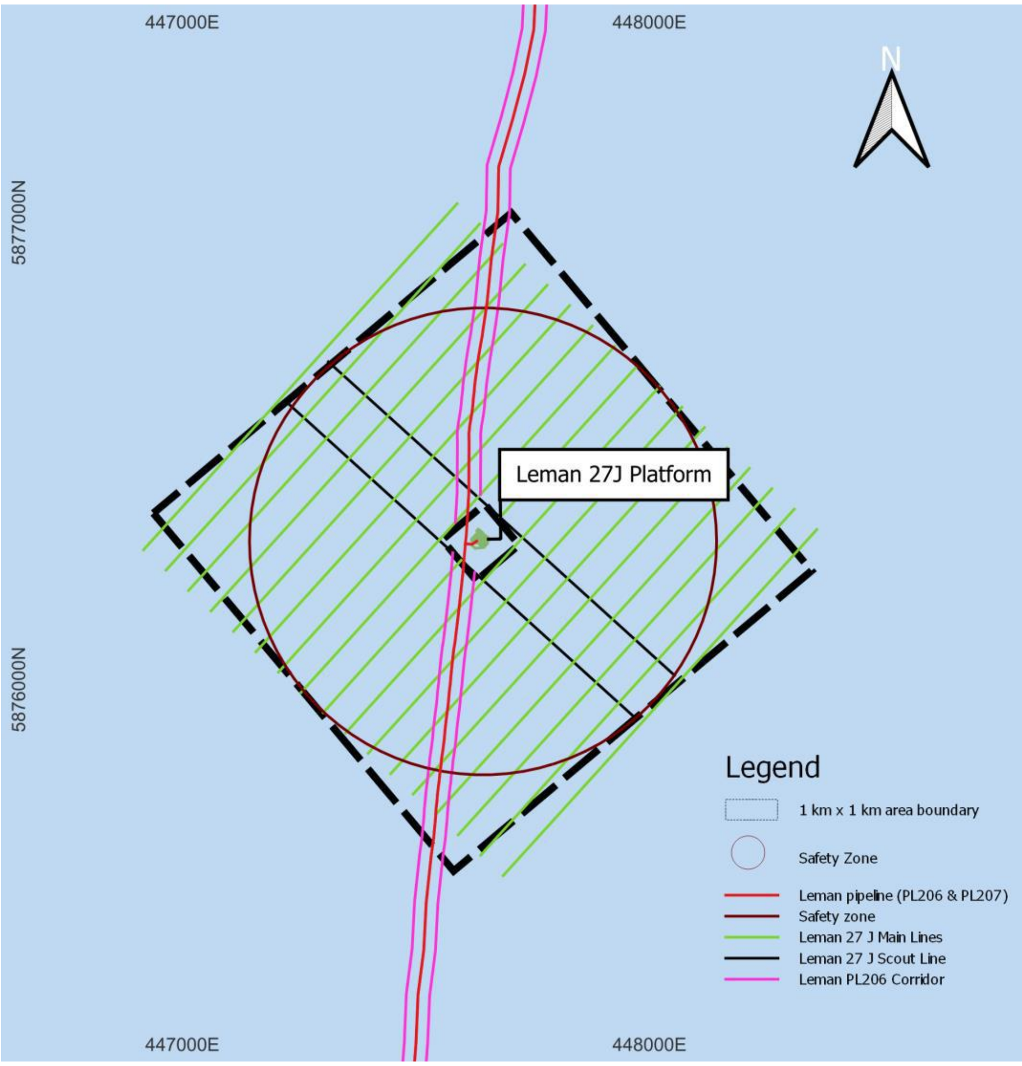
A geophysical survey was completed with the Braveheart Spirit vessel in Leman 27J area, between 19 December 2022 and 03 January 2023.

The scope of work at the Leman 27J platform and PL207 pipeline consisted of Multibeam Echosounder (MBES), Side scan sonar (SSS), and single magnetometer surveys covering 1km x 1km platform box-in and 100m wide pipeline corridor. An environmental work scope was also completed in this area (see Table 5-1 and Figure 8).

**Table 5-1: N-Sea work scope**

| Asset | Corridor/ area | Geophysical survey | | | Environmental survey | |
|---|---|---|---|---|---|---|
| | | MBES coverage | SSS coverage | MAG | Benthic grabs | Drop down camera |
| Leman 27J | 1km x 1km | 150% | 200% | Single magnetometer | Min. 10 locations | Min. 10 locations |

**Figure 8: Leman 27J and Leman Pipeline line plan**



### 5.1.3 N-Sea Leman 49/27 J PL207 16” Riser Survey 2016 [54]

ROV footage was collected of PL207 in 2016 to gather information on the pipeline’s condition and layout [54]. The footage was used to create a drawing of the pipeline provided in Figure 3. The survey identified that PL207 is located above the seabed, and it supported by grout back bags as shown in Figure 5.

### 5.1.4 Debris Site Surveys – Leman 27J 2025 [56]

Additional pre-decommissioning site surveys, including MBES, SSS, Single Magnetometer and Drop Down Camera (DDC) transects were completed by N-Sea in July 2025. The purpose of the survey work was to:

- Acquire geophysical data to evaluate the potential hazards for a self-elevating platform and to ensure there is no debris which may impede the safe operation of the jack-up barge.
- Assess the status of the benthic communities, including the status of *S. spinulosa* biogenic reef habitats surrounding the Leman 27J platform.

The survey found that the seafloor in the survey area was characterised by a varying depth profile with a general shoaling to the West and characterised by the presence of megaripples. The maximum water depths are noted in the East of the survey area and in the area of scour related to the platform. The minimum depths are recorded on a bank to the East of the platform.

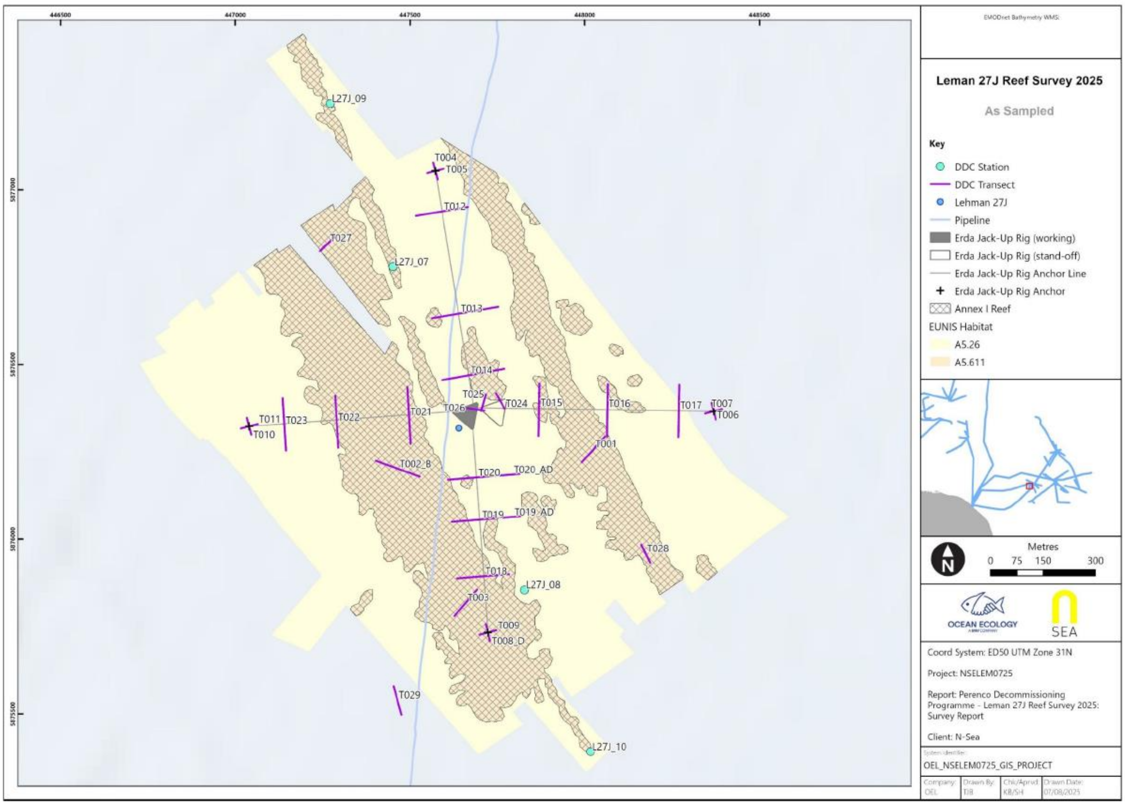
The seabed sediments in the Leman 27J platform survey area were interpreted primarily as sand, with an area of sandy mud correlated with sections of hummocky / mottled seabed.

The common substrates identified by the onboard ecologists during live review of the seabed imagery before in-depth analysis were EUNIS A5.26 ‘Circalittoral muddy sand’ and EUNIS A5.611 ‘*S. spinulosa* on stable circalittoral mixed sediment’.

Potential Annex I reef features were identified along the transects and points shown in Figure 9. Observed Annex I reef broadly followed the existing Annex I reef mapping shown in Figure 9. However, despite being within an area previously mapped as Annex I habitat, Stations T022, T015, T016, T019 and T009 did not meet the definition of ‘Potential Annex I reef’. It is noted that *Saballaria spinulosa* clumps were recorded at these stations but that these clumps were considered too patchy to meet the definition of biogenic reef. Comparatively, *Saballaria spinulosa* was observed at T012 and that transect was classified as Potential Annex I reef despite not being in previously mapped reef area.

Potential Annex I reef features were identified along the transects and points shown in Figure 9. The distribution of observed Annex I reef features generally corresponded with the existing Annex I reef mapping shown in Figure 9. However, despite being located within areas previously mapped as Annex I habitat, Stations T022, T015, T016, T019, and T009 did not meet the definition of ‘Potential Annex I reef’. Although *Sabellaria spinulosa* clumps were recorded at these stations, they were considered too patchy to qualify as biogenic reef. In contrast, *Sabellaria spinulosa* was observed at T012, and this transect was classified as Potential Annex I reef, despite falling outside the previously mapped reef area.

**Figure 9: Overview of as-sampled stations in the 2025 reef survey [56]**




### 5.1.5 Bathymetry

The SNS extends from the Flamborough front in the South (S) to N of the Dover Strait in the S, with a transition from North Sea water to Atlantic water. This region is shallow (generally 0-50m), with a predominantly sandy seabed [6]. Mapped information [46] indicates that the SNS generally comprises of sand and muddy sand with significant areas of coarse sediment, especially closer to shore.

The SNS has many extensive sandbanks features present at less than 25m depth; these include areas which have been designated under the EU Habitats Directive (92/43/EEC) such as Dogger Bank SAC and the North Norfolk Sandbanks SAC [6].

Water depths at the Leman 27J jacket area range from 39.3m to 43.7m LAT, with average water depth of approximately 41.6m LAT. Sand wave features were visible within the Leman 27J survey area, mostly to the northwest of the platform (447072 E, 5876629 N) [54] (see Figure 10).

The seabed within the Leman 27J platform area is characterised by the presence of megaripples (wavelengths varying between 3m to 14m approximately), interspersed with large, NNW-SSE bands (the largest band is approximately 250m wide) of hummocky, mottled seabed. Furthermore, one band of highly bifurcated sand waves (wavelengths 30 – 60m) is present and associated with the largest band of mottled/hummocky seabed.

All megaripples and sand wave features are generally sub-parallel to cuspate and occasionally linguoid in character, with crests roughly oriented NEE – SWW. A raised ridge in the east of the site is also apparent and is associated with a hummocky region. Trending to the north of the platform, two regions of scour were observed, conforming with the predominant northerly current direction.

PL207 was identified in MBES dataset as 21m long, starting at the Leman 27J platform and finishing at the Tee Piece connecting to the PL206 pipeline. Water depths along the pipeline range from 44.8m to 46.9m LAT.

Throughout the entire survey area, 44 contacts were interpreted as debris and 267 as boulders. Contacts to the north of the platform were interpreted as debris due to their location down-current from the platform and proximity to the platform. One cluster of debris was also interpreted 12m N of the platform [54].

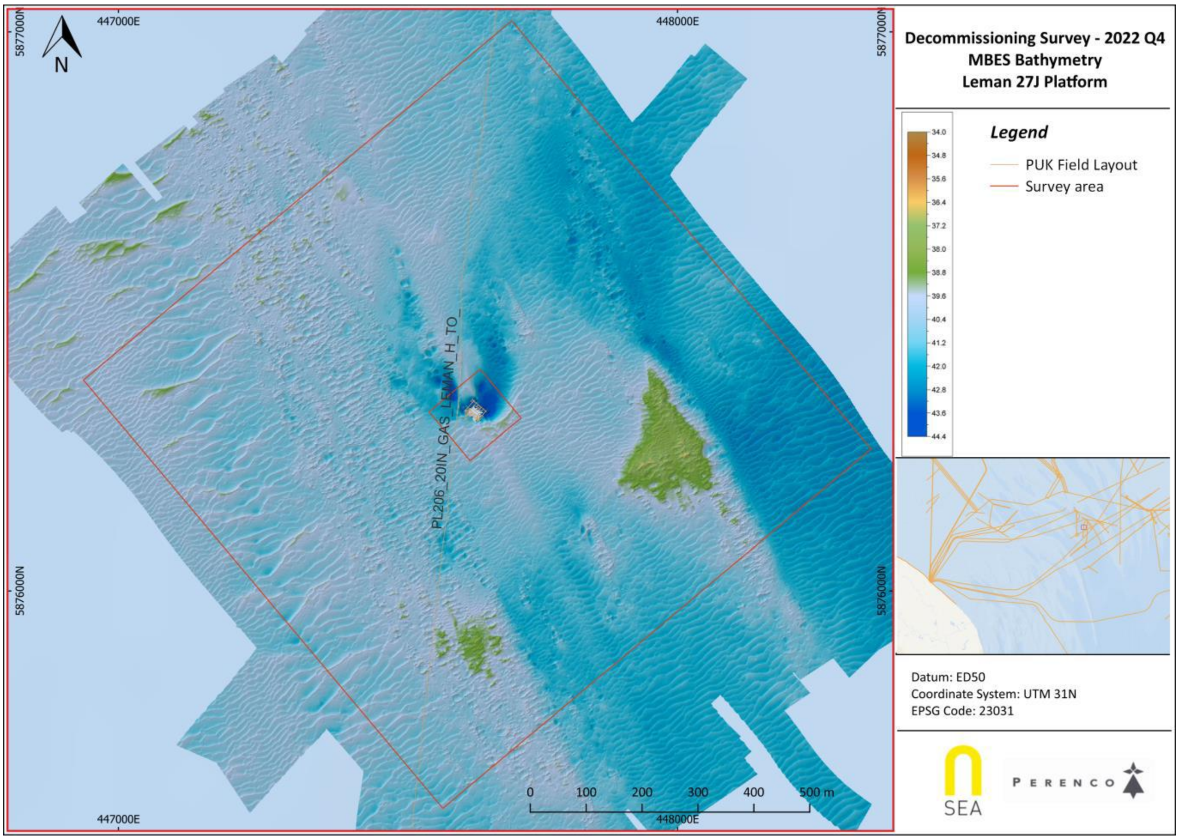
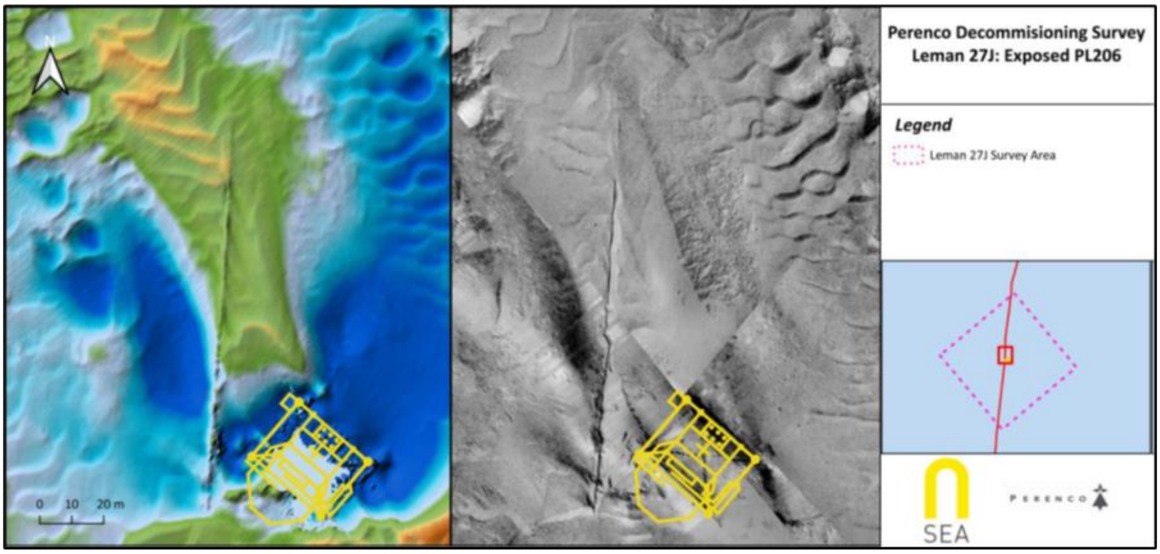



**Figure 10: Overview of Leman 27J bathymetry**

**Figure 11: Identified exposure segment of PL206 in Leman 27J Area (MBES Left & SSS Right)**




### 5.1.6 Habitat Classification

The following European Nature Information System (EUNIS) seabed classifications has been identified to be present within the Leman jacket area (Figure 14) [10, 6]:

**A5.27 Deep circalittoral sand** - Offshore (deep) circalittoral habitats with fine sands or non-cohesive muddy sands. Very little data is available on these habitats however they are likely to be more stable than their shallower counterparts and characterised by a diverse range of polychaetes, amphipods, bivalves and echinoderms.

Additional EUNIS habitats are also present in the near vicinity of Leman 27J jacket area:

**A5.25/A5.26 Circalittoral sand** - Circalittoral clean fine sands with less than 5% silt/clay in deeper water, or either on the open coast or in tide-swept channels of marine inlets in depths of over 15-20m or non-cohesive muddy sands with the silt content of the substratum typically ranging from 5% to 20% generally found in water depths of over 15-20m. This habitat is generally more stable than shallower, infralittoral sands and consequently supports a more diverse community. This habitat extends offshore, while very little information is available on these, they are likely to be more stable than their shallower counterparts. This habitat is characterised by a range of taxa including polychaetes, bivalve molluscs, and amphipod crustacea.

**A5.23 or A5.24: Infralittoral fine sand or Infralittoral muddy sand** - Non-cohesive muddy sand (with 5% to 20% silt/clay) in the infralittoral zone, extending from the extreme lower shore down to more stable circalittoral zone at about 15-20 m. The habitat supports a variety of animal-dominated communities, particularly polychaetes (*Magelona mirabilis, Spiophanes bombyx* and *Chaetozone setosa*), bivalves (*Fabulina fibula* and *Chamelea gallina*) and the urchin *Echinocardium cordatum*.

The 2022 pre-decommissioning Habitat Assessment Surveys [60, 61] was conducted in Leman 27J area (see Figure 12). There was little variation in sediment composition across the survey area, with most stations characterised predominantly by sand. Mud contribution to sediment was higher than gravel at most sites, but it never constituted a substantial proportion of the sediments.

In general, most stations were classified as sand and muddy sand (BSH A5.2), suggesting the survey area could represent the habitat of principal conservation importance “Subtidal sands and gravels” under the Section 41 of the Natural Environment and Rural Communities Act 2006.

Based on the interpretation of the acoustic data and seabed imagery analysis alone, the survey area was categorised primarily as homogenous circalittoral muddy sand (A5.26). Extensive areas of the biotope *S. spinulosa* on stable circalittoral mixed sediment (A5.611) were also interpreted throughout the survey area. Sand ripples, and mega ripples were identified throughout the surveyed area.

Seabed imageries of the EUNIS habitats encounter within the survey area are shown in Figure 13.

**Figure 12: EUNIS classification habitat mapping at the Leman 27J survey area [10; 6]**

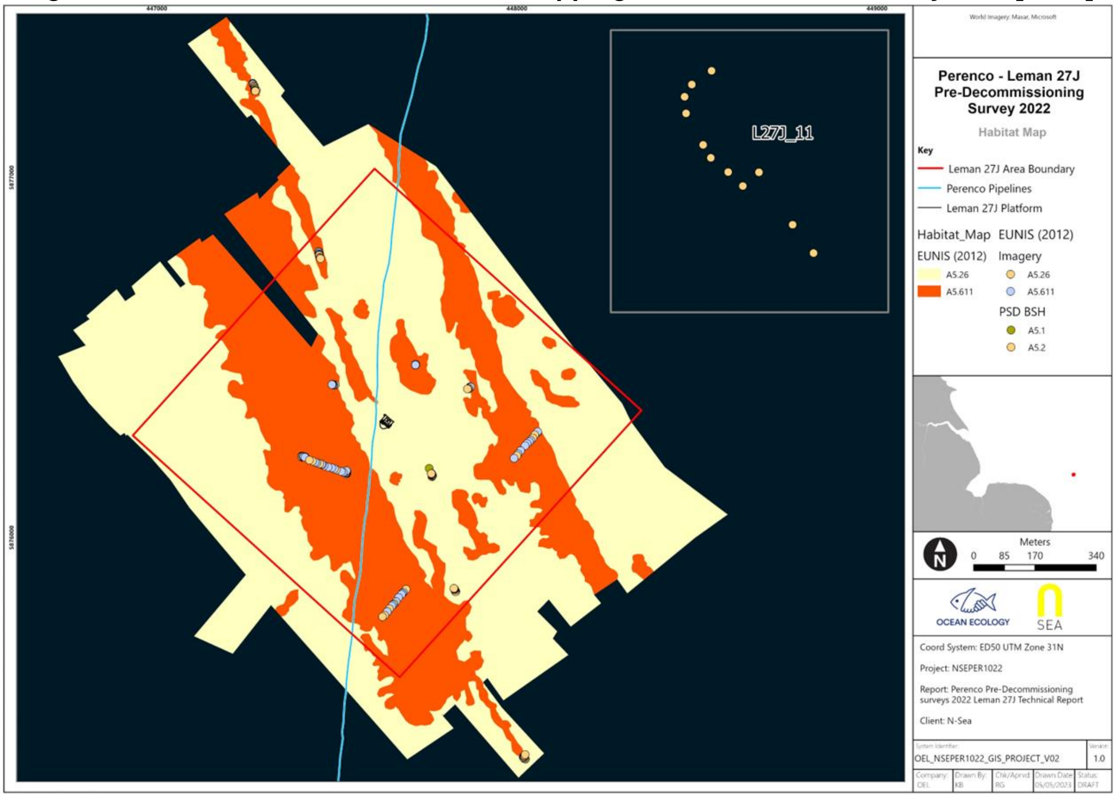
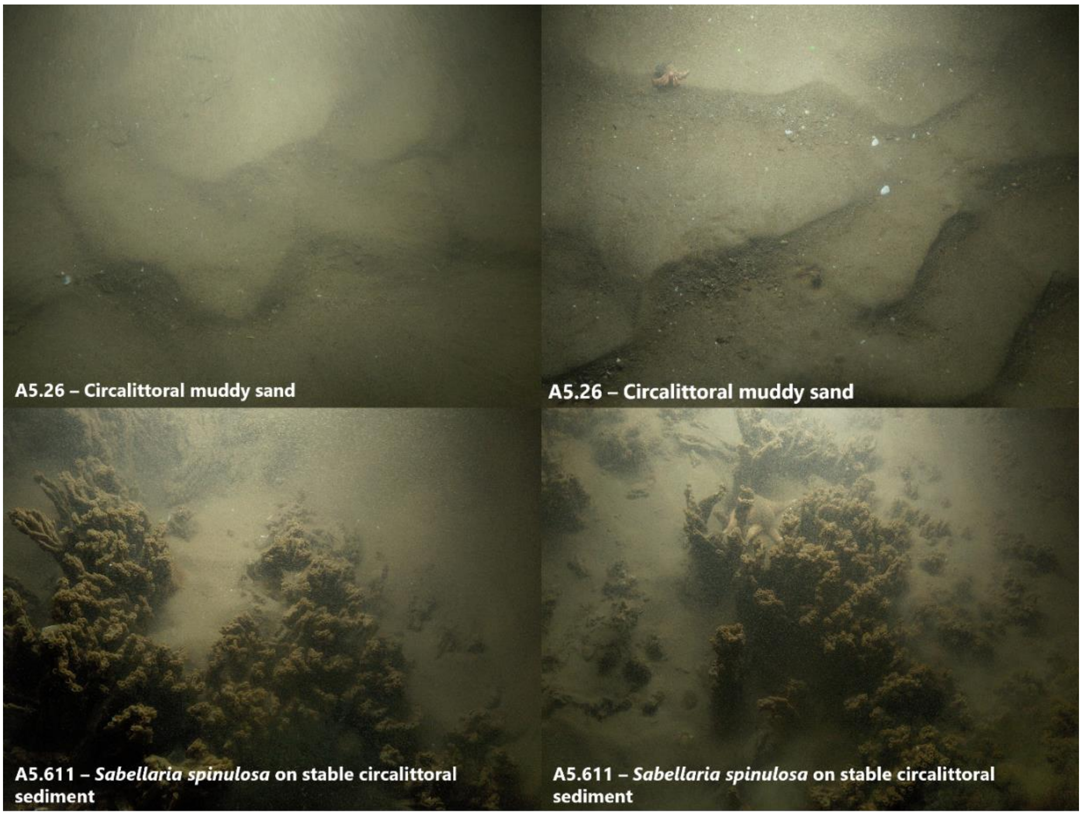


**Figure 13: Examples of EUNIS habitat identified from imagery analysis at pre-decommissioning survey**



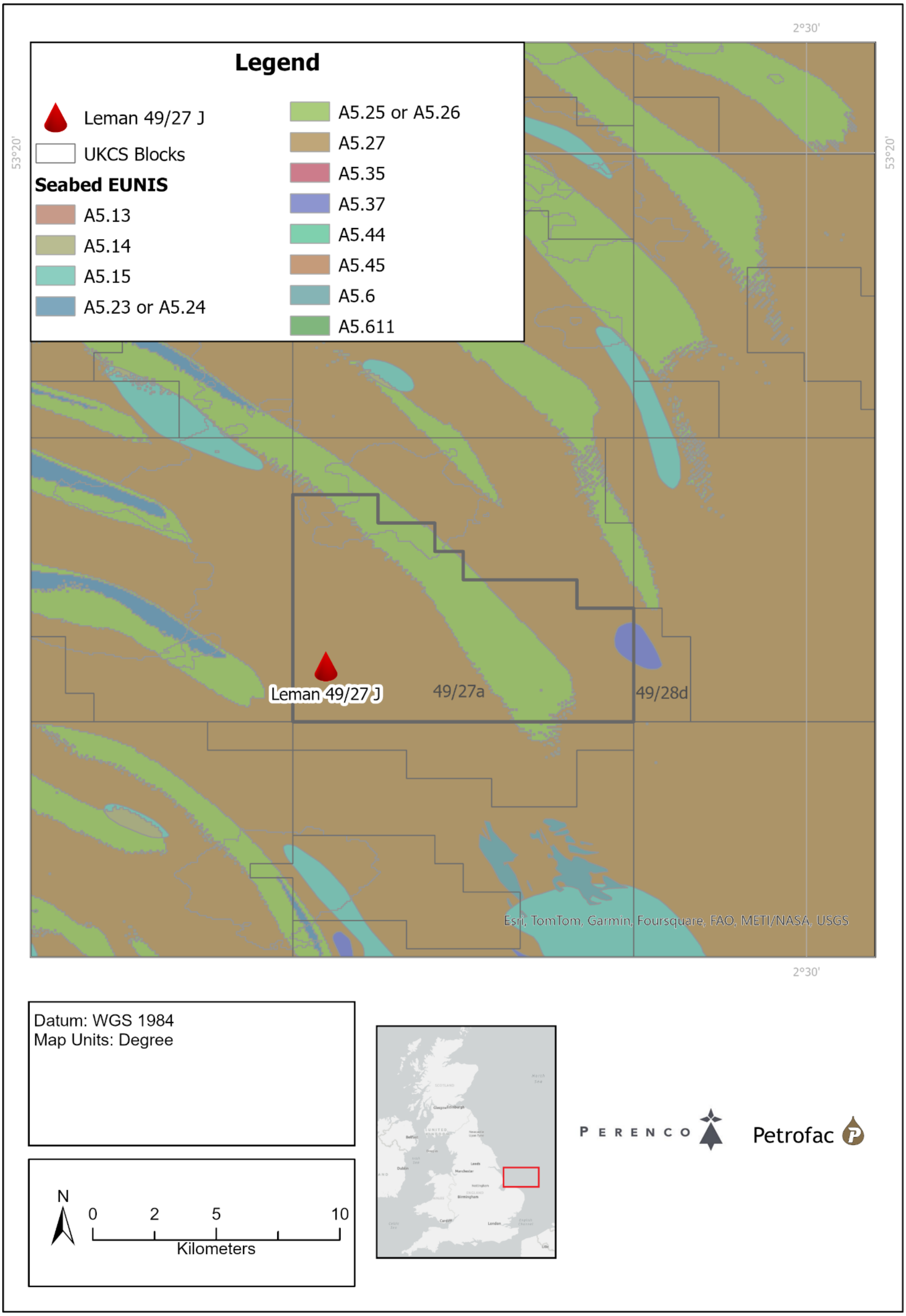

### 5.1.6.1 Annex 1 Habitat

The pre-decommissioning survey identified *S. spinulosa* aggregations of significant size that qualified as Annex I biogenic reef (see Figure 13). *S. spinulosa* are ecosystem engineers and high abundances of *S. spinulosa* can form loose agglomerations of tubes which form into a low-lying matrix of sand, gravel, mud, and tubes on the seabed. These reefs increase biodiversity by consolidate sediments and allow the settlement of species not found within adjacent habitats.

The presence of such extensive areas of good quality *S. spinulosa* reef promotes the settlement of larval Sabellaria, therefore promoting the continued development and expansion of such reefs. Biogenic reefs such as *S. spinulosa* are sensitive habitats, easily impacted by changes to the environment such as poor water quality and increased sediment load, as well as physical damage caused by trawling and dredging activities. It is possible these reefs are being offered protection by the exclusion zones implemented around oil and gas structures. Further, subsea structures associated with oil and gas infrastructure could be sheltering or promoting the growth of biogenic reef by acting as suitable hard substrates in which individuals may propagate and grow in otherwise unsuitable habitat conditions.

The offshore waters of the central and southern North Sea contain some of the most well developed and stable *S. spinulosa* reefs in the UK. Several extensive *S. spinulosa* reef areas have been mapped < 12km to the south and <20 km to southwest of the Leman 27J survey area. This data further extended the northerly range of mapped biogenic reef features for this region and signified an important area of Annex I biogenic reef habitat.

**Figure 14: Seabed EUNIS broad-scale seabed classification**



### 5.1.7 Particle Size Distribution

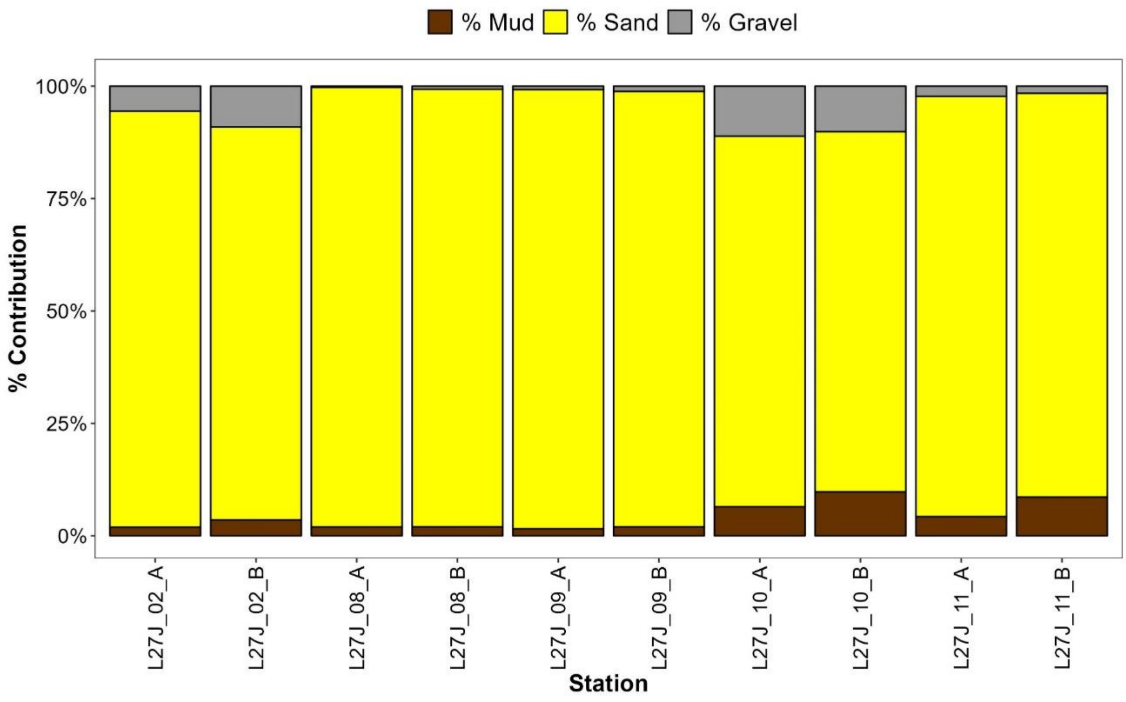
Very little variation in sediment composition was observed between stations across the Leman 27J survey area, with the majority of stations being primarily characterised by sand and all samples being described as `medium sand` under the Folk and Ward description.

In terms of sediment type, 6 samples were identified as Slightly Gravelly Sand ((g)S and classified as A5.2 Sand and Muddy Sand (EUNIS BSH), 3 samples were identified as Gravelly Sand (gS) and classified as A5.1 Coarse Sediment and one station was made of Gravelly Muddy Sand (gmS) and classified as A5.4 Mixed Sediments.

Sorting was relatively homogeneous across most samples. 4 samples were moderately sorted, 4 were poorly sorted and the remaining 2 samples were moderately well sorted.

The percentage contribution of gravels (> 2mm), sands (0.63mm to 2mm), and fines (< 63µm) within each sample are presented in Figure 15. Sand was the main sediment fraction present at most stations, comprising the largest percentage contribution across the survey area. The mean proportion (± Standard Error (SE)) of sands across all stations was 92% (± 0.3), the mean (± SE) gravel and mud content across the survey area was 4% (± 0.1) and 4% (± 0.1) respectively.

**Figure 15: Contribution to sediment volume of gravel, sand, and mud at each sampling station across the survey area**



### 5.1.8 Seabed Chemistry

Grab samples taken for chemical analyses were analysed for Total Organic Carbon (TOC), heavy and trace metals, Polycyclic Aromatic Hydrocarbon (PAH) and Total Hydrocarbon Content (THC).

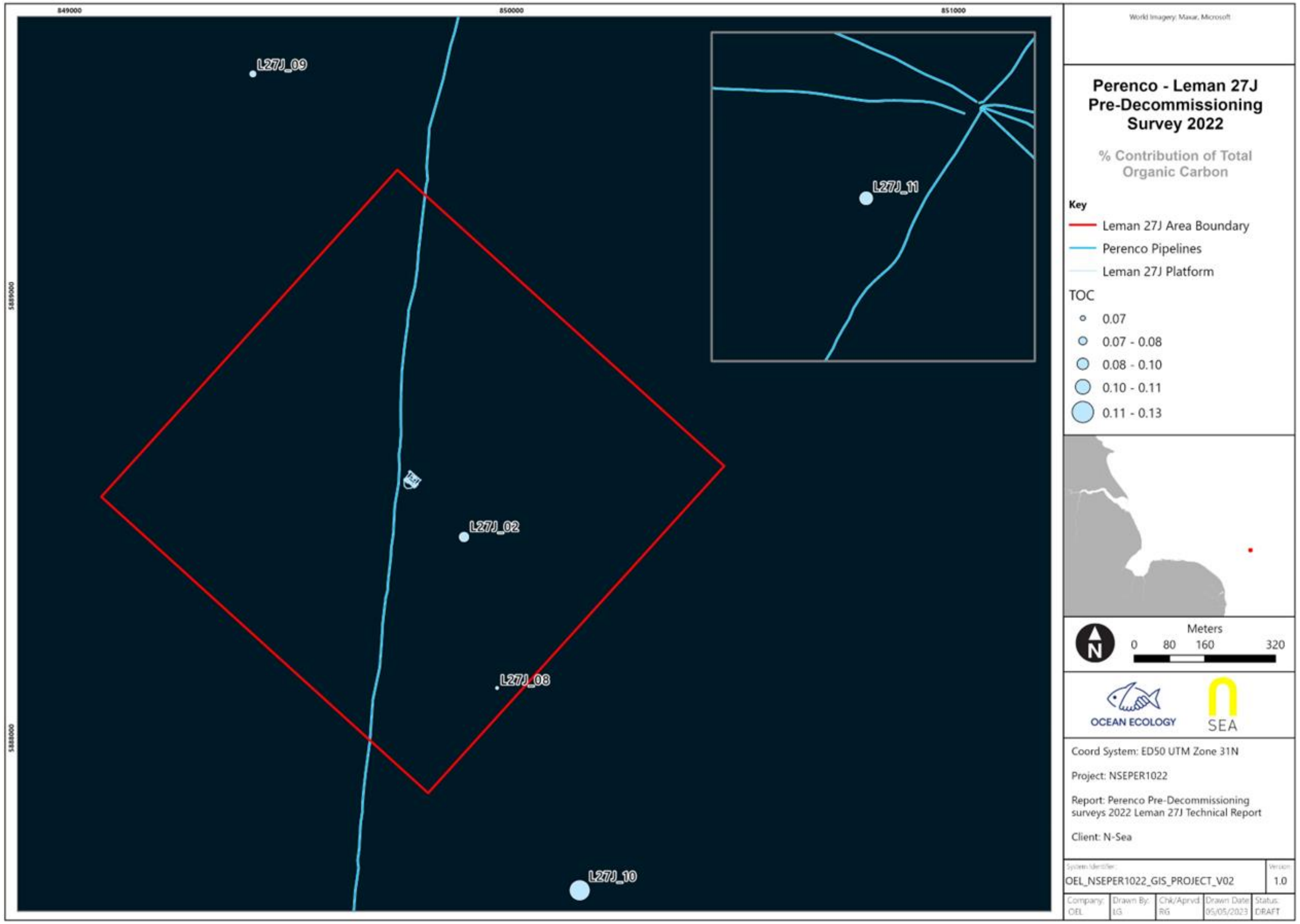
To evaluate the potential ecological impacts of contaminants in marine sediments and the degree of contamination, several guidelines exist. These guidelines define the levels below which effects are of no concern or rarely occur (Assessment Level (AL)1, Background Assessment Concentration (BAC), Threshold Effects Level (TEL)), and the levels above which adverse biological effects are considerable or occur frequently (AL2, effect range low (ERL), Probable Effects Level (PEL)). *Ad hoc* decisions must be made when contaminant concentrations fall between these levels. Notably, Cefas AL1 is often a more conservative measure when assessing sediment contamination, potentially resulting in false positives, meaning that non-toxic sediment samples fail to pass this screening test. Conversely, ALs2 tend to be more permissive, allowing samples with relatively high contaminant concentrations to fall between AL1 and AL2, requiring expert judgment to assess potential toxicity [43, 48].

#### 5.1.8.1 TOC

TOC represents the proportion of biological material and organic detritus within the substrates. This method is less susceptible to the interference sometimes recorded using crude combustion techniques, such as analysing total organic matter by Loss on Ignition.

TOC content in sediments across the Leman 27J survey area was low compared to the average content of 0.5% for the deep ocean and 2% for coastal seas [76]. TOC concentrations ranged from 0.07% at station L27J_08 to 0.13% at station L27J_10, with an average value (± SE) of 0.098 ± 0.01%. Despite the limited range in TOC content in sediments, a positive correlation was observed between mud and TOC possibly suggesting a common pattern in the transport and deposition of these two sediment components across the survey area. No pattern was observed between TOC content and distance from the platform.

**Figure 16: TOC Leman pre-decommissioning environmental survey**



#### 5.1.8.2 THC

The THC in sediment samples across the Leman 27J survey area ranged from 3,360 µg kg-1 at station L27J_09 to 6,960 µg kg-1 at station L27J_10 with an average value (± SE) for the whole area of 5,446 ± 614.81 µg kg-1 (Figure 17).

N-alkanes (saturates) in sediments had carbon chains length ranging between C14 and C37, with the dominant chain being C31. The highest concentration of total n-alkanes of 151 µg kg-1 was recorded at station L27J_08, while the lowest concentration of 77.8 µg kg-1 was found at L27J_09.

Pristane reached a maximum concentration at station L27J_08 (29.22 µg kg-1) and Phytane reached maximum levels at station L27J_02 (6.18 µg kg-1). Phytane was BDL (<1 µg kg-1) at stations L27J_09, L27J_10, and L27J_11, therefore, the Pri/Ph ratio could not be calculated at these stations. The results obtained when using the Pri/Ph ratio indicated a biogenic predominance in the source of n-alkanes, as the ratio was larger than one at all stations where it could be calculated. Notably the Pri/Ph ratio was higher than three at all the stations where it could be measured (i.e., L27J_02, L27J_08), possibly indicating terrestrial input.

The Carbon Preference Index (CPI) was also used to assess n-alkanes origin sources, and the origin of n-alkanes was considered predominantly biogenic (CPI >1) at all stations.

Figure 17 represents the distribution of THC and N-Alkanes across the Leman 27J survey area.

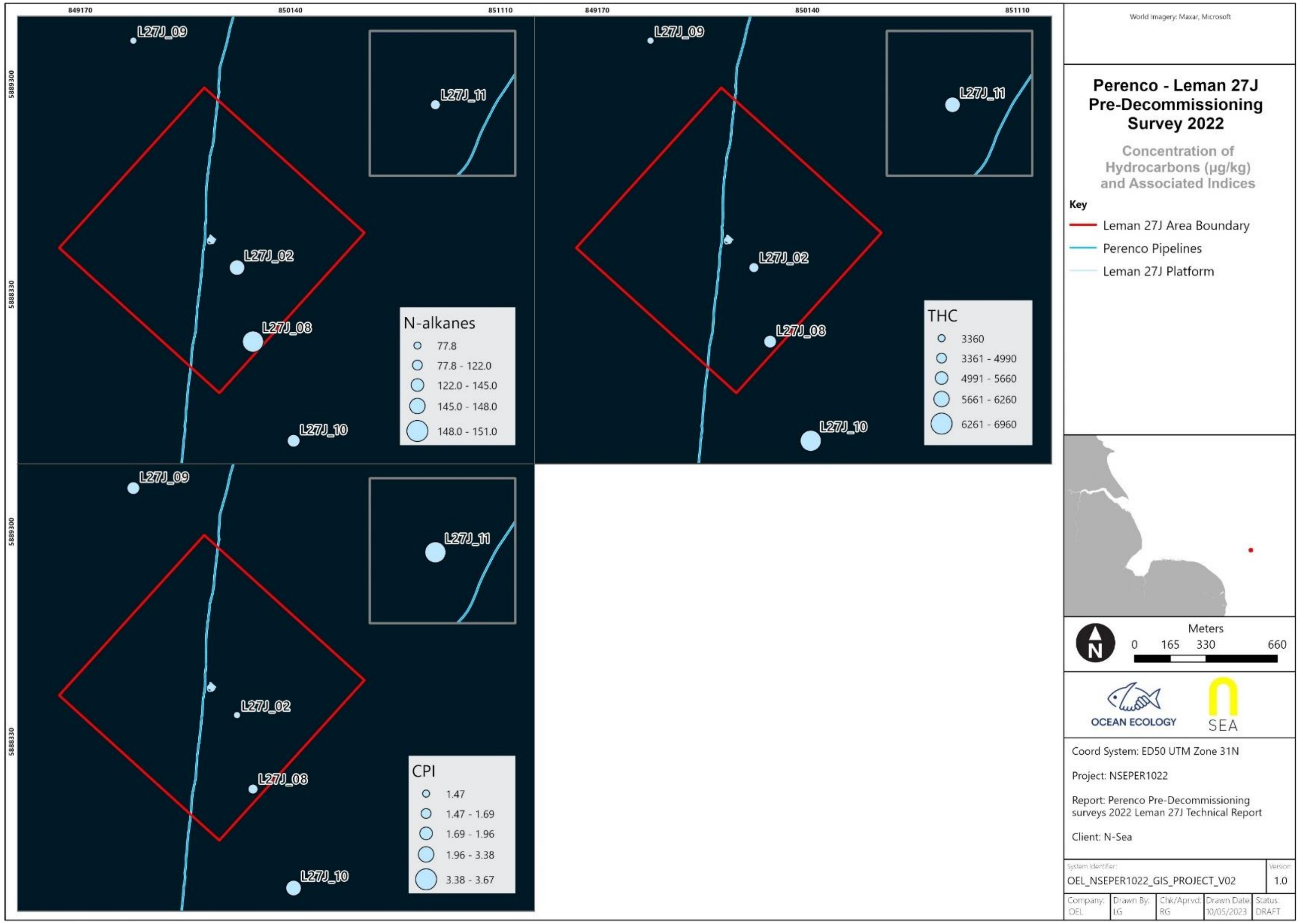
#### 5.1.8.3 PAH

PAH concentrations were compared to Cefas AL1 (no Cefas AL2 available for PAHs), OSPAR BAC and ERL, and TEL and PEL where possible.

None of the guidance levels were exceeded for any of the measured PAHs across the Leman 27J survey area. The most abundant PAH was Phenanthrene, with concentrations ranging from <1 µg kg-1 at stations L27J_09, L27J_10, and L27J_11 to 9.36 µg kg-1 at station L27J_08. Total PAHs concentration across the survey area varied between Below Detection Limit (BDL) at stations L27J_09, L27J_10 and L27J_11 and 193 µg kg-1 at station L27J_08. The highest concentration of lightweight PAHs was recorded at station L27J_08 (92.2 mg kg-1).

Based on the ratio between light (LMW) and heavy molecular weight (HMW) PAH, stations L27J_08 and L27J_10 were characterised by PAHs of a predominantly pyrogenic origin (LMW/HMW PAH ratio < 1), while station L27J_02 was characterised by PAHs of a predominantly petrogenic source, with a ratio of 0.46. The Ph/Ant ratio for L27J_08 was above 10 µg kg-1 indicating petrogenic origin of PAHs at this station, whereas all the other stations had ratios indicative of a pyrogenic origin (<10). Fl/Py ratios at all stations were above one indicating a predominance of PAHs of pyrogenic origin.

**Figure 17: Spatial distribution of N-Alkanes and THC across the Leman 27J survey area. *Note different scales**



### 5.1.8.4 Heavy and Trace Metals

Metals occur naturally in the marine environment and are widely distributed in both dissolved and sedimentary forms. Some are essential to marine life while others may be toxic to numerous organisms [65]. Rivers, coastal discharges, and the atmosphere are the principal modes of entry for most metals into the marine environment [73], with anthropogenic inputs occurring primarily as components of industrial and municipal wastes. Historically, several heavy and trace metals are found in elevated concentrations where drilling fluids or produced waters have been discharged by oil and gas installations. These include intentional additives (such as metal-based salts and organo-metallic compounds in the fluids) as well as impurities within the drilling mud systems such as clays (e.g. bentonites; a gelling and viscosifying agent) and metal lignosulphates (a viscosity controller). The metals most characteristic for offshore contamination of marine sediments from oil and gas activities are barium (Ba), chromium (Cr), lead (Pb) and zinc (Zn) [51], although these may vary greatly dependent upon the constituents used.

Trace metal contaminants in the marine environment tend to form associations with the non-residual phases of mineral matter, such as iron and manganese oxides and hydroxides, metal sulphides, organics, and carbonates. Metals associated with these non-residual phases are prone to various environmental interactions and transformations (physical, chemical, and biological), potentially increasing their biological availability. Residual trace metals are defined as those which are part of the silicate matrix of the sediment and that are located mainly in the lattice structures of the component minerals. Non-residual trace metals are not part of the silicate matrix and have been incorporated into the sediment from aqueous solution by processes such as adsorption and organic complexes and may include trace metals originating from sources of pollution. Therefore, in monitoring trace metal contamination of the marine environment, it is important to distinguish these more mobile metals from the residual metals held tightly in the sediment lattice [11], which are of comparatively little environmental significance.

Of particular relevance to the offshore oil and gas industry are metals associated with drilling related discharges. These can contain substantial amounts of barium sulphate (barites) as a weighting agent and Ba is frequently used to detect the deposition of drilling fluids around offshore installations. Barites also contain measurable concentrations of heavy metals as impurities, including Cadmium (Cd), Cr, Copper (Cu), Pb, Mercury (Hg), and Zn. Heavy metals, either as impurities or additives are also present in other mud components.

Metals are generally not harmful to organisms at concentrations normally found in marine sediments and some, like Zn, may be essential for normal metabolism although they can become toxic above a critical threshold. In order to assign a level of context for toxicity, an approach used by Long, et al. [42] to characterize contamination in sediments was used within the Environmental Baseline Survey (EBS). Consequently, the defined ERL values represents the lowest concentration of a metal that produced adverse effects in 10% of the data reviewed, whilst ERM values represents the level at which half of the studies reported harmful effects. In accordance with this, metal concentrations recorded below the ERL value are not expected to elicit adverse effects, while levels above the ERM value are likely to be toxic to some marine life.

The question of bioavailability of metals to marine organisms is a complex, as sediment granulometry and the interface between water and sediment all affect bioavailability and subsequently toxicity. Therefore, even if a metal is found in higher concentrations it does not necessarily conclude a detrimental effect on the environment, if present in an insoluble state.

Heavy and trace metal concentrations in sediments across the Leman 27J survey area were analysed, focusing on Arsenic (As), Cd, Cr, Cu, Pb, Hg, Nikel (Ni), and Zn, as these metals can provide insight into the potential impact of the oil and gas industry on the marine environment. Overall, heavy and trace metal concentrations in the Leman 27J survey area were mostly below the threshold levels, except for As at stations L27J_02, L27J_09 and L27J_10 (see Table 5-2 and Table 5-3).

In line with the OSPAR commission's recommendations for the oil and gas industry, this study focused on Cd, Pb, and Hg levels. For context, Cd, Pb, and Hg concentrations were compared across the Leman 27J survey area to their respective background levels in the North Sea.

Hg was below detection limit at all stations except station L27J_02, where it registered a low concentration of 0.02 mg kg-1. Cd was only above detection limit at station L27J_10, with a concentration of 0.09 mg kg-1, which is well below the North Sea background level of 0.20 mg kg-1 [81]. Pb concentrations in the Leman 27J survey area ranged from 5.4 mg kg-1 to 10.3 mg kg-1, consistently lower than the North Sea background levels, which vary between 57.52 mg kg-1 within 500m from an active platform and 12.12 mg kg-1 at locations over 5,000m away from active platforms [81].

In addition to the main heavy and trace metals, Ba and Barium by Fusion (TBa) were monitored, as they are relevant to the oil and gas industry due to their association with drilling fluids. Ba levels varied between 8.8 mg kg-1 at station L27J_09 and 13.9 mg kg-1 at station L27J_10. TBa concentration was 100 mg kg-1 at stations L27J_02, L27J_09, and L27J_10, and 200 mg kg-1 at station L27J_11. These TBa concentrations were below the United Kingdom Offshore Operators Association (UKOOA) [81] background levels, which range between 33,5562.12 mg kg-1 within 500m of an active platform and 320.26 mg kg-1 at locations over 5,000m away from active platforms.

The positive correlation between mud content and Cd, Al, and Ba is indicative of a higher affinity for these metals to associate with finer sediments. Higher mud content in the sediment can be the results of terrigenous runoff from the coast. However, there was no pattern in the distribution and concentration of these metal content and proximity to land, most likely due to the limited number of stations sampled.

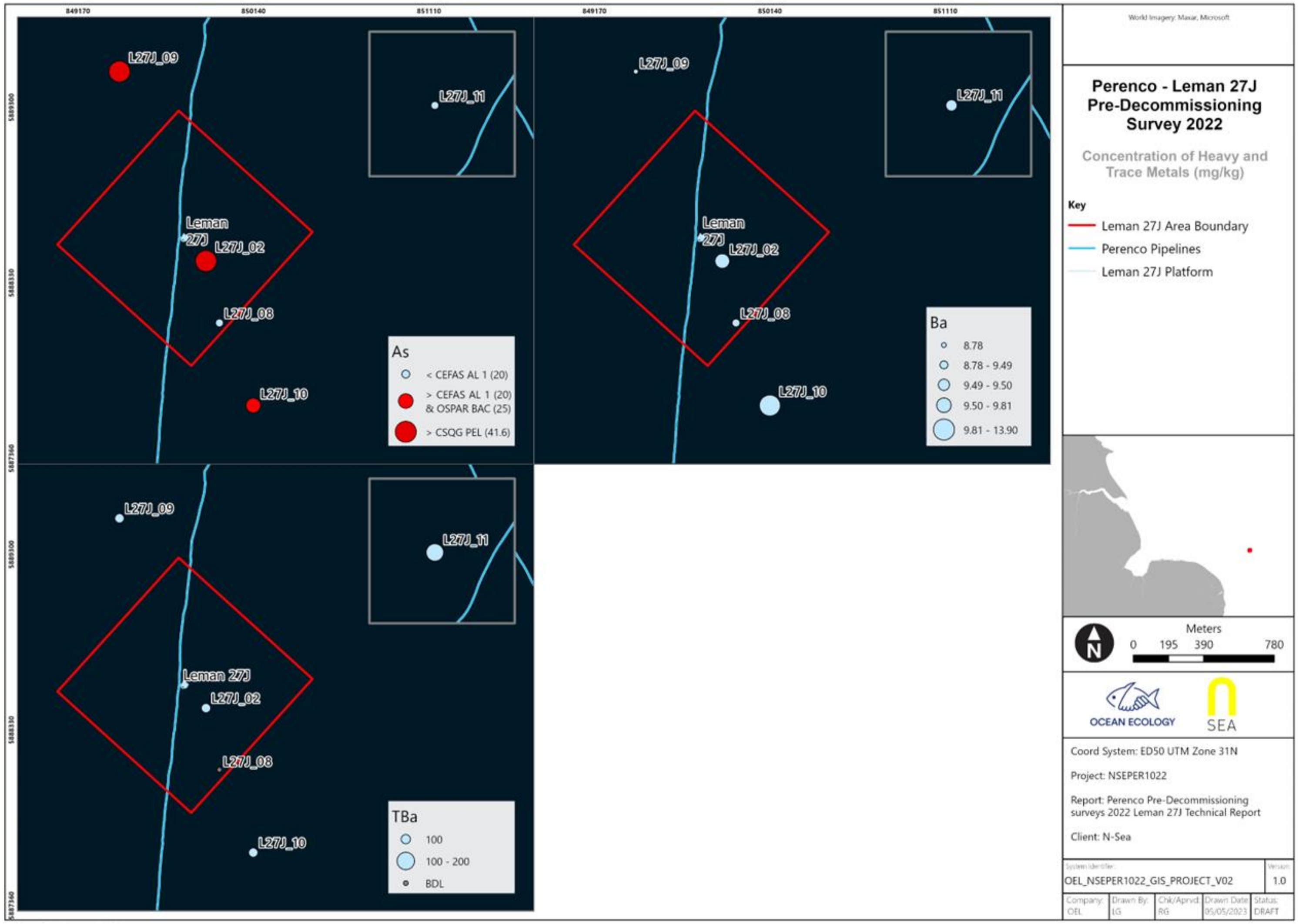
**Table 5-2: Summary of heavy and trace metal concentrations (mg.kg$^{-1}$) in sediments**

| Station | As | Cd | Cr | Cu | Pb | Hg | Ni | Zn |
|---|---|---|---|---|---|---|---|---|
| **L27J_02** | 65.5 | <0.04 | 5.9 | 3.5 | 10.3 | 0.02 | 5.0 | 23.0 |
| **L27J_08** | 16.7 | <0.04 | 6.9 | 5.1 | 5.4 | <0.01 | 4.0 | 15.9 |
| **L27J_09** | 44.0 | <0.04 | 6.0 | 2.7 | 8.8 | <0.01 | 4.6 | 20.0 |
| **L27J_10** | 37.0 | 0.09 | 5.60 | 4.90 | 6.50 | <0.01 | 4.80 | 17.6 |
| **L27J_11** | 18.2 | <0.04 | 4.90 | 3.90 | 6.20 | <0.01 | 4.10 | 16.9 |
| **MIN** | **16.7** | **0.09** | **4.9** | **2.7** | **5.4** | **BDL** | **4** | **15.9** |
| **MAX** | **65.5** | **0.09** | **6.9** | **5.1** | **10.3** | **BDL** | **5** | **23** |
| **MEAN** | **36.28** | **0.09** | **5.86** | **4.02** | **7.44** | **BDL** | **4.5** | **18.68** |
| **Cefas AL1** | 20 | 0.4 | 40 | 40 | 50 | 0.3 | 20 | 130 |
| **CefasAL2** | 100 | 5 | 400 | 400 | 500 | 3 | 200 | 800 |
| **OSPAR BAC** | 25 | 0.31 | 81 | 27 | 38 | 0.07 | 36 | 122 |
| **OSPAR ERL** | 8.2* | 1.2 | 81 | 34 | 47 | 0.15 | 21* | 150 |
| **CSQG TEL** | 7.24* | 0.7 | 52.3 | 18.7 | 30.2 | 0.13 | - | 124 |
| **CSQG PEL** | 41.6 | 4.2 | 160 | 108 | 112 | 0.7 | - | 271 |

**Table 5-3: Number of stations across the Leman 27J survey area exhibiting elevated heavy and trace metals levels in comparison to reference levels.**

| Metal | Cefas AL1 | Cefas AL2 | OSPAR BAC | OSPAR ERL | CSQG TEL | CSQG PEL |
|---|---|---|---|---|---|---|
| **As** | 3 | 0 | 3 | 5 | 5 | 2 |
| **Cd** | 0 | 0 | 0 | 0 | 0 | 0 |
| **Cr** | 0 | 0 | 0 | 0 | 0 | 0 |
| **Cu** | 0 | 0 | 0 | 0 | 0 | 0 |
| **Pb** | 0 | 0 | 0 | 0 | 0 | 0 |
| **Hg** | 0 | 0 | 0 | 0 | 0 | 0 |
| **Ni** | 0 | 0 | 0 | 0 | - | - |
| **Zn** | 0 | 0 | 0 | 0 | 0 | 0 |

**Figure 18: Contribution of Arsenic, Barium and barium by fusion across the Leman 27J survey area. *Note different scales**



### 5.1.9 Waves

Waves are the result of energy being transferred between two fluids moving at different rates [19]. They are caused at sea by the differential motion of the air (wind) and the seawater. The height of a wave is the distance from the crest to trough, but as the waves at any one time are not of equal size, the significant wave height is taken and corresponds approximately to the mean height of the highest third of the waves. The wave period is the (mean) time between two wave crests, called the zero up-crossing period and is given in seconds. The wave climate of the area provides information on the physical energy acting on structures and dictates the structural design requirements.

The highest mean wave height corresponds to the Leman jacket infrastructure is recorded as 1.47m, with an annual mean power of 8.71 Kilowatt/metre (kW/m) [1].

### 5.1.10 Water Circulation and Tides

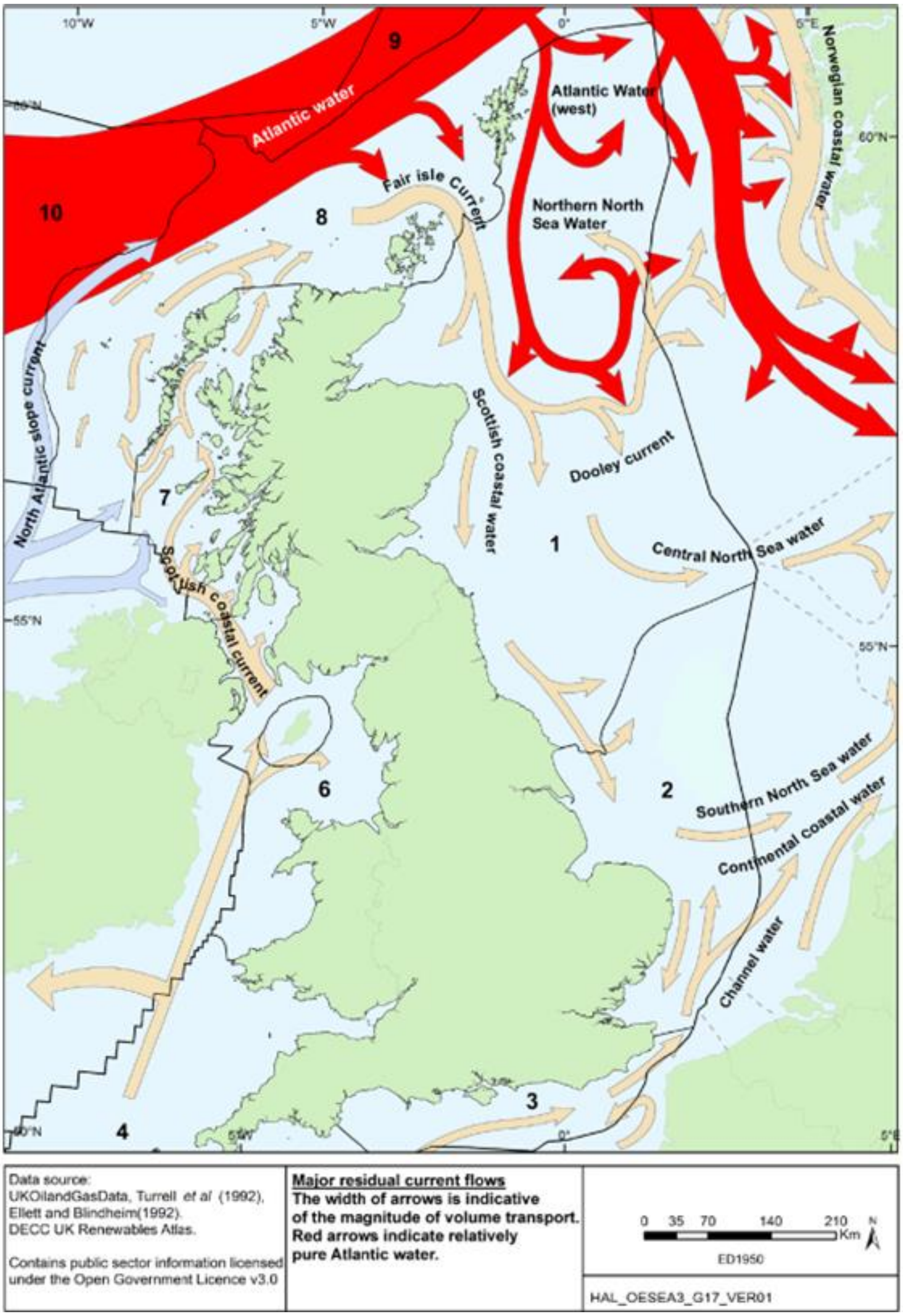
The general circulation of near-surface water masses in the North Sea is cyclonic, mostly driven by the ingression of Atlantic surface water in the western inlets of the Northen North Sea. As a result, residual water currents near the sea surface tend to move in a SE direction along the coast towards the English Channel [57; 2].

In addition, counter currents occur towards the English/ Dutch sector median line, flowing NE towards Denmark (Figure 19). The effect of this counter current in the vicinity of the blocks of interest pushes the near-surface water movement towards a more southerly and easterly direction.

Significant variations in local currents are observed near the UKCS Block 49/27, primarily due to the presence of large bedforms such as sandbanks and ridges. These features can alter near-bottom flow patterns and amplify currents in their vicinity [28; 13]. Additionally, the shallow bathymetry and relatively fast water circulation in this area of the SNS lead to a relatively well-mixed water column throughout the year. This leads to a consistent level of biological productivity throughout the year, with only minor peaks seen in spring and late summer, which are typical of deeper waters [8].

Tides in this region of the SNS are predominately semi-diurnal and increase towards Hunstanton coast. The mean spring tidal range in the blocks of interest is 1.65m [2].

**Figure 19: Major Current flows around the UK [6]**



### 5.1.11 Temperature & Salinity

Winter water temperatures in the SNS are in the range of 4 – 8°C, while summer water surface temperatures are in the range of 16°C – 19°C, with little variation, either down the water column or from near shore to offshore waters [21]. Salinities decrease both towards the S and towards the coastline, reflecting the influence of freshwater inputs from the adjacent landmasses.

Sea surface temperatures at the Leman 27J jacket reach the minimum peak in February (5.32 °C) and maximum peak in August (16.76°C), with an average mean annual temperature in the range of 10.79 – 10.94°C. Near seabed temperatures follow the same monthly variation pattern, varying from 5.44°C to 16.50°C, with an annual mean of 10.69 – 10.87°C.

The salinity in the blocks of interest varies throughout the year. The mean annual salinity of the sea surface varies between 34.417 parts per thousand (ppt) to 34.635ppt, with an overall mean of 34.550ppt. While the mean salinity of the near seabed varies between 34.439ppt to 34.646ppt, with an overall mean of 34.549ppt [53].

## 5.2 Biological Environment

### 5.2.1 Benthic Biodiversity

The predicted EUNIS seabed habitats in Leman 27J installation was A5.27 Deep circalittoral sand [10, 6] while A5.25/A5.26 Circalittoral sand and A5.23 or A5.24: Infralittoral fine sand or Infralittoral muddy sand were also identified in the near vicinity.

Species characteristic of the sediment type A5.27 Atlantic (deep) circalittoral sand include: *Maldane sarsi, Eudorellopsis deformis, Amphiura filiformis*, polychaetes such as *Terebellidae* sp., *Chaetozone setosa, Levinsenia gracilis, Scoloplos armiger*, the amphipod *Harpinia antennaria* and the bivalves *Nuculoma tenuis* and *Parvicardium minimum*, the tube building polychaete *Owenia fusiformis* often with the brittlestar *Amphiura filiformis*, the polychaetes *Goniada maculata, Pholoe inornata, Diplocirrus glaucus, Chaetozone setosa* and *Spiophanes kroyeri* with occasional bivalves such as *Timoclea ovata* and *Thyasira equalis*, the sea cucumber *Labidoplax buski* and the cumacean *Eudorella truncatula*. In the Kattegat infaunal bivalves achieve the highest biomass, with infaunal polychaetes, crustaceans and insect larvae less dominant. Characteristic species are *Macoma balthica Arctica islandica, Cerastoderma* spp., *Mya arenaria, Astarte borealis, Macoma calcarea, Mya truncata, Astarte* spp., *Spisula* spp, *Chamelea gallina* [23].

The Leman 27J pre-decommissioning survey was conducted in 2022. A total of 10 macrobenthic samples, 11 DDC stations and 3 additional DDC transects were successfully obtained during the survey.

Based on the 10 macrobenthic replicate samples collected from the five stations across the Leman 27J survey area, a macrobenthic assemblage was identified consisting of 363 individuals and 60 different taxa. Each station had a mean of 16 ± 2 taxa, with an average abundance of 36 ± 6 and a biomass of 0.489 ± 0.165 gAFDW (see Figure 20).

The findings indicated that *U. brevicornis* was the most abundant taxon, representing 17.5% of all individuals sampled and occurring in nearly 82% of the samples. These results align with the established understanding of *U. brevicornis* distribution, as they are recognized as being ubiquitous and prevalent in the Southern Bight [27], a region in close proximity to the survey area.

*N. cirrosa* and *S. armiger* were also an important component of the macrobenthic assemblages observed across the survey area. Both these species are known to be adaptable to a variety of sediment types, which could explain their presence across the survey area. *N. cirrosa* is a detritivore, feeding on organic particles within the sediment, while *S. armiger* is a deposit feeder, consuming organic matter from the sediment surface. Their prevalence suggests that the area provides a sufficient supply of organic material to support their presence in relatively high numbers. *N. cirrosa* is a dominant species in the Southern Bight with high densities at the Brown Bank and near the coast [27].

The Ross worm *S. spinulosa* was found across the Leman 27J survey area with 5 individuals counted at station L27J_02 and one specimen identified at station L27J_09. This species is protected under the Habitats Directive when in reef form however no reef forming features were observed at the stations. However, seabed imagery analysis revealed the presence of a low and medium resemblance *S. spinulosa* reef at stations which were located close to stations L27J_02 and L27J_09 and would explain why a few *S. spinulosa* individuals were found at this location.

11 DDC stations and three transects resulted in the collection of 167 still images and 18 videos. This data corroborated geophysical observations, especially in areas with a high density of indentations indicative of potential reef presence. Annex I biogenic reefs recorded in still images were assigned to EUNIS classification A5.611 '*Sabellaria spinulosa* on stable circalittoral sediment'. The reefs appeared healthy and covered a significant proportion of the seabed. Conversely, areas without *S. spinulosa* were classified as A5.26 or "Circalittoral muddy sand".

Across the survey area, epifauna was typically scarce becoming more prevalent in proximity of biogenic reefs, a known hot spot for biodiversity. Conversely, the rest of the survey area was characterised by an infauna-dominated community. The presence of healthy *S. spinulosa* reefs in some areas suggested that conditions such as water quality and sediment stability could be favourable for these organisms.

Potential Annex I reef features were identified in 67 images (55%) across the survey area. Examples of the imagery of Annex I *S. spinulosa* reef habitat are represented in Figure 21. These images depicted circalittoral muddy sand with low reefiness and clumps of *Sabellaria*, as well as *S. spinulosa* on stable circalittoral sediment with reefiness ranging from low to medium, presenting both clumps and tube structures. The seabed video and still imagery captured several epifaunal taxa, including hydrozoans, Paguridae (*Pagurus bernhardus*), Actinaria, and echinoderms.

As discussed in Section 5.1.4, more recent ground-truthing of Annex I *S. spinulosa* reef habitat was conducted in 2025. This survey took place in July 2025. As the survey took place after the topside removal in 2024, it is possible to observe evidence of seabed disturbance impacts on the reef.

The distribution of observed Annex I reef features generally corresponded with the existing Annex I reef mapping shown in Figure 9. However, some stations previously mapped as Annex I reef habitat no longer met the definition due to the patchy distribution of *S. spinulosa*. These included stations located within the impact area of the 2024 decommissioning HLV anchors and anchor lines, such as T009, T016, and T022. It is noted that *S. spinulosa* was still present at these stations, though not at sufficient density or extent to qualify as reef under Annex I criteria. Interestingly, other stations within the same impact area retained their reef status, including T008, T003, and T018, while T012 was newly classified as reef. Given that this survey took place approximately one year after the decommissioning activities, it is possible that some of the observed differences in reef classification reflect either damage from the works or early stages of natural recovery.

**Figure 20: Percentage contributions of the top 10 macrobenthic taxa to total abundance (a) and occurrence (b) from samples collected across the Leman 27J survey area. Also shown are the maximum densities of the top 10 taxa per sample (c) and average densities of the top 10 taxa per sample (d)**

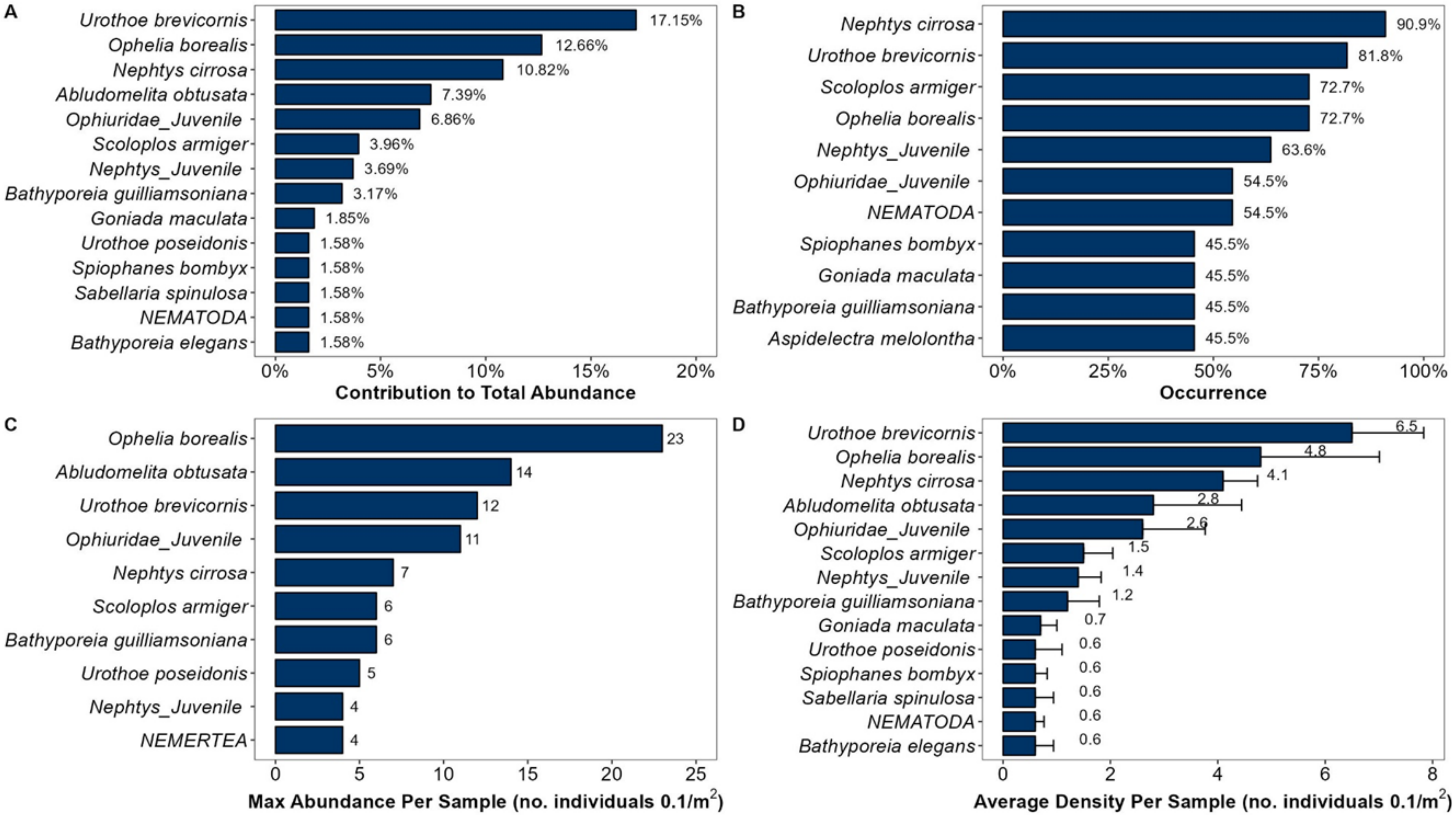


**Figure 21: Example imagery of Annex I *S. spinulosa* reef habitat observed during the survey. Top: Medium resemblance reef (Station L27J 03, T001). Bottom: Low resemblance reef (Station T002, L27J 04).**

### 5.2.2 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. Typically, in the SNS a phytoplankton bloom occurs every spring, generally followed by a smaller peak in the autumn [6].

The SNS is characterised by shallow, well-mixed waters, which undergo large seasonal temperature variation. 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 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 [41]. 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 Hyalochaete 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 [6].

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 cladocerans such as *Evadne* spp [6].

There has been a marked decrease in copepod abundance in the SNS, which has been linked to changes in global weather phenomena [6]. However, the planktonic assemblage in the vicinity of the proposed operations is not considered unusual.

### 5.2.3 Fish & Shellfish

The North Sea supports a diverse fish community, many species of which are umbrella species, providing an essential food source for larger marine predators (such as marine mammals and seabirds), or an area of commercial importance. Several fish species of conservation importance also utilise the North Sea.

Generally, there is little interaction between fish and offshore developments, although some species congregate around platforms and along pipelines. Spawning individuals and juveniles can however be sensitive to seismic activities, seabed disturbance activities, discharges to sea and, in some cases, accidental spills.

A number of species, which have benthic eggs, have a dependency on specific substrata for spawning. For example, sandeels lay their eggs on sandy sediments and therefore may spawn on discreet sandy sediments within the blocks of interest. Such sediments would therefore be considered important for this species [6]. A number of other species, including some demersal species, have pelagic eggs and/or larvae including cod, haddock, Norway pout and saithe and are therefore less reliant on specific sediment types for spawning [6].

Juvenile fish are vulnerable to predators and harsh conditions in the open water. Therefore, it is typical for juvenile fish to stay in sheltered nursery grounds, which also provide an abundance of food [6].

The North-East Atlantic and North Sea is split into statistical grids called International Council for the Exploration of the Sea (ICES) Rectangles in order to map statistical information about the area. Leman 27J is located within UKCS Blocks 49/27, corresponding to ICES Rectangle 35F2.

CEFAS/Marine Scotland has published data on critical spawning and nursery grounds for selected fish species around the UK [14, 20, 3]. Data is based on historic and more recent ichthyoplankton trawls to identify key spawning, nursery habitats and species of interest.

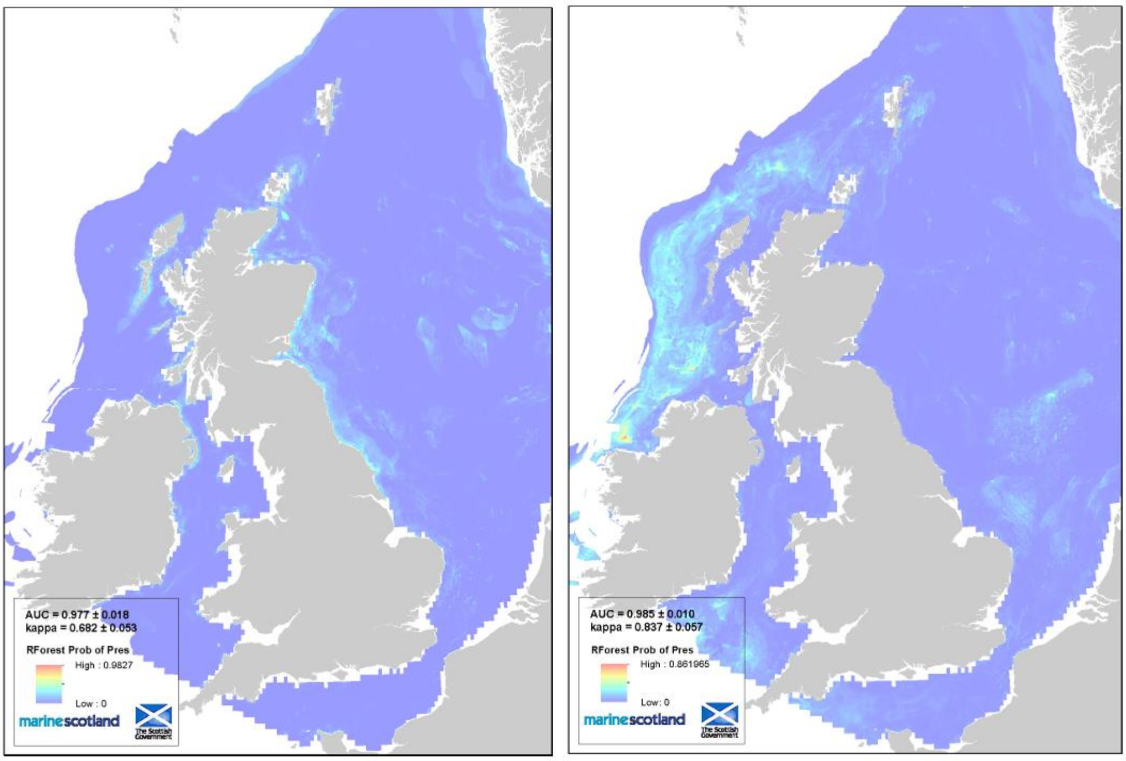
Species that spawn or nurse within ICES 35F2 rectangle are represented in Table 5-4, and includes, mackerel (*Scomber scombrus*), sandeel (Ammodytes spp.), whiting (Merlangius merlangus), cod (*Gadus morhua*), plaice (*Pleuronectes platessa*), lobsters (*Nephrops norvegicus*), sprat (*Sprattus sprattus*), sole (*Solea solea*), and lemon sole (*Microstomus kitt* ) [14; 20].

All the species listed in Table 5-4, with the exception of lemon sole and sprat are listed as UK Biodiversity Action Plan (BAP) priority marine species. Cod is on the OSPAR List of Threatened and/or Declining Species and Habitats [64]. In addition, cod is listed as 'Vulnerable' globally on the International Union for the Conservation of Nature (IUCN) Red List of Threatened Species and should therefore be considered as a priority for protection. All other species from Table 5-4 are listed as Least Concern IUCN [31].

**Table 5-4: Fish spawning and nursery areas within ICES Rectangle 35F2 [14, 20]**

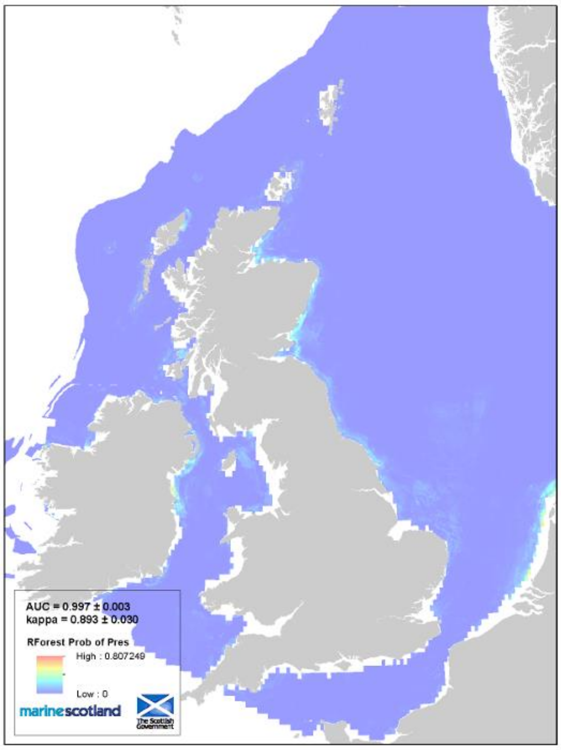
| Month / Species | Jan | Feb | March | April | May | June | July | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sandeel** | SN | SN | N | N | N | N | N | N | N | N | SN | SN |
| **Cod** | N | N | N | N | N | N | N | N | N | N | N | N |
| **Mackerel** | N | N | N | N | S | SN | SN | SN | N | N | N | N |
| **Plaice** | S | S | S | | | | | | | | | S |
| **Lemon sole** | N | N | N | SN | SN | SN | SN | SN | SN | N | N | N |
| **Sole** | | | S | S | S | | | | | | | |
| **Nephrops** | SN | SN | SN | SN | SN | SN | SN | SN | SN | SN | SN | SN |
| **Sprat** | N | N | N | N | SN | SN | SN | SN | N | N | N | N |
| **Whiting** | N | N | N | N | N | N | N | N | N | N | N | N |
| | Spawning | Peak Spawning | S = Spawning | N= Nursery | | | | | | | | |

**Figure 22: Sensitivity maps for selected fish species [3]**

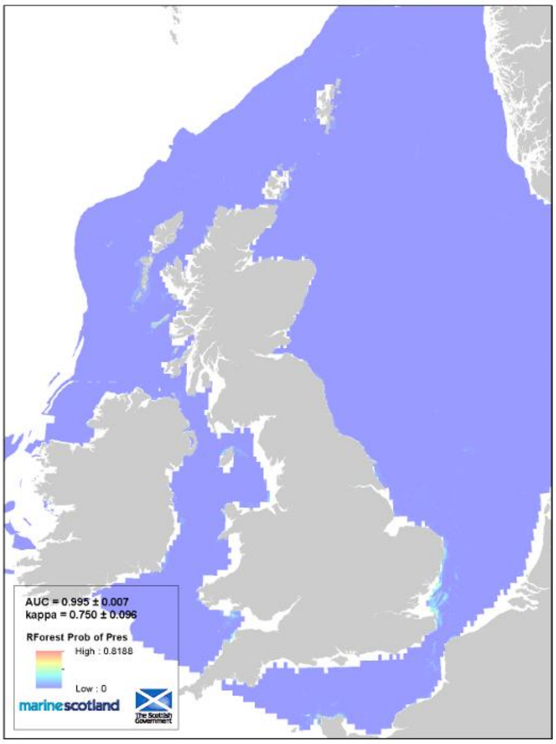



Probability of presence of 0 group aggregations. Cod.

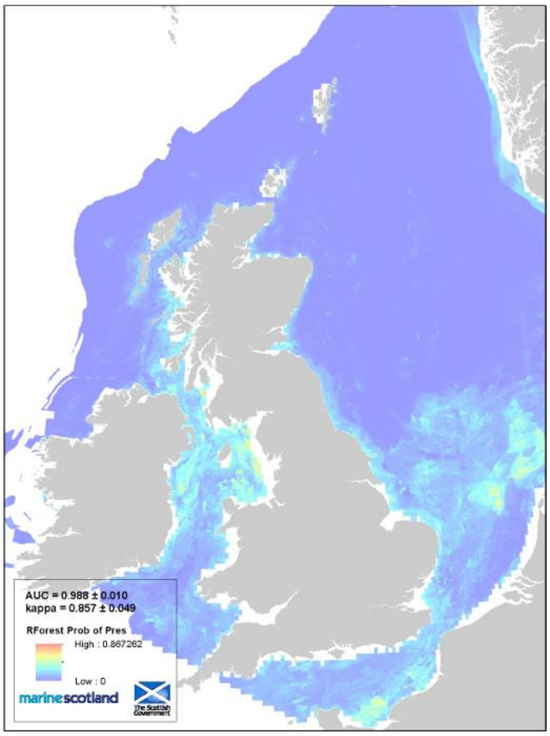
Probability of presence of 0 group aggregations. Mackerel.



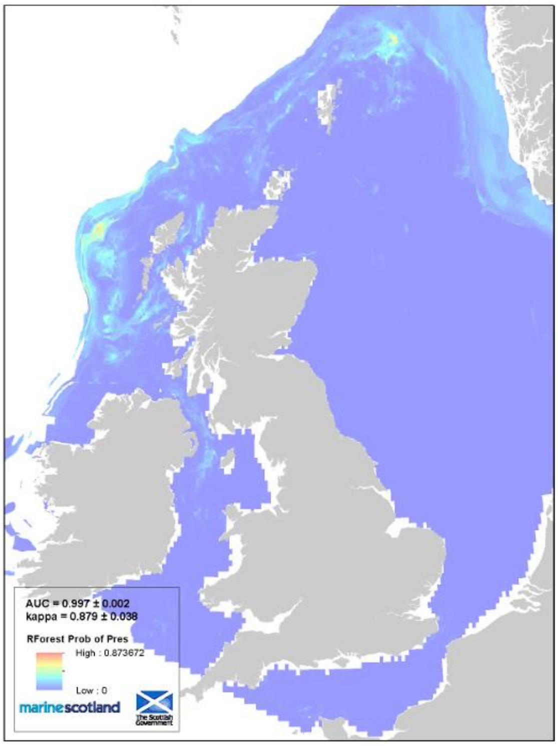

Probability of presence of 0 group aggregations. Plaice.




Probability of presence of 0 group aggregations. Sole.




Probability of presence of 0 group aggregations. Sprat.




Probability of presence of 0 group aggregations. Blue whiting.

### Elasmobranch Species

Elasmobranch species (sharks, skates, and rays) are also an important component of the North Sea ecosystem. Elasmobranchs have a low fecundity and slow growth rate, leaving them vulnerable to overfishing pressures and pollution events, and subsequent recovery of populations in response to disturbance events is low. Historically, many elasmobranch species have been fishery targets due to their fins and liver oils [39]. While many species are no longer subjects of targeted fisheries, they are still under threat from commercial pelagic and demersal fishery by-catch.

In a survey of the distribution of elasmobranchs in UK waters undertaken by Ellis et al. in 2012, a total of 26 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 block of interest, are listed in Table 5-5 [20].

**Table 5-5: Elasmobranch species likely to be found in the vicinity of the Leman pipelines**

| Common Name | Latin Name | Depth Range (m) | Common Name Note 1 |
|---|---|---|---|
| Blonde skate | *Raja brachyura* | 10 – 900 | Near Threatened |
| Common smoothhound | *Mustelus mustelus* | 5 – 350 | Endangered |
| Cuckoo skate | *Leucoraja naevus* | 12 – 290 | Least Concern |
| Small spotted catshark | *Scyliorhinus canicula* | Less than (<) 400 | Least Concern |
| Spiny dogfish | *Squalus acanthias* | 15 – 528 | Vulnerable |
| Spotted skate | *Raja montagui* | < 530 | Least Concern |
| Starry smoothhound | *Mustelus asterias* | 0 – 100 | Near Threatened |
| Thornback skate | *Raja clavata* | 10 – 300 | Near Threatened |
| Tope shark | *Galeorhinus galeus* | 0 – 2000 | Critically/ Endangered |
| Undulate skate | *Raja undulata* | 50 – 200 | Near Threatened |

**Note 1: Status as of January 2025.**

Of these species, blonde skate, common smooth-hound, spiny dogfish, starry smooth-hound, thornback skate and tope shark are of most concern due to their unfavourable conservation status [31]. In addition, spotted skate, thornback skate, and spiny dogfish are listed on the OSPAR list of threatened and/or declining species and habitats [64].

### 5.2.4 Seabirds

The offshore SNS area is an important area for numerous seabird species, mainly for feeding purposes in and around the shallow sandbanks [6], although total numbers are generally lower in the Regional Sea 2 area compared to areas further N [6]. The Regional Sea 2 area also includes several areas suitable for cliff nesting seabirds and some of the most important sites for wintering and passage waterbirds in a national and international context, including the Wash and Thames Estuary. Individuals found offshore in the vicinity of the Leman jacket location may originate from these onshore colonies or be passing migrants. Numbers of seabirds are generally lower in Regional Sea 2 compared to further N [8].

The most common species of seabird found in this area of the SNS include: Northern fulmar (*Fulmarus glacialis*), Great Skua (*Stercorarius skua*), Black legged kittiwake (*Rissa tridactyla*), Great black backed gull (*Larus marinus*), Common gull (*Larus canus*), Lesser black backed gull (*Larus fuscus*), Herring gull (*Larus argentatus*), Common guillemot (*Uria aalge*), Razorbill (*Alca torda*), Little auk (*Alle alle*) and Atlantic puffin (*Fratercula arctica*) [38] (see Figure 23).

Fulmars are present in highest numbers during the early and late breeding seasons, leading to peak densities in September. Kittiwakes are widely distributed throughout the year. Lesser black-backed gull are mainly summer visitors, while in contrast guillemot numbers are greatest during winter months. In addition, substantial numbers of terns migrate northwards through the offshore North Sea area in April and May, with return passage from July to September [6].

For many years, the presence of seabirds on or within proximity to offshore installations has been well documented [75]. The use of offshore platforms by seabirds, is also documented within the HSE offshore technology report [26], which highlights the impact of Guano on helicopter operations on several platforms across the North Sea. The use of offshore infrastructure is primarily assumed to be for the purposes of roosting and providing resting places during foraging or migration trips, however recent observations have indicated the use of offshore platforms for nesting purposes, particularly by Kittiwakes. Due to the significant records of usage of both manned and unmanned offshore infrastructure by seabirds, it is reasonable to conclude that seabirds are not disturbed by most offshore operations and that they actively seek out such areas as they provide some form of benefit to the individual such as nesting/roosting sites and increased access to feeding areas.

Leman 27J is located 34km from the Greater Wash Special Protection Area (SPA) which covers an area of 3,536km$^2$ and classified for the protection of red-throated diver (*Gavia stellata*), common scoter (*Melanitta nigra*), and little gull (*Hydrocoloeus minutus*) during the non-breeding season, and for breeding Sandwich tern (*Sterna sandvicensis*), common tern (*Sterna hirundo*) and little tern (*Sternula albifrons*).

An overview of bird species surface density is provided in Figure 23.

#### 5.2.4.1 Seabird Vulnerability to Oil Pollution

Seabird populations are particularly vulnerable to surface pollution. The vulnerability of bird species to oil pollution 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. Species considered most vulnerable to sea surface pollution are those which spend a great deal of time on the sea surface, for example, puffin, guillemot, and razorbill. Species considered to be at lower risk due to spending less time on the sea surface include gannet, cormorant, and kittiwake.

The Seabird Oil Sensitivity Index (SOSI) has been developed to identify areas where seabirds are likely to be most sensitive to oil pollution [84]. The SOSI combines seabird data collected between 1995 and 2015 and individual seabird species sensitivity 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) (Table 5-6). An assessment of the median SOSI scores indicates that the sensitivity of seabirds to oil pollution in UKCS blocks 49/27 can be extremely high in November, December and January (Table 5-6).

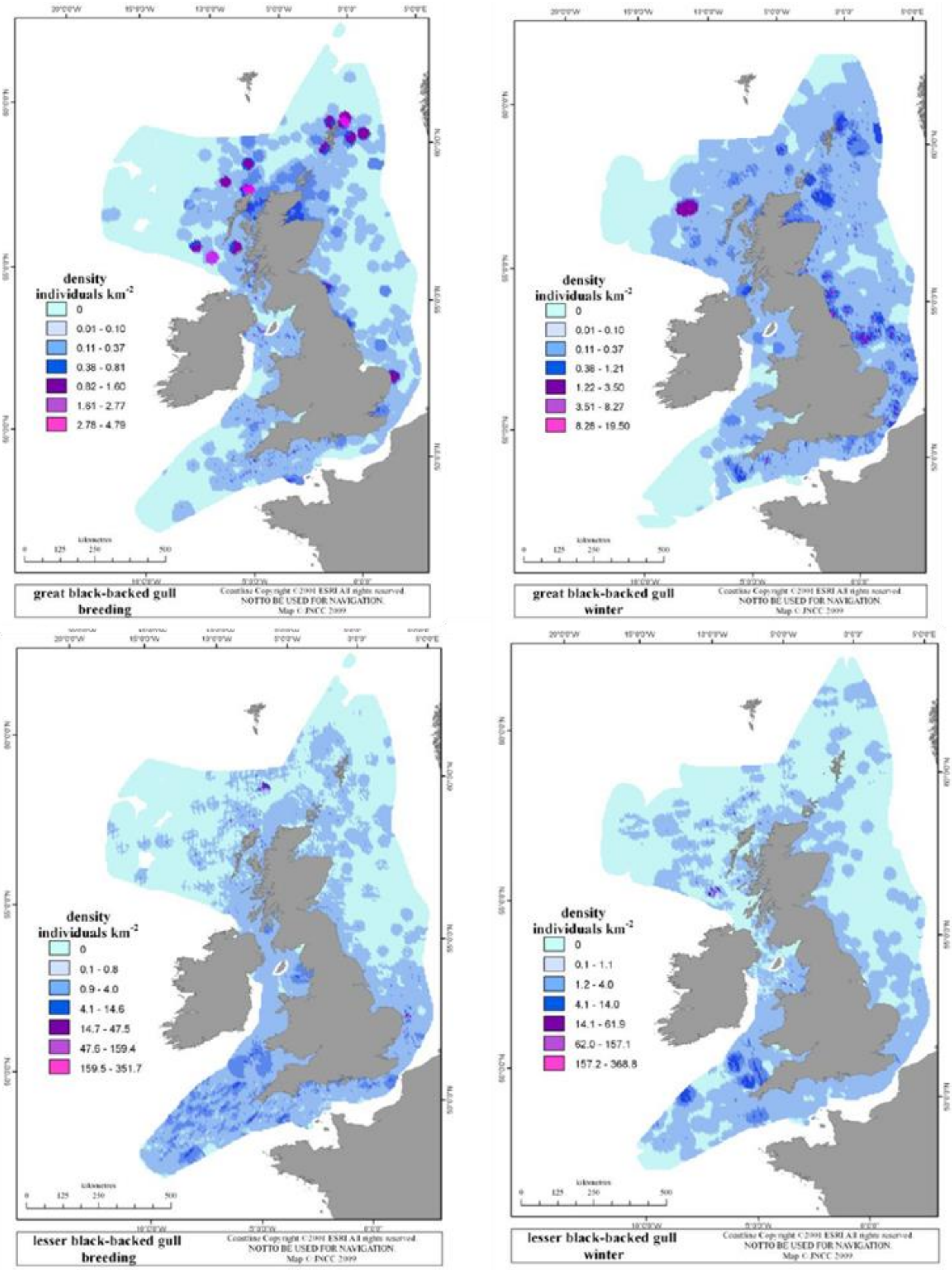
**Table 5-6: SOSI scores for UKCS blocks 49/27 [84]**

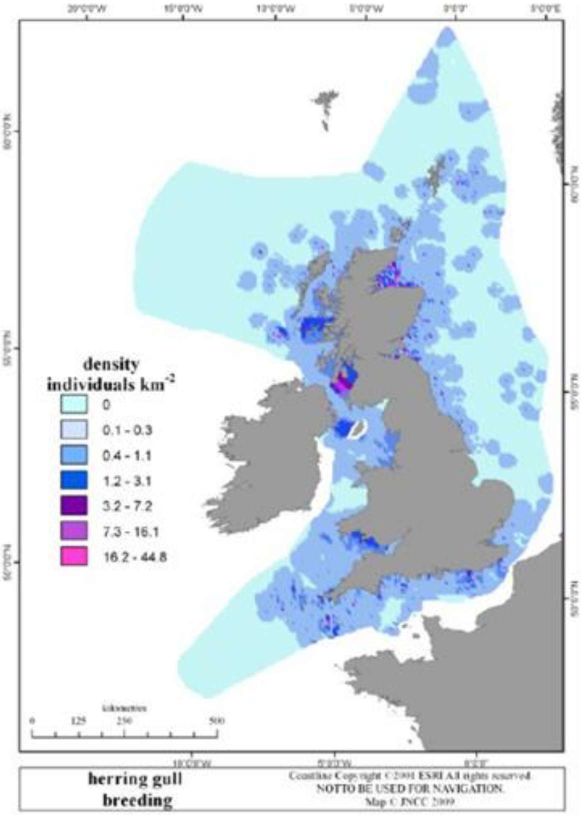
| UKCS Block | January | February | March | April | May | June | July | August | September | October | November | December |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 49/21 | 1 | 1 | 2 | 2 | N | N | 5 | 5 | 5 | N | 1 | 1 |
| 49/22 | 1 | 3 | 3 | 3 | N | 5 | 5 | 5 | 3 | 3 | 1 | 1 |
| 49/23 | 3 | 4 | 4 | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 3 | 3 |
| 49/26 | 2 | 1 | 4 | 4 | 5 | 5 | 5 | 5 | 5 | 3 | 3 | 2 |
| 49/27 | 1 | 4 | 4 | 4 | N | 5 | 5 | 5 | 5 | N | 1 | 1 |
| 49/28 | 1 | 4 | 4 | 4 | N | 5 | 5 | 5 | 5 | N | 1 | 1 |
| 53/1 | 1 | 2 | 3 | 3 | 5 | 3 | 5 | 5 | 5 | 3 | 3 | 2 |
| 53/2 | 1 | 3 | 3 | 3 | 5 | 3 | 5 | 5 | 5 | 4 | 4 | 2 |
| 53/3 | 1 | 4 | 3 | 3 | N | 5 | 5 | 5 | 5 | 5 | 5 | 2 |

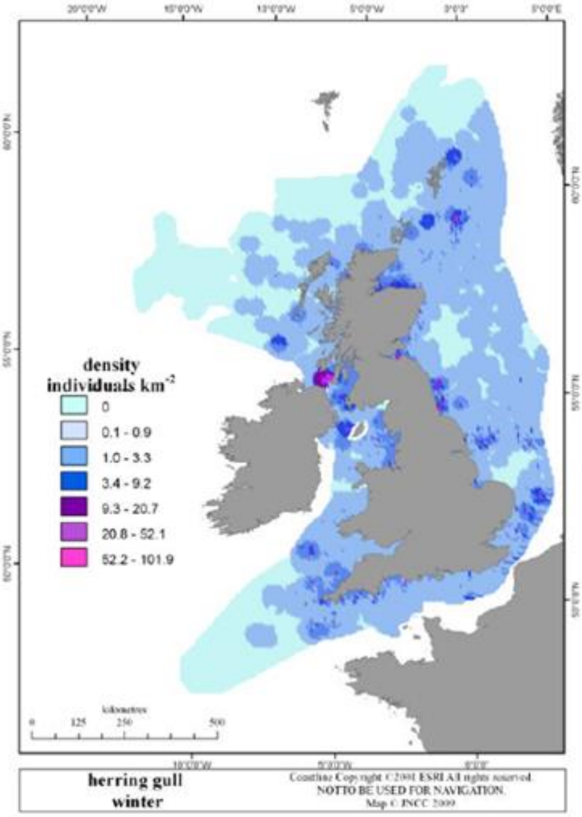
**Key:** 1 = Extremely High; 2 = Very High; 3 = High; 4 = Medium; 5 = Low; 'N'= No Data. Red box indicates operational window.

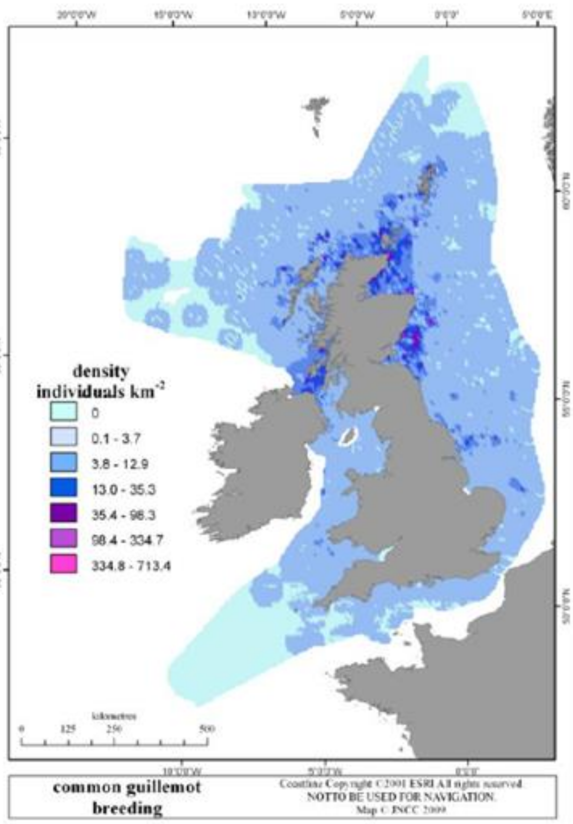
SOSI sensitivity category in red and underlined indicates an indirect assessment of SOSI scores, in light of coverage gaps.

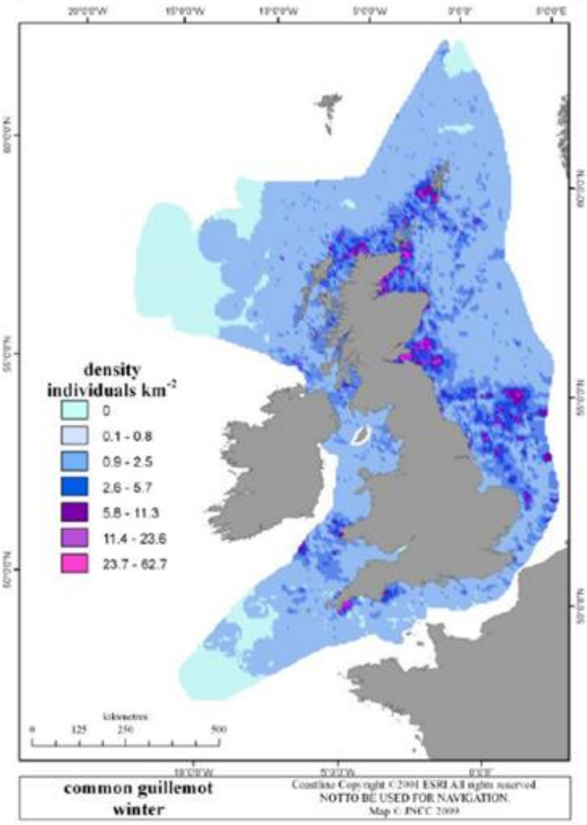
**Figure 23: Seabird density surface maps for the species identified as frequently occurring in the SNS [38]**

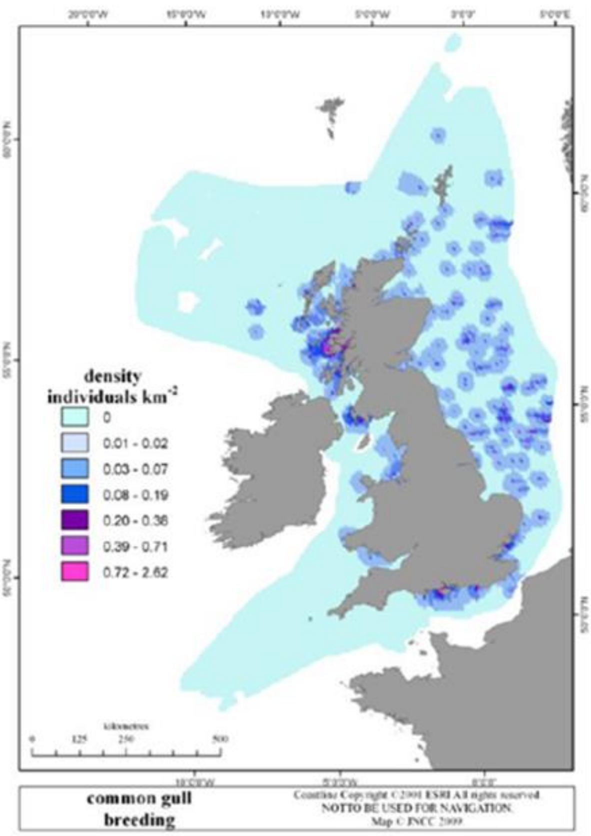


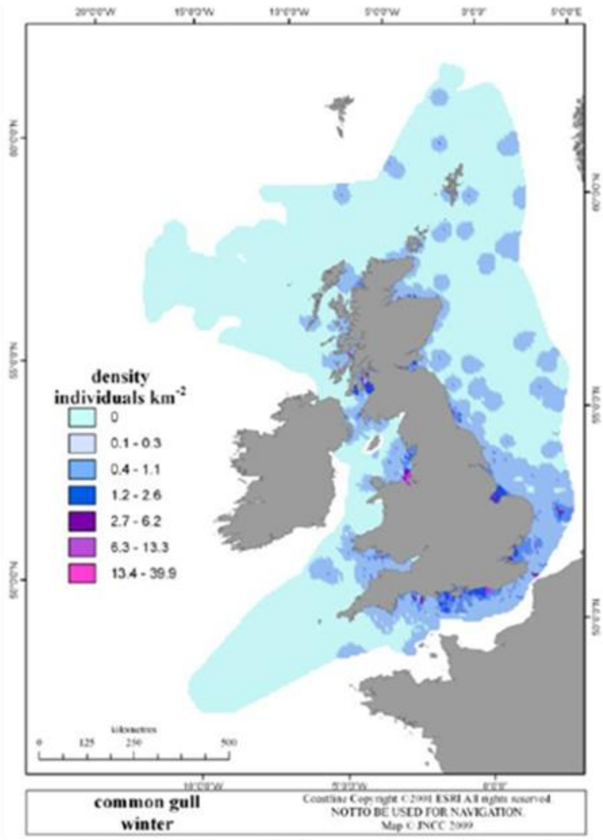

density
individuals km-2
0
0.1 - 0.3
0.4 - 1.1
1.2 - 3.1
3.2 - 7.2
7.3 - 16.1
16.2 - 44.8
herring gull
breeding
Coastline Copyright ©2001 ESRI All rights reserved
NOT TO BE USED FOR NAVIGATION.
Map © JNCC 2009

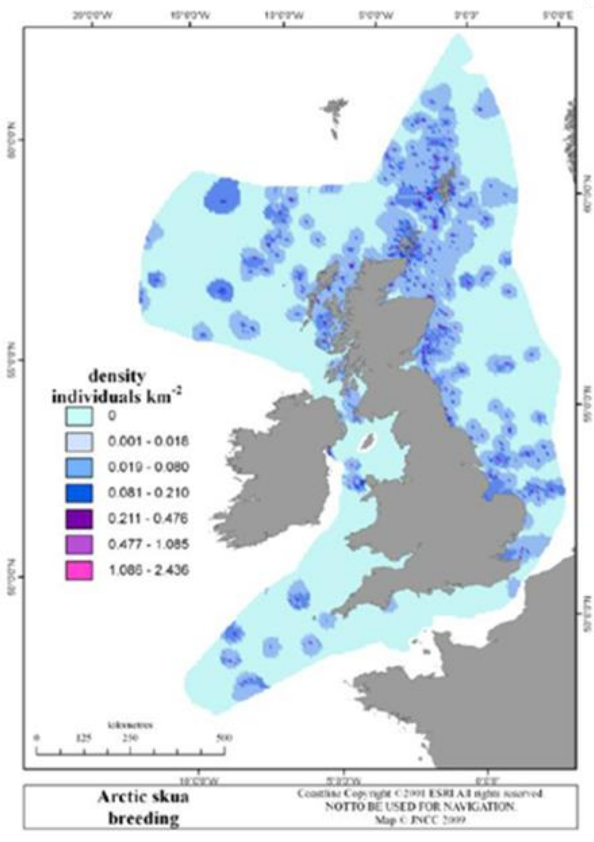

density
individuals km-2
0
0.1 - 0.9
1.0 - 3.3
3.4 - 9.2
9.3 - 20.7
20.8 - 52.1
52.2 - 101.9
herring gull
winter
Coastline Copyright ©2001 ESRI All rights reserved
NOT TO BE USED FOR NAVIGATION.
Map © JNCC 2009

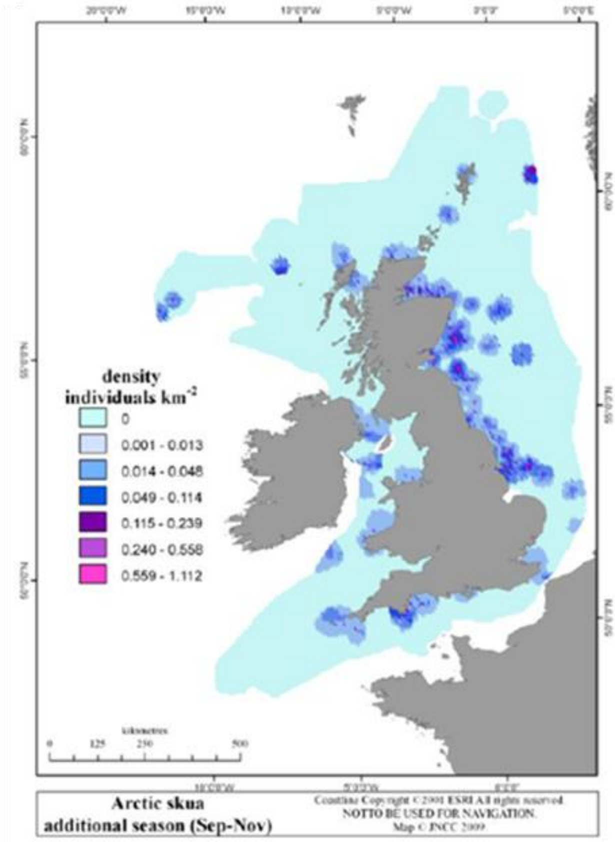

density
individuals km-2
0
0.1 - 3.7
3.8 - 12.9
13.0 - 35.3
35.4 - 98.3
98.4 - 334.7
334.8 - 713.4
common guillemot
breeding
Coastline Copyright ©2001 ESRI All rights reserved
NOT TO BE USED FOR NAVIGATION.
Map © JNCC 2009

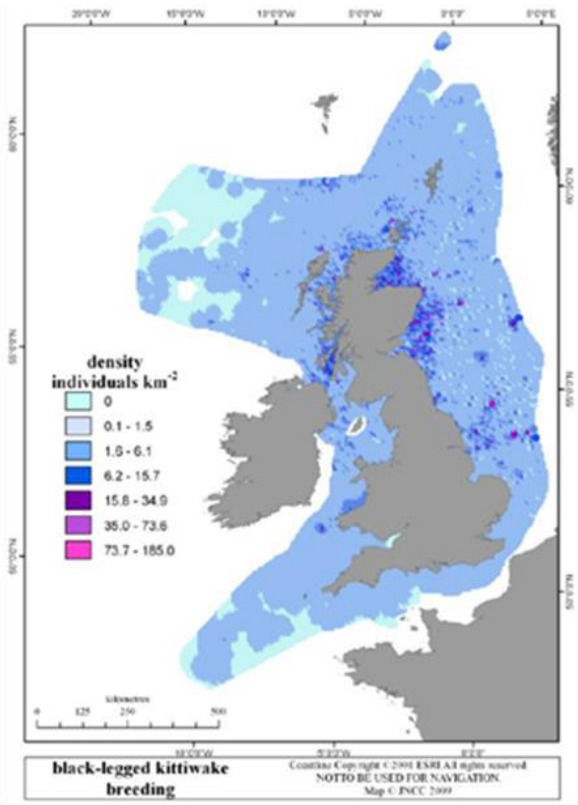

density
individuals km-2
0
0.1 - 0.8
0.9 - 2.5
2.6 - 5.7
5.8 - 11.3
11.4 - 23.6
23.7 - 62.7
common guillemot
winter
Coastline Copyright ©2001 ESRI All rights reserved
NOT TO BE USED FOR NAVIGATION.
Map © JNCC 2009

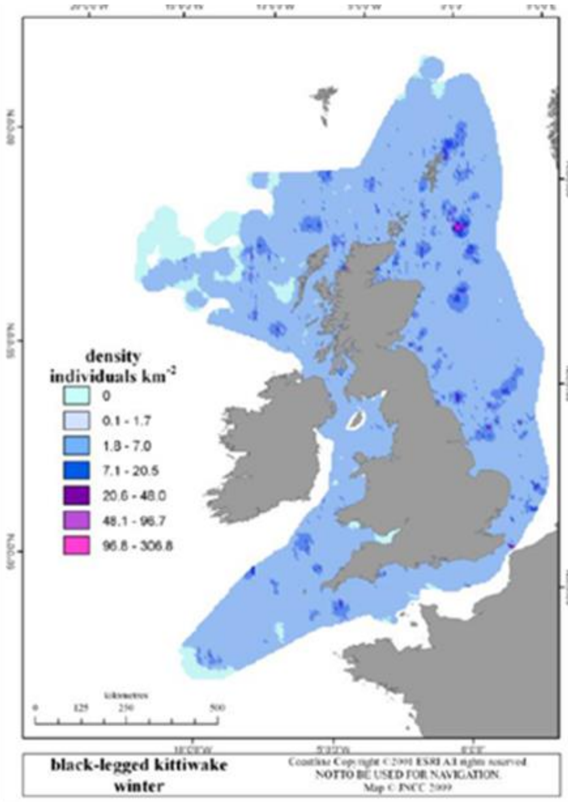

density
individuals km$^{-2}$
0
0.01 - 0.02
0.03 - 0.07
0.08 - 0.19
0.20 - 0.38
0.39 - 0.71
0.72 - 2.62
common gull
breeding
NOT TO BE USED FOR NAVIGATION.


density
individuals km$^{-2}$
0
0.1 - 0.3
0.4 - 1.1
1.2 - 2.6
2.7 - 6.2
6.3 - 13.3
13.4 - 39.9
common gull
winter
NOT TO BE USED FOR NAVIGATION.


density
individuals km$^{-2}$
0
0.001 - 0.018
0.019 - 0.080
0.081 - 0.210
0.211 - 0.476
0.477 - 1.085
1.086 - 2.436
Arctic skua
breeding
NOT TO BE USED FOR NAVIGATION.


density
individuals km$^{-2}$
0
0.001 - 0.013
0.014 - 0.048
0.049 - 0.114
0.115 - 0.239
0.240 - 0.558
0.559 - 1.112
Arctic skua
additional season (Sep-Nov)
NOT TO BE USED FOR NAVIGATION.


density
individuals km$^{-2}$
0
0.1 - 1.5
1.6 - 6.1
6.2 - 15.7
15.8 - 34.9
35.0 - 73.6
73.7 - 185.0
kilometres
black-legged kittiwake
breeding
Coastline Copyright ©2001 ESRI All rights reserved
NOT TO BE USED FOR NAVIGATION
Map © JNCC 2009


density
individuals km$^{-2}$
0
0.1 - 1.7
1.8 - 7.0
7.1 - 20.5
20.6 - 48.0
48.1 - 96.7
96.8 - 306.8
kilometres
black-legged kittiwake
winter
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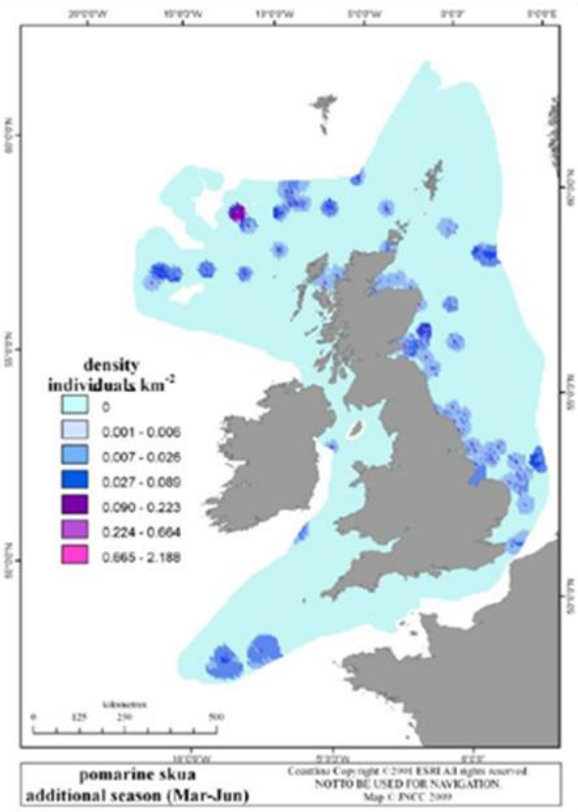
Map © JNCC 2009


density
individuals km$^{-2}$
0
0.001 - 0.006
0.007 - 0.026
0.027 - 0.089
0.090 - 0.223
0.224 - 0.664
0.665 - 2.188
kilometres
pomarine skua
additional season (Mar-Jun)
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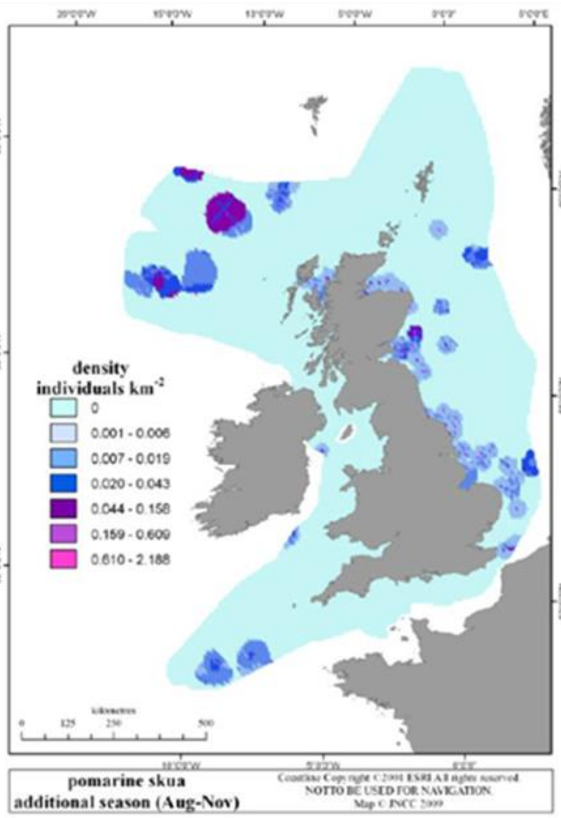
Map © JNCC 2009


density
individuals km$^{-2}$
0
0.001 - 0.006
0.007 - 0.019
0.020 - 0.043
0.044 - 0.158
0.159 - 0.609
0.610 - 2.188
kilometres
pomarine skua
additional season (Aug-Nov)
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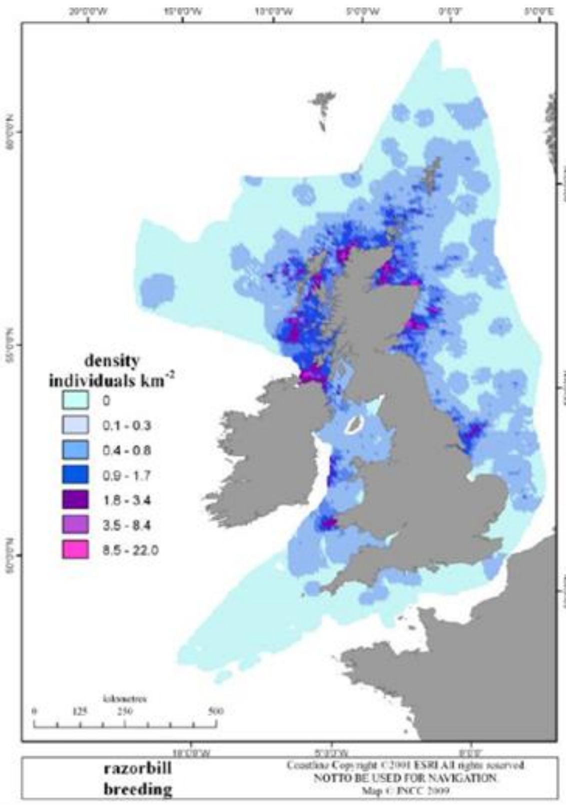
Map © JNCC 2009


density
individuals km-2
0
0.1 - 0.3
0.4 - 0.8
0.9 - 1.7
1.8 - 3.4
3.5 - 8.4
8.5 - 22.0
razorbill
breeding
Coastline Copyright ©2001 ESRI All rights reserved
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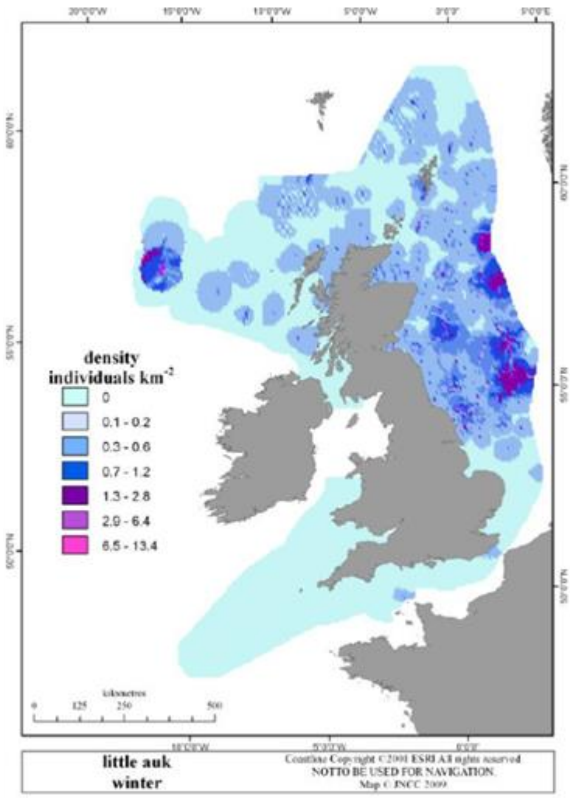
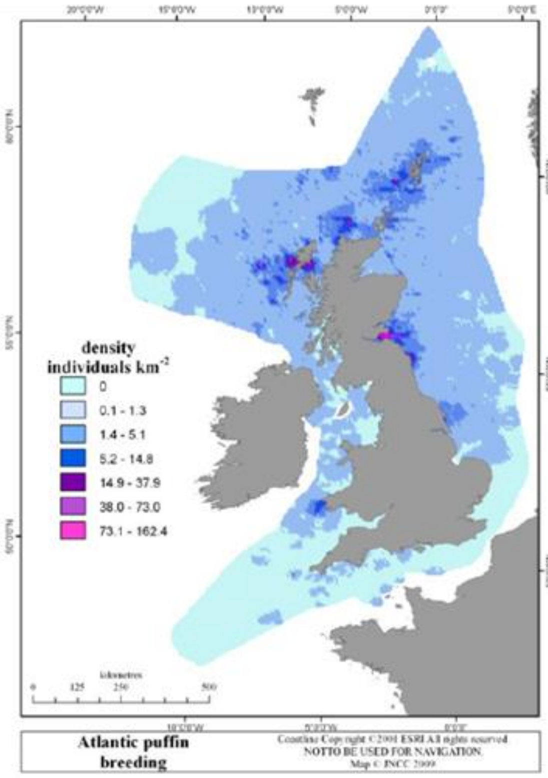
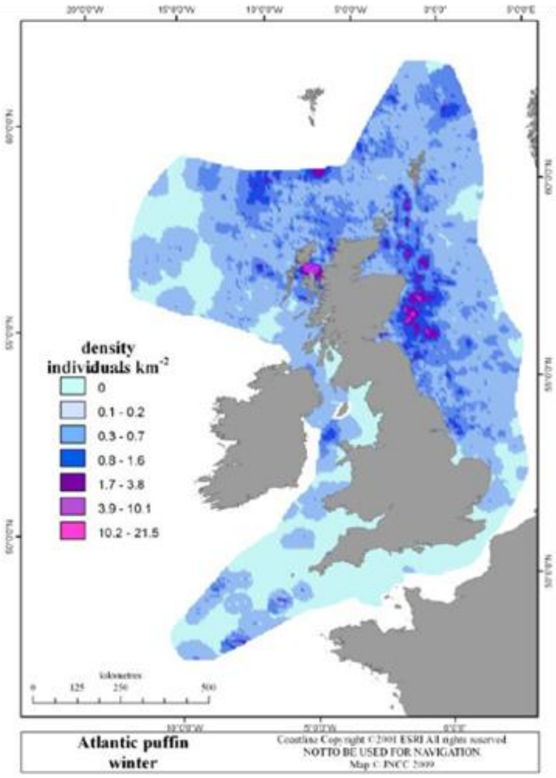
Map © JNCC 2009


density
individuals km-2
0
0.1 - 0.2
0.3 - 0.6
0.7 - 1.2
1.3 - 2.8
2.9 - 6.4
6.5 - 13.4
little auk
winter
Coastline Copyright ©2001 ESRI All rights reserved
NOT TO BE USED FOR NAVIGATION
Map © JNCC 2009


density
individuals km-2
0
0.1 - 1.3
1.4 - 5.1
5.2 - 14.8
14.9 - 37.9
38.0 - 73.0
73.1 - 162.4
Atlantic puffin
breeding
Coastline Copyright ©2001 ESRI All rights reserved
NOT TO BE USED FOR NAVIGATION
Map © JNCC 2009


density
individuals km-2
0
0.1 - 0.2
0.3 - 0.7
0.8 - 1.6
1.7 - 3.8
3.9 - 10.1
10.2 - 21.5
Atlantic puffin
winter
Coastline Copyright ©2001 ESRI All rights reserved
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### 5.2.5 Marine Mammals

#### 5.2.5.1 Cetaceans

Cetaceans (whales, dolphins, and porpoises) are protected under Annex IV of the Council Directive 92/43/EEC (also known as the Habitats Directive). Cetacean abundance in the SNS is relatively low compared to the northern and central North Sea, with the exception of the harbour porpoise (*Phocoena phocoena*).

The relative abundance and density of cetaceans in the vicinity of the Leman jacket can be derived from data obtained during the Small Cetacean Abundance of the North Sea (SCANS-IV) aerial and ship-based surveys. This project identified the abundance and density of cetacean species within predefined sectors of the North Sea and Northeast Atlantic. The Leman field is situated within the SCANS-IV Block 'NS-C' and was surveyed by air [25]. The density of the harbour porpoise within the SCANS-IV Block 'NS-C' is higher than the total surveyed area, suggesting that the area may be important for these species (Table 5-7). Densities for minke whale were similar to the total surveyed area, whereas densities for white-beaked dolphin were a magnitude lower.

In addition to the aforementioned cetaceans, other species have been observed or have been modelled to have presence in the North Sea [83]. These include the Atlantic white-sided dolphin (*Lagenorhynchus acutus*), Risso's dolphin (*Grampus griseus*), short-beaked common dolphin (*Delphinus delphis*), and killer whale (*Orcinus orca*).

**Table 5-7: Cetacean abundance and density recorded in SCANS-IV aerial survey area block 'NS-C' [25]**

| Species | SCANS-IV Block 'NS-C' | |
|---|---|---|
| | Abundance | Density Note1 |
| **Harbour porpoise** | 36,286 | 0.6027 |
| **Bottlenose dolphin** | 2,520 | 0.0419 |
| **White-beaked dolphin** | 894 | 0.0149 |
| **Minke whale** | 412 | 0.0068 |
| **Common dolphin** | 192 | 0.0032 |
| Note1: Density is the number of animals per $km^2$ | | |

For the management of marine mammals, the UK Statutory Nature Conservation Bodies have identified Marine Mammal Management Units (MMMU's) to provide information on the geographical range and abundance of marine mammals, and therefore understand the potential effects of anthropogenic activities on populations [32]. The abundance of cetacean species within their respective MMMU is shown in Table 5-8.

The most abundant species in the North Sea is the Harbour porpoises when compared to other species identified in Table 5-8, despite its MMMU being smaller in area. White-sided dolphins are the next most abundant; however, these were not recorded in significant numbers in other surveys (refer to Table 5-7 and Table 5-9).

**Table 5-8: Estimates of cetacean abundance in the relevant MMMUs [30]**

| Species | Management unit | Abundance of animals | 95% Confidence Interval | Density Note 1 |
|---|---|---|---|---|
| **Bottlenose dolphin** | Greater North Sea ($639,886km^2$) | 0 | - | - |
| **Harbour porpoise** | North Sea ($678,206km^2$) | 227,298 | 176,360 – 292,948 | 0.335 |
| **Risso's dolphin** Note 2 | Marine Atlantic Note 3 | - | - | - |
| **Common dolphin** | Celtic and Greater North Sea ($1,560,875km^2$) | 56,556 | 33,014 – 96,920 | 0.036 |
| **Minke whale** | | 23,528 | 13,989 - 39,572 | 0.015 |
| **White-beaked dolphin** | | 15,895 | 9,107 – 27,743 | 0.010 |
| **White-sided dolphin** | | 69,293 | 34,339 – 139,828 | 0.044 |

**Note 1:** Density (individuals per km) was calculated using the total area of the Management Unit (MU) and the abundance of animals within that MU
**Note 2**: There is no current abundance estimate available for Risso's dolphin
**Note 3:** 'Marine Atlantic' Management Unit comprises all UK waters and extends to the seaward boundary used by the EC for Habitats Directive reporting

Additional to the above marine mammal abundance surveys, the Atlas of Cetacean Distribution in Northwest European Water [68] provides a comprehensive review of cetacean sightings in Northwest European waters. The seasonal sightings data for ICES Rectangles 35F2 is summarised in Table 5-9.

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

Harbour porpoise have been recorded in the vicinity of the project area for all months, with offshore sightings peaking in the early months between January to April. The Southern North Sea SAC lists Harbour porpoise as its protected feature making the reduction of noise in this environment a key objective. Bottlenose dolphin have not been recorded in the area.

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

**Table 5-9: Cetacean sightings in ICES Rectangle 35F2 [68]**

| Month / Species | Jan | Feb | March | April | May | June | July | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Harbour porpoise** | Peak | Peak | Peak | Peak | | | | | | | | |
| **Minke Whale** | | | | | | | Peak | Peak | Peak | | | |
| **White-beaked dolphin** | | | | | | Peak | Peak | Peak | Peak | Peak | | |

#### 5.2.5.2 Pinnipeds

Two species of seals are found in the North Sea around the English E coast; grey seal (*Halichoerus grypus*) and the harbour (or common) seal (*Phoca vitulina*) (Figure 24, Figure 25). Both species are listed under Annex II of the EC Habitats Directive and protected under the Conservation of Seals Act 1970 (from 0 to 12 nautical miles (nm) from the coast) as well as being listed as UK Biodiversity Action Plan priority marine species.

Grey and harbour seals feed both in inshore and offshore waters depending on the distribution of their prey, which changes both seasonally and yearly. Both species tend to be concentrated close to shore, particularly during the pupping and moulting season. Important number of grey and harbour seals are present off the east coast of England, particularly around The Wash [18].

Established colonies of grey seals are present on the E coast of England, at Donna Nook, at the mouth of the Humber, and around Blakeney on the North Norfolk coast [74]. Like all seals, grey seals spend a significant proportion of their time hauled out on land during the breeding, moulting and pupping seasons and also between tides and foraging trips [74]. Grey seals forage down to depths of 100m and at distances of up to 100km from their haul-out sites and, therefore, whilst unlikely, could be present in the vicinity of the Leman field, particularly at their western most extent. Models of marine usage by grey seals show that there are high levels of foraging activity along the E coast of England. The nearest landfall from Leman jacket is located approximately 489 was my measu to shore in Winterton-on-Sea, and thus the distribution of grey seals may be considerable very low (0-15 individuals per 25km$^2$) (Figure 24) [72].

Harbour seals are the smaller of the two species and tend to be found closer to the coast [74]. As with grey seals, the UK harbour seal population is predominantly found around the Scottish coast with smaller colonies around The Wash and along the E coast of England [74]. Harbour seals are restricted to their haul-out sites and the surrounding waters during pupping (June and July) and during their annual moult (August) [72]. This species can be found offshore from late August through to the following June and tends to forage within 40 – 50km of its haul-out sites. The harbour seal at-sea utilisation of waters surrounding the Leman jacket may be consider very low (0-10 individual per 25km$^2$) (Figure 25) [72].

**Figure 24: Grey seal (*H. grypus*) at sea density**

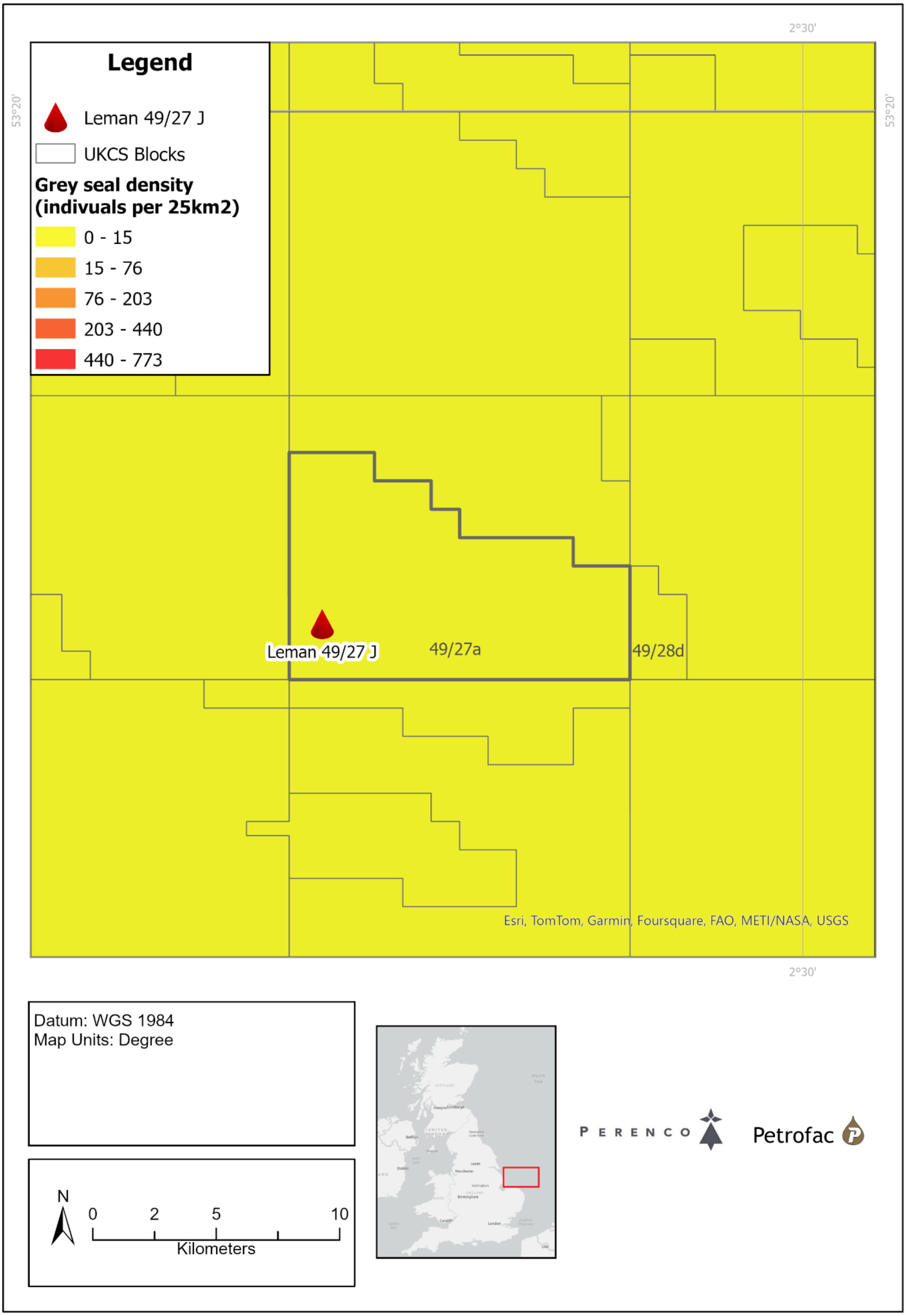
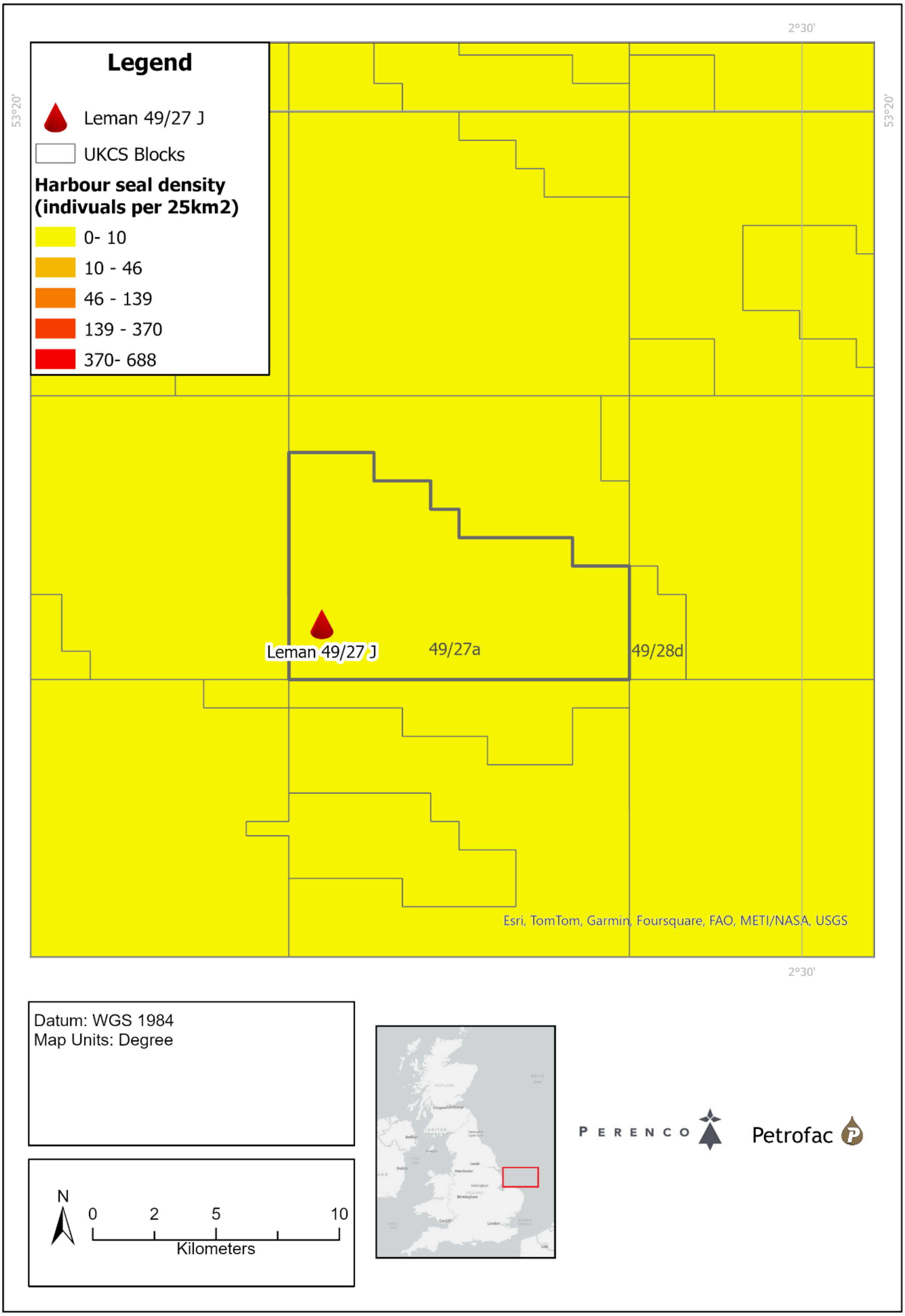


**Figure 25: Harbour seal (*P. vitulina*) at sea density**



## 5.3 Management

### 5.3.1 Conservation Areas

The UK is party to a number of international agreements to establish an ecologically important network of Marine Protected Areas (MPA's) within UK waters. As a signatory to the OSPAR Convention the UK must establish an ecologically coherent and well-managed network of MPA's across the Northeast Atlantic by 2016 [34]. These commitments are transposed through national legislation and regulations. The main types of MPA's in UK waters are:

**SAC** (also known as European Sites of Community Importance which are designated for habitats and species listed under the EU Habitats Directive. These qualifying features include three marine habitat types (shallow sandbanks, reefs and submarine structures made by leaking gases) and four marine species (grey seal, harbour seal, bottlenose dolphin and harbour porpoise) [34]. In the UK there are 116 SACs with marine components [34].

**Special Protection Areas** (SPA's) which are designated to protect birds under the EU Wild Birds Directive. The Directive requires conservation efforts to be made across the sea and land area. In the UK 112 SPAs with marine components have been designated, including four wholly marine SPA's [34].

**Marine Conservation Zones** (MCZ's) which are designated under the Marine and Coastal Access Act (2009) to protect nationally important marine wildlife, habitats, geology, and geomorphology and can be designated anywhere in English, Welsh territorial, or UK offshore waters [34]. To date there are 97 designated MCZ's in UK waters [34].

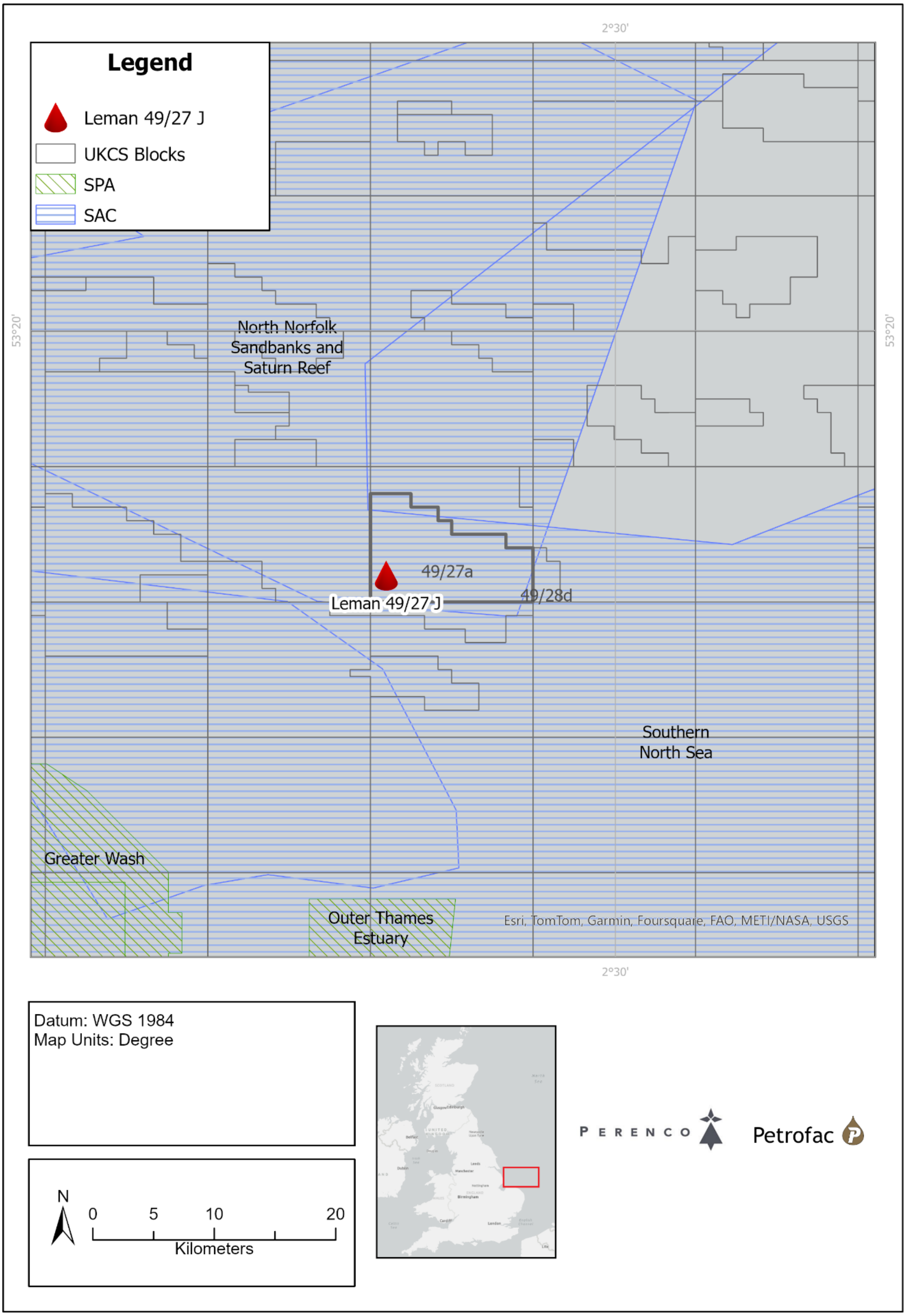
SAC's and SPA's form part of the European Natura 2000 network. Other international designations such as Ramsar Wetlands of International Importance (hereafter referred to as Ramsar sites), and national designations such as Sites of Special Scientific Interest also form part of the UK MPA network through their protection of marine, coastal terrestrial and geological features [34]. OSPAR MPA's encompass existing MPA's designated under existing legislation including SAC's, SPA's and MCZ's [34].

There are four MPA's within 40km of the Leman 27J jacket location with two of them overlapping. Table 5-10 presents the qualifying features and a description for each of these sites and Figure 26 shows the MPA's in the vicinity of the of the Leman field.

**Table 5-10: MPA's within 40km of the Leman 27J jacket**

| Site Name | Distance and Direction | Qualifying Features and Site Description |
|---|---|---|
| Southern North Sea SAC | 0km | **Features:** Annex II species; Harbour porpoise (*P. phocoena*) (1351).<br>**Description**: The site has been identified as an area of importance for harbour porpoise and supports 17.5% of the UK North Sea Management Unit population. This site covers an area of 36,951km$^2$. 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 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). |
| **North Norfolk Sandbanks and Saturn Reef SAC** | 0km | **Features:** Annex I habitats; Sandbanks which are slightly covered by sea water all the time (1110) and Reefs (1170).<br>**Description**: The North Norfolk Sandbanks are the most extensive example of the offshore linear ridge sandbank type in UK waters. The site encloses a series of 10 main sand banks and associated smaller banks. Invertebrate communities are typical of sand sediments in the SNS such as polychaete worms, isopods, crab, and starfish. Areas of *S. spinulosa* biogenic reef are present within the site, consisting of thousands of fragile sand-tubes mad by ross worms (polychaetes) which have consolidated together to create solid structures rising above the seabed. |
| Greater Wash SPA | 34km E | **Features:** Seabirds and waterbirds<br>**Description:** The site has been designated to protect important areas of sea used by waterbirds during the nonbreeding period, and for foraging terns in the breeding season. Breeding tern colonies along the coast are already protected by a number of existing classified SPAs: Humber Estuary, Gibraltar Point, North Norfolk Coast, Breydon Water and Great Yarmouth North Denes. The Greater Wash SPA boundary is a composite of the areas used by these foraging terns, common scoter and red-throated diver. |
| Haisborough, Hammond and Winterton SAC | 8.5km SW | **Features:** Annex I habitat; Sandbanks which are slightly covered by sea water all the time (1110) and Reefs (1170).<br>**Description:** The site features a series of sandbanks formed through geological processes. These curved, parallel sandbanks consist of sandy sediment in full salinity water with intermediate coastal influence. They support diverse habitats, including low-diversity polychaete and amphipod communities on the crests and more gravelly troughs with infaunal and epifaunal species, including *S. spinulosa* reefs. To account for feature uncertainty and projected movement, margins of 500m have been added around all sandbanks, with an additional 1,000m for Middle and North Cross sandbanks. Similar margins apply to *S. spinulosa* records. JNCC recommends a precautionary approach, treating these areas as confirmed features for conservation purposes. |

**Figure 26: Location of Leman 27J jacket in relation to the UK coast and environmentally sensitive areas.**



### 5.3.2 National Marine Plans

Through the Marine and Coastal Access Act (MCAA) 2009, the UK Government introduced a number of measures to deliver its vision of 'clean, healthy, safe, productive and biologically diverse oceans and seas'. This included the introduction of a new marine planning system with the Marine Management Organisation (MMO) being delegated a number of marine planning functions, although the Offshore Petroleum Regulator for Environment and Decommissioning manage a number of licencing functions pertaining to offshore energy activities rather than the MMO.

In line with the MCAA, a number of marine plans have been developed, or are being developed for inshore and offshore waters around the UK. Marine plans, together with the overarching Marine Policy Statement, underpin the new planning system for inshore and offshore activities.

The proposed overtrawl campaign is located within the East Offshore Marine Plan area. The area is predominantly open, expansive, shallow water supporting 39% of oil and gas license blocks in England and commercial activities such as shipping, aggregate extraction and fishing. Designated shipping routes, cables infrastructure and oil and gas pipelines cross the offshore area linking the UK mainland with Europe [47].

Table 5-11 details associated policies and objectives contained within relevant marine plans and highlights how these have been addressed by the proposed operations [47].

The indirect contributing policies specific to oil and gas are described in the East Inshore and East Offshore Marine Plans as follows:

**OG1** - Proposals within areas with existing oil and gas production should not be authorised except where compatibility with oil and gas production and infrastructure can be satisfactorily demonstrated.

**OG2** - Proposals for new oil and gas activity should be supported over proposals for other development.

The oil and gas policies outlined in the East Inshore and East Offshore Marine Plans support objectives related to economic productivity and employment creation in the offshore marine area. These policies encourage the sustainable development of oil and gas infrastructure, ensuring minimal environmental impact while optimising hydrocarbon production through advanced technologies. They aim to make substantial contributions to both local and national economies by creating skilled job opportunities and aligning with spatial needs for other essential marine activities.

**Table 5-11: Marine planning Associated objectives and policies relevant to the proposed decommissioning strategy**

| Relevant Objectives | Associated Policies | Addressed by Project |
|---|---|---|
| **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. | The proposed decommissioning strategy is in line with minimising taxpayer costs for decommissioning oil & gas infrastructure in the SNS. |
| **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. | The proposed operations will utilise local contractors in the area and a support base close to the proposed operations. |
| **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:<br>a) that they will not compromise or harm elements which contribute to the significance of the heritage asset;<br>b) how, if there is compromise or harm to a heritage asset, this will be minimised;<br>c) how, where compromise or harm to a heritage asset cannot be minimised it will be mitigated against,<br>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.<br>**SOC3** - Proposals that may affect the terrestrial and marine character of an area should demonstrate, in order of preference:<br>a) that they will not adversely impact the terrestrial and marine character of an area;<br>b) how, if there are adverse impacts on the terrestrial and marine character of an area, they will minimise them;<br>c) how, where these adverse impacts on the terrestrial and marine character of an area cannot be minimised they will be mitigated against;<br>d) the case for proceeding with the proposal if it is not possible to minimise or mitigate the adverse impacts. | The proposed decommissioning strategy is not anticipated to have an impact on any heritage assets or the character of the marine area. |

| Relevant Objectives | Associated Policies | Addressed by Project |
|---|---|---|
| **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. | Refer to Section 7. Environmental & Social impact assessment. |
| | **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. | The proposed decommissioning strategy minimises the risk of release of hazardous substances to low levels compared to alternative strategies. This includes the use of a HLV for the pipeline/riser cutting and jacket removal operations. |
| **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 strategy reduces any potential impact on biodiversity in the East Marine Plan and terrestrial areas. |
| **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 strategy will not impact on the SAC's located within the East Marine Plan area (refer to section 5.3.1). |

| Relevant Objectives | Associated Policies | Addressed by Project |
|---|---|---|
| **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. | Refer to Section 5.4 |
| | **GOV3** - Proposals should demonstrate in order of preference:<br>a) that they will avoid displacement of other existing or authorised (but yet to be implemented) activities;<br>b) how, if there are adverse impacts resulting in displacement by the proposal, they will minimise them;<br>c) how, if the adverse impacts resulting in displacement by the proposal, cannot be minimised, they will be mitigated against or;<br>d) the case for proceeding with the proposal if it is not possible to minimise or mitigate the adverse impacts of displacement. | Refer to Section 5.4 |

## 5.4 Societal

### 5.4.1 Commercial Fisheries

The North Sea is one of the world's most important fishing grounds, and major UK and international fishing fleets operate in the SNS, targeting a mix of demersal, shellfish and pelagic fish stocks.

The Leman wells of interest are located within ICES rectangle 35F2 there is currently no data published on fishing effort in this area. Activity within the adjacent ICES rectangle 36F2 included 193 days of fishing effort during 2021, 265 days of effort in 2020 and 112 days of effort in 2019. The types of gear used were primarily Seine nets, traps, trawls and dredges. A total of 289te were landed in 36F2 in 2021, 400te in 2020 and 215te in 2019. Landed species are made up predominantly of Edible crabs (*Cancer pagarus*), and Scallops [45].

### 5.4.2 Oil & Gas Activities

Oil and gas activity within the SNS is generally high and targets a number of existing gas fields. There is significant surface and subsurface infrastructure in UKCS Blocks 49/27 [59]. Leman field utilises 16 development platforms, of which 9 installations are now operated by PUK.

A total of 145 wells have been drilled across UKCS Blocks 49/27, all of them associated with the Leman development. Of these wells 11 have been abandoned to phase 1, 3 to phase 2, 15 to phase 3, 47 have been completed and shut in, 7 plugged, and 62 remain operative [59].

The surrounding area has also been heavily licensed for oil and gas development. Neighbouring fields include the Thames to the E, Hewett to the W, or Camelot field to the S.

Due to the high oil and gas activity in the area, there are also a number of pipelines, flowlines and umbilical's that pass through UKCS blocks 49/27 where Leman gas fields facilities are located. A total of 12 active gas lines pass through UKCS blocks 49/27, among which the PUK-operates 10 and Shell the remaining two [59] (Figure 27).

### 5.4.3 Marine Aggregates

There are no licenced marine aggregate within the close proximity to the Leman gas field [15] (Figure 28).

The closest offshore marine aggregate site is Indefatigable West, operated by DEME Building Materials Ltd, located 45.9 km NE of the Leman 27J jacket. The next nearest site, Indefatigable East, operated by the same company, is 51.8 km away [79]; [15].

### 5.4.4 Offshore Wind

The nearest offshore wind farm to the Leman 27J jacket is Norfolk Vanguard West, which has received consent for development. It is located approximately 12.4 km away within UKCS block 53/2 (Figure 28). The Norfolk Boreas wind farm development under Government Support on Offer, is also located in the near vicinity at 36km E. Additionally consent has been granted for the development of the Norfolk Vanguard East wind farm 38.3km S (Figure 28).

### 5.4.5 Commercial 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 [6].

The waters surrounding the Leman 7J jacket are described as having 'High' shipping activity [58], requiring a Vessel Traffic Survey and a Collision Risk Assessment under the Consent to Location application process [58] for any stationary installations.

### 5.4.6 Wrecks

There are no protected wrecks recorded within blocks 49/27 [49].

### 5.4.7 Telecommunications & Cables

The closest active telecommunication cable, NORSEA COM 1 LOW-MUR, runs along the eastern edge of UKCS block 49/27, approximately 12.1km from the intended installation and operated by Tampnet [37]. Additionally, 35.3km S is also located the active telecommunication cable BTNS operated by BT.

### 5.4.8 Military Activity

Blocks 49/27 and 49/28 do not lie within a known military practice and exercise area (PEXAs) [18, 58]

### 5.4.9 Tourism

Due to the distance between the Leman installation within scope and the nearest landfall (53km from the northeast of BGT), no recreational vessel use is known to occur in the area.

**Figure 27: Leman infrastructure in relation to surrounding oil and gas activity**

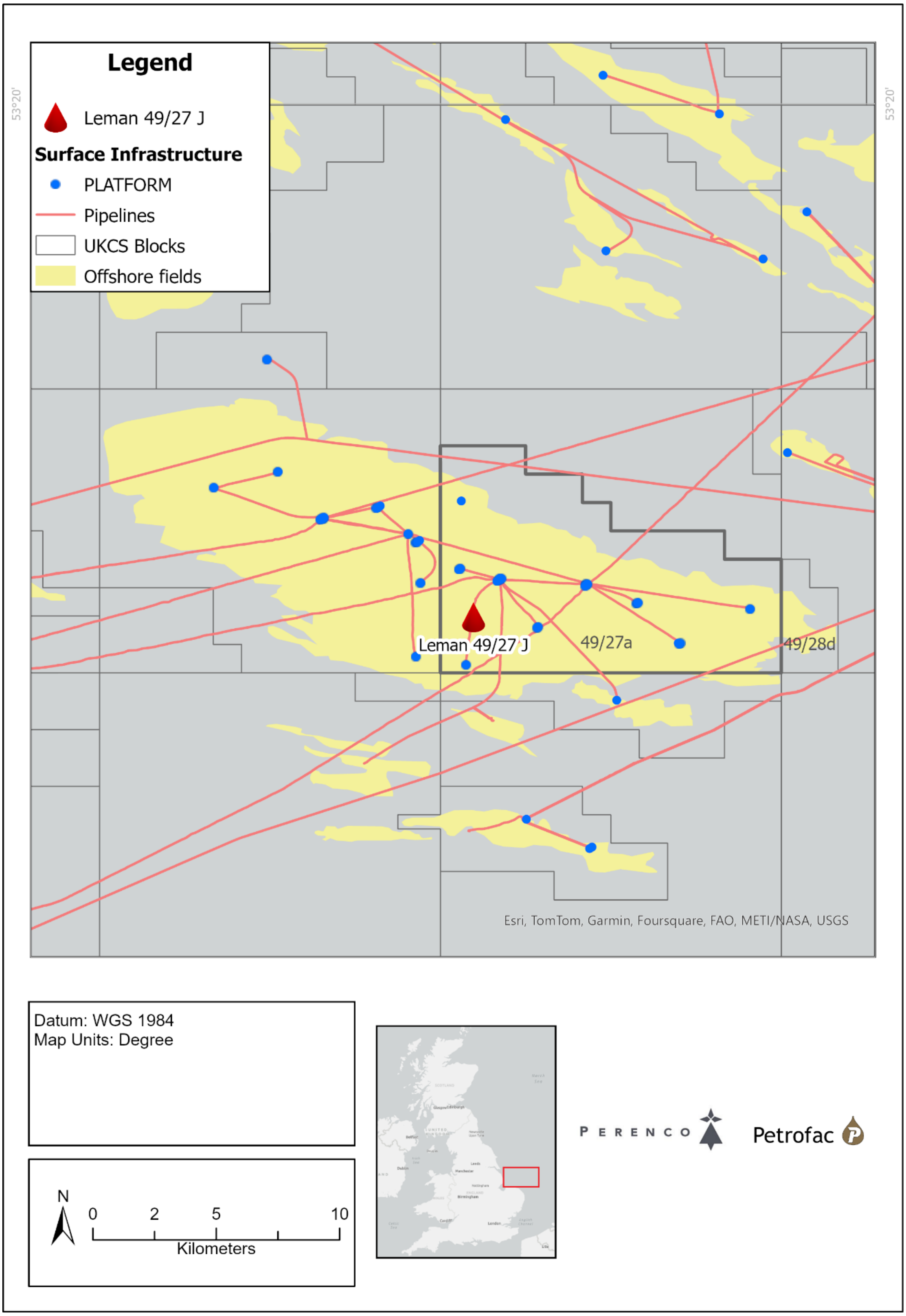
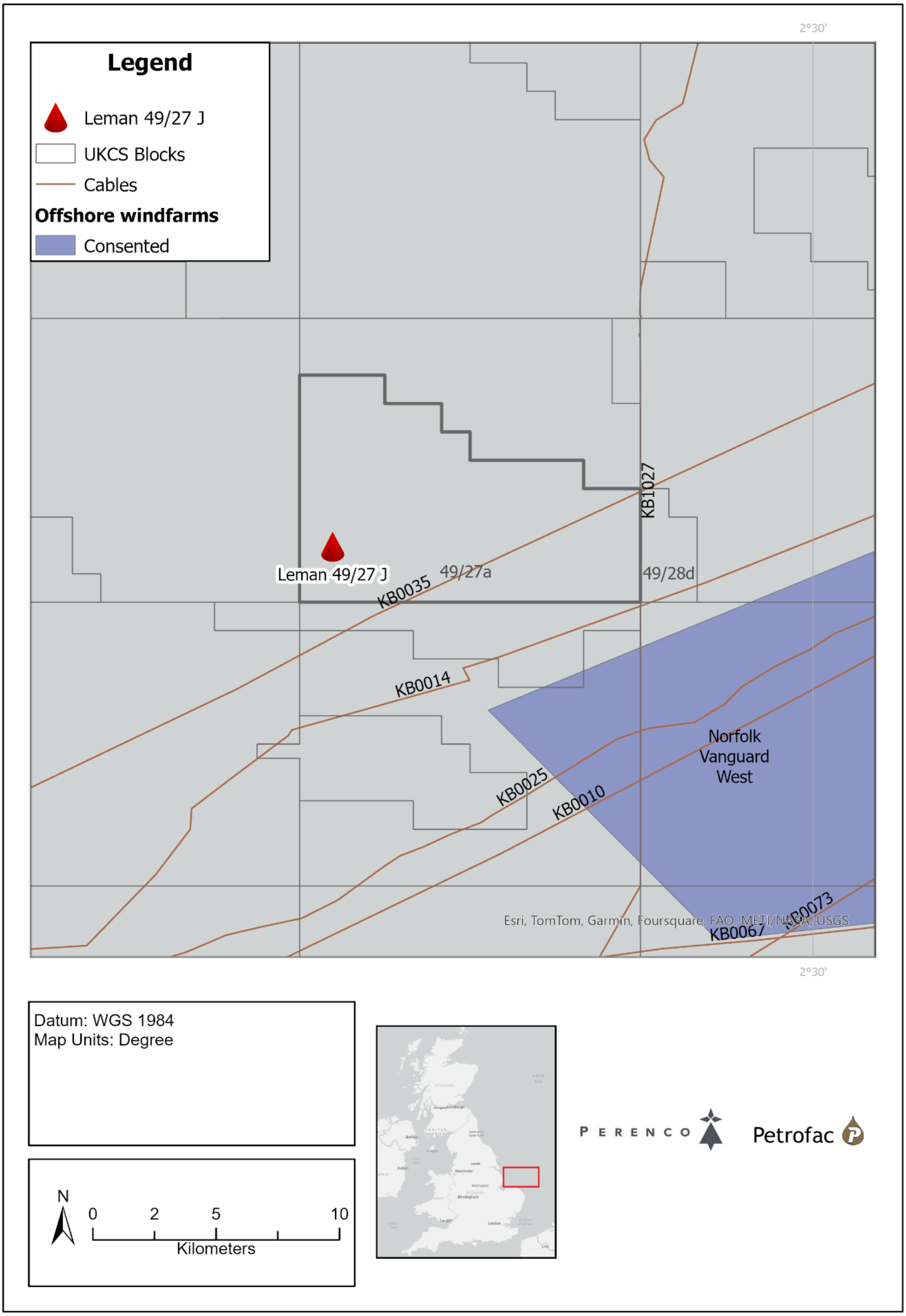


**Figure 28: Leman 27J infrastructure in relation to surrounding aggregate, offshore renewables, and cable activity.**



# 6 ENVIRONMENTAL IMPACTS IDENTIFICATION (ENVID) SUMMARY

Table 6-1 provides details of the potential impacts associated with the preferred decommissioning option as identified in the ENVID. All significant potential impacts have been scoped in for further assessment in section 7.

**Table 6-1: Assessment of impacts from the preferred decommissioning option across Leman 27J jacket and pipeline**

| Assessment Topic | Project Activity / Event | Physical Receptors | | | | Biological Receptors | | | | | | Human Receptors | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Seabed Sediments | Water Quality | Air Quality | Climate | Plankton | Benthic Communities | Fish & Shellfish | Seabirds | Marine Mammals | MPA | Shipping | Commercial Fisheries | Oil & Gas & CCS Activity | Subsea Cables | Renewable Energy Activity | Cultural Heritage | Military Activity | Disposal, Dredging & Aggregate Activity | Seascape | Tourism & Leisure | Population & Human Health |
| **Leman 27J removal** | | | | | | | | | | | | | | | | | | | | | | |
| Physical presence | Physical presence of vessels | * | * | * | * | * | * | * | * | * | * | A | * | * | * | * | * | * | * | A | * | * |
| | Removal of installation | * | * | * | * | * | * | * | A | * | * | * | * | * | * | * | * | * | * | A | * | * |
| Seabed Disturbance | Excavation around the piles | A | A | * | * | * | A | A | * | * | A | * | * | * | * | * | * | * | * | * | * | * |
| | Excavation for pipelines cuts | A | A | * | * | * | A | A | * | * | A | * | * | * | * | * | * | * | * | * | * | * |
| | Use of garnet | A | A | * | * | * | A | A | * | * | A | * | * | * | * | * | * | * | * | * | * | * |
| | Jacket removal | A | A | * | * | * | A | A | * | * | A | * | * | * | * | * | * | * | * | * | * | * |
| Noise emissions | Use of vessels | * | * | * | * | * | * | A | * | A | A | * | * | * | * | * | * | * | * | * | * | * |
| | Use of underwater cutting equipment | * | * | * | * | * | * | A | * | A | A | * | * | * | * | * | * | * | * | * | * | * |
| Marine discharges | Vessel discharges (operational/domestic) | * | A | * | * | A | A | A | A | A | * | * | * | * | * | * | * | * | * | * | * | * |
| Atmospheric emissions | Use of HLV | * | * | A | A | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * |
| Waste (Hazardous/non-hazardous) | Operational/domestic waste from HLV | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | A |
| | Decommissioning waste (jacket/risers/pipeline/sections) | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * |
| Accidental Events | Vessel collision | * | A | A | A | A | A | A | A | A | * | A | A | A | * | * | * | * | * | * | * | A |

**Key:**

| | | | | | | |
|---|---|---|---|---|---|---|
| (dark blue) | Potential for significant effects | (light blue) | No potential for significant effects | A - Adverse effect | P - Beneficial effect | * - No interaction |

# 7 ENVIRONMENTAL & SOCIAL IMPACT ASSESSMENT

## 7.1 Assessment Methodology

### 7.1.1 Introduction

The method PUK has been used to determine if the project is likely to have any significant effects on the environment is described in this section, and follows EIA good practice guidance [22, 12, 77, 30]. The process commences with the identification of project activities (or aspects) that could impact environmental and socio-economic receptors (i.e., components of the receiving environment), with consideration given to both planned (routine) activities and unplanned (accidental) events. The terms “impact” and “effect” have different definitions in EIA, and one may occur as a result of the other. Impacts are defined as changes to the environment as a direct result of project activities and can be either beneficial or adverse.

Effects are defined as the consequences of those impacts upon receptors. Impacts that could potentially result in significant effects are then subject to detailed assessment based on best available scientific evidence and professional judgement so that, where necessary, measures can be taken to prevent, reduce or offset what might otherwise be significant adverse effects on the environment through design evolution or operational mitigation measures. Residual effects are those that are predicted to remain assuming the successful implementation of the identified mitigation measures and are reviewed by PUK to confirm that the project complies with legal requirements and does not adversely impact the East Offshore Marine Plan policy goals and objectives.

### 7.1.2 Identification of Impacts

Environmental and social receptors that may be impacted by the project, have been identified in the receptor-based activity and events matrix in Table 6-1. The matrix has been populated by PUK after completion of an ENVID, with reference to the requirements of Article 3(1) of the EIA Directive [22], the OPRED EIA Guidance [7] and relevant OPRED Offshore Strategic Environmental Assessment Reports (2003-2022).

It is noted that the type of impacts which could occur from the project can be categorised as follows:

**Direct:** resulting from a direct interaction between a planned or unplanned project activity and a receptor;

**Indirect:** occurring as a consequence of a direct impact and may arise as a result of a complex pathway and be experienced at a later time or spatially removed from the direct impact;

**In-combination (or Intra-Project):** arising from different activities within the project resulting in several impacts on the same receptor or where different receptors are adversely affected to the detriment of the entire ecosystem;

**Cumulative (or Inter-Project):** resulting from incremental changes caused by other past, present, or reasonably foreseeable projects/proposals together with the project itself.

The nature, duration, scale, and frequency of the effects resulting from these impacts will vary and are described using the terminology in Table 7-1.

**Table 7-1: Categories and definitions of effects**

| Category | Descriptor | Definition |
|---|---|---|
| Nature | Adverse | Unfavourable consequences on receptors. |
| | Beneficial | Favourable consequences on receptors. |
| Duration | Short-term | Effects are predicted to last for a few days or weeks. |
| | Medium-term | Effects are predicted to last for a prolonged period of time, between one and five years. |
| | Long-term | Effects are predicted to last for a prolonged period of time, greater than 5 years. |
| | Temporary | Effects are reversible. |
| | Permanent | Effects are irreversible. |
| Scale | Local | Effects are limited to the area surrounding the project site or are restricted to a single habitat/biotope or community. |
| | Regional | Effects occur beyond the local area to the wider region. |
| | National | Effects occur at a national level (UKCS). |
| | Transboundary | Effects occur at an international level (outside of the UKCS). |
| Frequency | One-off | Effects which occur only once. |
| | Intermittent | Effects that occur on an occasional basis. |
| | Continuous | Effects that occur continuously. |

PUK has undertaken a preliminary assessment of the impacts identified in Table 6-1 to determine whether there is the potential for any significant effects on the environment to occur.

Where it has been identified that a project activity has the potential to result in a likely significant effect on the environment, a detailed assessment of the impact(s) and effect(s) has been undertaken, using the significance criteria defined in Section 7.1.3. The results of the assessment are documented in section 7.2 and 7.3. For some project activities, potential impacts have been identified, but none of the resulting effects are likely to be significant. These impacts have therefore been scoped out from detailed assessment.

Despite potential significance, in accordance with OPRED guidance [7], there is no requirement to assess accidental events such as spills from vessels within the EA. This has therefore been scoped out of further detailed assessment.

### 7.1.3 Evaluation of Impact Significance

This section describes the criteria used for determining the likely significance of effects on the environment and society to ensure the assessment process is as transparent and consistent as possible. Where uncertainty exists, this has been acknowledged in the assessment text.

### Planned Activities

For planned activities, the significance of effects has been evaluated by considering the sensitivity of the receptor affected in combination with the magnitude of impact that is likely to arise, having regard to the criteria detailed in Annex III of the EIA Directive, including:

The magnitude and spatial extent of the impact (geographical area and size of the population likely to be affected);

The nature of the impact;

The transboundary nature of the impact;

The intensity and complexity of the impact;

The probability of the impact;

The expected onset, duration, frequency, and reversibility of the impact;

The accumulation of the impact with the impact of other existing and / or approved projects and / or projects not yet approved, but that PUK is aware of;

The possibility of effectively reducing the impact.

### Sensitivity Criteria

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 7-2 has been used as a guide in this assessment to determine the sensitivity of receptors.

**Table 7-2: 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. |

### Magnitude of Impact Criteria

The magnitude of impact considers the characteristics of the change that are 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 beneficial. Where it is not possible to quantify impacts, a qualitative assessment has been carried out, based on best available scientific evidence and professional judgement. The criteria presented in Table 7-3 has been used as a guide in this assessment to define the magnitude of impact.

**Table 7-3: Determining magnitude of impact**

| Magnitude | Definition |
|---|---|
| **Substantial** | Permanent or long-term (>5 years) change in baseline environmental conditions, which is certain to occur.<br>Impact may be one-off, intermittent, or continuous and/or experienced over a very wide area (i.e., transboundary in scale).<br>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.<br>Impact may be one-off, intermittent, or continuous and/or experienced over a wide area (i.e., national in scale).<br>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.<br>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).<br>Impact is unlikely to result in exceedance of environmental quality standards or threshold criteria. |

| Magnitude | Definition |
|---|---|
| **Minor** | Short-term (a few days to weeks), temporary change in baseline environmental conditions, which could possibly occur.<br>Impact may be one-off, intermittent and/or localised in scale, limited to the area surrounding the proposed Project site.<br>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). |

**Significance of Effect**

For planned activities, 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 7-4.

In the context of this assessment, effects classed as **Major** or **Moderate** are considered to be "significant" in EIA terms and therefore mitigation measures are required to be identified in order to prevent, reduce, or offset adverse significant effects or enhance beneficial 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.

**Table 7-4: Significance Evaluation Matrix (Planned Activities)**

| | | **Magnitude of Impact** | | | | |
|---|---|---|---|---|---|---|
| | | **Negligible** | **Minor** | **Moderate** | **Major** | **Substantial** |
| **Receptor Sensitivity** | **Low** | Negligible | Minor | Minor | Minor | Minor / Moderate note1 |
| | **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 |

Note 1 The choice of significance level is based upon professional judgement and has been justified in the assessment text in section 7.2.

## 7.2 Insignificant Impacts

With regards to the aspects presented in Table 6-1 following the methodology outlined above, the aspects for which PUK consider there to be minimal or non-significant impact and therefore have been screened out from further detailed assessment within this EA report are described below.

### 7.2.1 Unplanned Events

The most significant unplanned event which could impact on the environment from the described operations is a loss of containment of hydrocarbons. All the Leman 27J wells, were plugged and abandoned in the autumn of 2024. As a result an Oil Pollution Emergency Plan (OPEP) is not required.

Operations are anticipated to be completed by an HLV. Any potential loss of containment from the vessel will be managed in line with MARPOL requirements including the requirement to operate a Shipboard Oil Pollution Emergency Plan (SOPEP) for hydrocarbon spills to sea.

No other unplanned events are anticipated.

Sensitivity: Medium

Magnitude: Moderate

**Significance: Minor**

Vessel best practices will be employed to minimise the potential for spills to sea and to minimise any impacts should they occur. This includes compliance with all MARPOL requirements and operation of a SOPEP.

As a result, no further assessment is required.

### 7.2.2 Energy And Emissions

Although the project will produce atmospheric emissions and consume energy, these activities are required to be undertaken to meet decommissioning obligations for the infrastructure.

The jacket lift and transportation to shore will be carried out using an HLV and is anticipated to be completed within 24 days. The pipeline removal is expected to be completed by a Multi-Service Vessel (MSV) within 5 days. The preferred option has been considered with a focus on minimising vessel time and therefore minimising any associated emissions.

An assessment of air emissions associated with the jacket removal is presented in Appendix A. These air emission contributions are far below any thresholds for emissions in the UKCS or on a global scale and are not significantly larger than general vessel operations in the region, resulting in negligible emissions. Future legacy surveys will be related to Leman pipelines which will be determined and agreed with OPRED in a separate DP.

Although there will be a short term and localised increase in emissions from the proposed operations, the total emissions will contribute an extremely small percentage to the offshore and UK total Carbon dioxide equivalent ($CO_2e$) emissions.

Sensitivity: High

Magnitude: Negligible

**Significance: Negligible**

Best practices will be employed to minimise this environmental footprint. This includes optimal pipeline removal and jacket removal operations, planning and procurement of vessels which operate effective EMS minimising their emissions.

As a result, no further assessment is required.

### 7.2.3 Waste Generation

All waste generated from decommissioning activities will be limited to the jacket, riser section, pipeline and vessel derived waste from the HLV. The generated waste will be handled and recovered or disposed of in line with existing waste management legislation following the principles of the waste hierarchy.

Cleaning, break up and recycling is considered the current most likely removal methodology for Leman jacket and pipeline. Raw materials will be returned to shore with the expectation to recycle the majority of the returned non-hazardous material.

Other non-hazardous waste which cannot be reused or recycled will be disposed of to a landfill site. Hazardous waste will be disposed of in accordance with established waste legislation. Only licensed contractors will be used for waste handling and treatment/disposal.

Tests for Naturally Occurring Radioactive Material (NORM) will be undertaken offshore by the Radiation Protection Supervisor, and any NORM encountered will be dealt with and disposed of in accordance with guidelines and company policies and under appropriate permit.

PL207 was made HCS, flushed, cut above water just below the cellar deck elevation, and filled with seawater. No NORM was detected when the risers were previously cut. Therefore NORM waste is not expected.

Sensitivity: Medium

Magnitude: Negligible

**Significance: Negligible**

As a result, no further assessment is required.

### 7.2.4 Physical Presence of Vessels in Relation to Other Sea Users

The pipeline cutting and removal is expected to be completed by an MSV. The jacket lift and transportation to shore will then be carried out using an HLV within the Leman 27J 500 m exclusion zone.

The project area has a high amount of shipping activity within it. However, this will not be significantly increased due to project activity.

The HLV is expected to remain within the existing Leman 27J 500m exclusion zone for a total of 20 days in order to complete the decommissioning works.

No impacts are anticipated for the transportation of the decommissioning asset to shore via HLV. Instead, the impacts of this presence will be managed via standard maritime navigational rules.

Sensitivity: Low

Magnitude: Negligible

**Significance: Negligible**

The HLV will be positioned within the existing Leman 27J 500m exclusion zones only. Vessel traffic and activity will be managed by the issuing of kingfisher notice to mariners and vessel operated Automatic Identification System.

As a result, no further assessment is required.

### 7.2.5 Operational Discharges to Sea

Vessel based discharges will be limited to those generally associated with HLV operations and controlled via established methods under the International Convention for the Prevention of Pollution from Ships. Approved contractor procedures will assess and minimise vessel-based discharges.

Prior to lifting the Leman jacket from the seabed, PL207 will be cut at the tee junction on PL206 and on the seabed near the base of the Leman 27J jacket to facilitate the removal of the jacket structure, allowing the internal pipeline fluids to enter the open sea. PL207 and PL206 have been flushed clean to a standard agreed upon with OPRED, rendered HCS and remain filled with sea water.

Any potential residual hydrocarbon and chemical volumes that may escape to sea during pipeline cutting operations are expected to be minimal and will be considered under the individual permit consent applications for the decommissioning activities through the Portal Environmental Tracking System.

Sensitivity: Medium

Magnitude: Negligible

**Significance: Negligible**

Potential residual volumes discharged to sea during cutting operations will be assessed and permitted under an Oil Pollution Prevention and Control and Chemical permit applied for via the UK energy portal.

Vessel based discharges will be limited to those generally associated with the decommissioning vessel controlled via established methods under (Convention on Marine Pollution). Approved contractor procedures will assess and minimise vessel-based discharges.

As a result, no further assessment is required.

### 7.2.6 Seabirds

The proposed decommissioning activities could disrupt seabirds if they are present or nesting during the removal of the Leman 27J jacket.

There are numerous records of seabirds using both manned and unmanned offshore structures, indicating they are generally undisturbed by most offshore operations. Instead, seabirds are drawn to these areas, as they offer some form of benefits to the individuals such as roosting sites and increased access to feeding grounds. 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).

No nests or kittiwakes were identified on the former 27J platform during a bird survey carried out by RSK in June 2023 [71]. A bird survey was repeated by Xodus Group in May 2024 where, again, no nesting birds were observed [85]. Finally, a bird survey was completed Xodus Group in May 2025 where no nesting birds were recorded [86]. It was also noted that it would be unlikely that there would be any successful nesting activity initiated during the 2025 breeding season.

Decommissioning activities for Leman 27J jacket are expected to begin in Q2-Q3 of 2026. Where feasible, PUK plans to avoid the nesting seasons when removing the jacket. Despite no evidence of nesting activity in 2024, a further assessment on the presence of nesting will be carried out prior to the works starting. Should any nesting be observed, decommissioning options will be discussed with OPRED.

Sensitivity: High

Magnitude: Minor

**Significance: Minor**

As a result of 2024 survey, no impacts from the proposed jacket decommissioning activities are anticipated for any nesting seabirds on Leman 27J jacket. Should nesting birds be identified on the platform during the breeding season PUK will assess ongoing activities to determine the potential for disturbance.

As a result, no further assessment is required.

## 7.3 Assessment of Potentially Significant Impacts

### 7.3.1 Seabed Disturbance

#### 7.3.1.1 Source of Potential Impacts

The Leman Jacket and pipeline decommissioning option will require activities that interact with the seabed which may result in either short-term or long-term disturbance to the seabed sediments and marine organisms. The extent of any disturbance, combined with the seabed type and hydrodynamic conditions during the activities, will determine the burial and smothering from suspended sediments and any indirect impact to species or habitats.

The proposed decommissioning activities at the jacket location will directly impact the seabed and benthic fauna living in and on the sediments in the following ways:

- Positioning the HLV jack-up rig legs, anchors and chains;
- Excavation of seabed for pipeline cutting operations;
- Jacket pile internal cutting, including dredging soil plug from pile annulus, complete pile cuts, and garnet deposition;
- Excavation of seabed around piles for external cutting (if internal cutting unfeasible)
- Removal of jacket and attached riser section;
- Removal of pipeline and grout bags;
- Indirect disturbance through re-suspension and deposition of seabed sediments.

The principal sources of potential seabed impacts from the selected decommissioning option are from the positioning the HLV, seabed excavation and jacket lifting activities.

The largest direct impact to the seafloor and benthic habitats Table 7-5 provides a seabed footprint estimate from positioning the HLV and discussed the methods that will be applied to minimised impacts from this activity.

Table 7-7 describes the indirect expected environmental seabed impacts duration from Leman 27J decommissioning operations activities, such as suspended sediments and release of contaminates that could occur as a result of sediment interaction. Overall seabed impact area is summarised in Table 7-6.

**Positioning the jack-up rig legs, anchors and chains**

The HLV will have direct interaction with the seabed during the positioning of the jack-up rig legs, anchors, and mooring chains. Positioning of the jack-up rig will result in smothering and compression of benthic organisms within the sediment underlying the spud cans.

The exact anchor plan for the Leman 27J jacket and pipeline decommissioning is not yet known. However, it is expected that the HLV will involve placement of six legs. At the bottom of each rig leg, a large stabilising structure called a ‘spud can’ provides the contact point with the seabed.

It is expected that the HLV may need to lower its jack-up legs twice: first at a stand-off position where anchor wires, chains, and anchors will be deployed; and then again at the final working position adjacent to the platform. After initial deployment, the legs will be jacked up, and the HLV repositioned before the legs are lowered again.

As such, seabed disturbance may occur twice due to spud can placement, while the anchors and anchor wires / chains will likely be positioned once. Each spud can has a seabed footprint of approximately 260 m² (based on an 18.2 m diameter), giving a total of 1,561 m² for all six legs. If spud can placement occurs twice, the combined seabed disturbance would be approximately 3,122 m².

While the exact anchor configuration is not yet finalised, it is assumed that eight anchors, each with a disturbance area of 13.5 m², will be used — resulting in a total anchor footprint of 108 m². Eight anchor chains, each approximately 645 m in length, are expected to be deployed. To reduce contact with the seabed, buoys will be attached to sections of the chains, lifting portions off the seabed wherever possible. Despite this, it is estimated that up to 250 m of each chain may remain in contact with the seabed.

Assuming a maximum of 250 m of each chain lies in contact with the seabed and sweeps laterally up to 30 m during the re-positioning of the HLV to final position, the seabed disturbance from each chain is estimated by modelling the chain drag as a triangular swept area. Since one end is anchored, the chain movement creates a triangle with a base of 30 m and height of 250 m. The area of this triangle is calculated as 0.5 × 30 m × 250 m = 3,750 m² per chain. The total seabed footprint from eight chains is therefore approximately 30,000 m².

As such a total seabed footprint of 33,230 m² has been estimated. Once the installation has been removed, the jack-up rig, anchors, and chains will be removed from the seabed.

**Table 7-5: Seabed footprint from HLV positioning**

| Component | Number | Footprint per Unit (m²) | Total Footprint (m²) | Notes |
|---|---|---|---|---|
| Spud cans (1st placement) | 6 | 260 | 1,561 | Twice placement assumed → total doubled to 3,122 m² |
| Spud cans (2nd placements) | 6 | 260 | 1,561 | |
| Anchors | 8 | 13.5 | 108 | Assumed anchor footprint per anchor |
| Anchor chains | 8 | 3,750 | 30,000 | 250 m seabed contact length × 30 m lateral drag (triangular area) |
| **Total estimated footprint** | – | – | **33,230** | Sum of spud cans (2x), anchors, and chains |

**Pipeline Cutting**

The Leman 27J jacket decommissioning will begin by isolating the jacket and riser from the subsea infrastructure currently attached. This operation will be carried out by performing a cut on the pipeline at the seabed near the base of the Leman 27J jacket using a hydraulic shear or diamond wire saw. Similarly, another cut will be carried out at the tee junction on PL206. It is expected that the pipeline cutting will occur using a vessel with dynamic positioning and as such no anchoring will be required for this activity.

The pipeline is free spanning in this area, supported by grout bags as shown in Figure 5. As such in Figure 29 and Figure 30. Similarly, on the tee junction side, the pipeline is fully supported by PL206 rather than the seabed, as shown in Figure 4. It is expected that the pipeline will be cuttable without excavation. As such, no excavation of the seabed is expected to cut the pipeline or lift it off the seabed. In order to be conservative, the length of the pipeline on the seafloor by 5 m (2.5 m either side) has been added to the seabed footprint of the project in Table 7-7, however minimal disturbance is expected.

The grout bags are estimated to be about one tonne and be approximately 1 $m^2$ at their base on the seabed. The grout bags will also be removed so they cannot pose a snagging hazard. To be considered a seabed disturbance of two 5 $m^2$ areas has been estimated, however, no excavation is expected to be required to remove them.

**Figure 29: Exposed riser section which continues up to jacket at the back of the structure [54]**


Image shows Index 9 in Figure 3.

**Figure 30: Riser tie-in flange at base of jacket [54]**


Image shows Index 9 in Figure 3.

**Jacket Piles Cutting and Lifting**

Leman 27J jacket has four piles, one in each leg. Piles will be cut to 3m below the seabed by internal abrasive cutting. The cutting head will use an abrasive cutting stream (garnet and water mix used at high pressure) to sever the piles. The garnet will be deposited in the vicinity of the cutting operations causing localised seabed disturbance. The maximum garnet discharge expected from the abrasive cutting would be 5800kg for each pile, resulting in 1.41$m^3$ seabed disturbance for each pile. Consequently, a total of 23,200kg (5.65$m^3$), in a worst-case scenario, could be deposited on the seabed, accounting for the four piles present in total for the Leman 27J jacket. It is assumed that the area of seabed sediment disturbed will be equal to the volume of garnet discharged (maximum disturbance depth assumed to be 1m).

A small amount of seabed material may be dredged from inside the piles to remove any potential soil plugs formed, in order to ensure clear access for the high-abrasion internal cutting tool. The internally dredged material for the four piles (15.2$m^3$) will be suspended on the water column and deposited on the seabed close to the jacket. It is assumed that the volume of seabed impact will be equivalent to the amount of dredged material. However, the dredged material will disperse over a larger area, forming a 0.5m layer of sediment on top of the seabed.

In addition, seabed sediments may also be mobilised as the jacket are lifted out of the seabed. It is assumed, as a conservative estimate, that seabed sediments may be disturbed to a diameter of approximately 2m around each of the piles, resulting an impact area of 19.97$m^2$ for each pile, and 79.88$m^2$ for all the piles. Furthermore, the expected piles cutting depth is 3m (10ft) below the mud line. Consequently, the resulting seabed disturbance for the jacket lifting operation is calculated as 239.64$m^3$.

Should internal cutting prove to be unfeasible, it would be necessary to excavate the seabed around the piles in order to enable external cutting with a diamond wire saw. The excavation is anticipated to disturb a diameter of approximately 2m around each of the piles and 3m deep, resulting in the same seabed impact as per the lifting operation.

In total, 33,580.79 $m^2$ of seabed may be impacted from and up to 9,626.08 $m^3$ of sediment may be disturbed from decommissioning the Leman 27J jacket (Table 7-6).

**Table 7-6: Summary of the potential seabed impact for Leman 27J decommissioning**

| Seabed impact activities | Total area ($m^2$) | Depth (m) | Total volume ($m^3$) |
|---|---|---|---|
| Spud cans placement | 3,121.86 | 3.00 | 9,365.59 |
| Anchors and anchor chains | 30,108.00 | - | - |
| Pipeline removal | 225 | - | - |
| Grout bag removal | 10.00 | - | - |
| Jacket piles internal dredging | 30.40 | 0.50 | 15.20 |
| Jacket piles internal cutting (garnet) | 5.65 | 1.00 | 5.65 |
| Jacket lifting [Note 1] | 79.88 | 3.00 | 239.64 |
| **Total Seabed impact** | **33,580.79** | **n/a** | **9,626.08** |

**Note 1:** Should internal cutting be unfeasible, the seabed impact resulting from excavation around the piles for external cutting will be equal to the jacket lifting impact

### 7.3.1.2 Impacts from Seabed Resuspension and Mobilisation of Contaminants

Indirect disturbance may occur through re-suspension and deposition of seabed sediments; however, it is likely to be temporary and short term in all instances. Resuspension of sediments is not predicted to exceed levels of natural variability. Overall, it is expected that these effects will be limited and occur within close proximity to the disturbance footprint.

Annex I *S. spinulosa* reefs were identified in the vicinity of Leman 27J jacket. A detail assessment of the impacts on *S. spinulosa* due to sediment resuspension is provided in section 7.3.1.5.

The resuspension and spread of contaminants present within the seabed footprint of oil and gas installations may lead to additional environmental impacts through the re-suspension of sediment contaminants. However, the EBS completed pre-decommissioning indicated a low level of contaminants in the seabed adjacent to the previous platform locations and along the pipeline routes (see section 5.1.6).

Environmental effects from the discharge of chemicals into the marine environment can include acute or long term toxic effects to marine organisms [62]. Persistent and bioaccumulate chemicals can magnify in the food chain and result in high exposure levels for top predators like seabirds and marine mammals and for human seafood consumers. Low concentrations of some substances are sufficient to interfere with the hormone and immune system and reproduction processes. Biological effects can extend beyond individual marine organisms to a whole population with adverse consequences for species composition and ecosystem structures [62], although previous studies suggest the effects of oil contaminated drill cuttings deposits on the benthos are likely to be confined to within less than 2km [4].

The pre-decommissioning survey of the Leman 27J carried out in 2022 [60, 61] indicates no significant contamination or presence of drilling cuttings on the seabed adjacent to the installation. TOC content was low, with a correlation to mud suggesting natural sediment transport. Heavy and trace metal concentrations were mostly below threshold levels, with minor exceptions for As at three stations and low, isolated detections of Hg and Cd. Pb and Ba concentrations remained below North Sea background levels, and there was no distinct pattern linking metal distribution to proximity to land. PAH concentrations were also low, with no exceedances of guidance levels, and the highest detected lightweight PAH concentration was well below background levels. THC varied within a narrow range, with no clear pattern related to TOC, mud content, or platform distance, and all THC concentrations remained below North Sea background levels. Overall, the findings suggest no significant contamination or drilling-related disturbances within the survey area (see section 5.1.6).

The potential level of impact for the mobilisation of contaminants is similar to that of seabed disturbance, where it is the physical disturbance of the seabed which may mobilise embedded contaminants. As seabed disturbance for the selected method is relatively low both in spatial extent and frequency, and there is no signal of seabed contamination around the jacket, the potential for the mobilisation of contaminants is also expected to be minimal. Therefore, the proposed decommissioning method is unlikely to lead to the mobilisation of significant levels of contaminants into the water column.

Sensitivity: High

Magnitude: Minor

**Significance: Minor**

#### 7.3.1.3 Impacts from Seabed Clearance Survey

Following approval of the Leman 27J Jacket & Pipeline DP and the execution of the decommissioning operations, the 500m exclusion zone will remain active until a dedicated DP for the Leman pipeline PL206 is completed and the PL206 pipeline and stabilisation material are decommissioned.

Verification of seabed clearance will be provided to OPRED following the completion of post-decommissioning surveys. The proposed method for clear seabed validation will be through non-intrusive methodologies such as Side Scan Sonar/ROV. If non-intrusive methods are deemed inconclusive during verification alternative methods will be discussed and agreed with OPRED. Therefore, no seabed disturbance from seabed clearance activities is expected.

Sensitivity: Very High

Magnitude: Negligible

**Significance: Negligible**

#### 7.3.1.4 Impacts on Benthic Communities

Species within highly mobile sandy biotopes are adapted to high levels of disturbance. They are able to withstand mobile sediments and are opportunistic [44]. The faunal communities that are typical of the sediments in the working area are highly resilient to any level of impact with recovery often within a few days or weeks. Following severe disturbances recovery is expected to occur within 12 months [44]. The communities have low sensitivity to smothering and abrasion or disturbance to the seabed surface. However, they are highly sensitive to changes to different types of sediment and the physical loss of suitable habitat [44].

The 2022 pre-decommissioning survey identified the following species as the most significant contributors to the total abundance within the survey area: *Nephtys cirrosa, Urothoe brevicornis, Ophelia borealis, Abludomelita obtusata, Ophiuridae juvenile, Scoloplos armiger, Bathyporeia guilliamsoniana* and *Nephtys_Juvenile.*

Based on the interpretation of the acoustic data and seabed imagery analysis alone, the survey area was categorised primarily as homogenous circalittoral muddy sand (A5.26). Extensive areas of the biotope *S. spinulosa* on stable circalittoral mixed sediment (A5.611) were also interpreted throughout the survey area.

**Direct impact**

As discussed in section 5.1.6, the area surrounding the 27J installation features extensive *Sabellaria spinulosa* reef habitat, a listed Annex I habitat and a designated feature of the North Norfolk Sandbanks and Saturn Reef SAC. Placement of spud cans, anchor chains and anchors has the potential to directly impact these reef structures.

Based on the pre-decommissioning survey, it is estimated that approximately 710,000 m² of Sabellaria reef habitat is present within the 1 km² area surrounding the installation. The anchor plan for the Leman 27J topside removal is provided in Figure 31. The anchor plan was designed to minimise interaction with the reef as far as feasible.

Development of an anchor plan for the jacket decommissioning works will likewise seek to miminise interaction with the Sabellaria reef and as such the HLV will likely be positioned in the sandy area to the east of the installation similar to the topside removal. Noting that there is a reef area to the north of the HLV position, it is assumed that, as a worst-case that three spud cans may cross into the reef area. Where possible, the anchors and anchor chains will also be placed outside the reef area. For this assessment, it has been assumed that four anchors and chains have direct interaction with the reef. The installation itself, as well as the pipeline, are not within reef areas and no interaction with the reef is expected to occur during work on these structures.

As such, it is estimated that seabed disturbance footprint of 16,615 m² overlaps with reef habitat, resulting in a potential impact to 2.34% of the reef present within that local area.

The total footprint of 16,615 m² comprises:

- Three spud can placements (two positions within reef): 1,561 m².
- Four anchor footprints: 54 m².
- Anchor chain disturbance (4 chains × 3,750 m²): 15,000 m².

The total area of the North Norfolk Sandbanks and Saturn Reef SAC is 3,603 km² (or 3,603,000,000 m²), meaning this impact represents approximately 0.0005% of the total SAC area.

**Figure 31: Anchor plan from the Leman 27J topside removal. Brown areas are Sabellaria reefs.**


The reef system around the installation may be subject to cumulative impacts. An estimated 8,363.5 m² of *Sabellaria* reef was previously impacted during jack-up rig operations for Leman 27J topside decommissioning in November 2024, equivalent to 1.12% of the reef area within 1 km². Evidence collected from the Debris Site Survey found the mapped reef area within the 2024 impact area continues to feature *S. spinulosa* with some areas retaining or gaining Annex I reef status while others having reef too patchy to meet the definition of biogenic reef. Given that this survey took place approximately one year after the decommissioning activities, it is possible that some of the observed differences in reef classification reflect either damage from the works or early stages of natural recovery.

Reefs potentially recovering from the 2024 impacts may experience further degradation from the current activity. If the new footprint overlaps completely with the previous impact area, then 8,363.50 $m^2$ of the newly impacted reef area would have been subject to multiple disturbances. In a scenario where the new and old impact areas are entirely separate, the cumulative area of disturbed reef could total up to 24,978.43 $m^2$ (approximately 3.5% of the reef within the 1 $km^2$ area, or 0.0007% of the total SAC).

However, recovery of *Sabellaria spinulosa* reefs is typically rapid, as the species is an r-strategist. Studies show that *S. spinulosa* can recover quickly from short- to medium-term disturbance. Juveniles grow rapidly, and adults reach full size within months of settlement [66]. The species is known to thrive in frequently disturbed or polluted environments and is adapted to recolonise temporary habitats. Sexual maturity can be reached within a year, enabling fast recovery when conditions allow.

Where extensive damage occurs, recovery depends on larval recolonisation. This process is accelerated when unaffected reef areas remain, as they act as larval sources [82]. In this case, over 95% of the local reef would remain intact, supporting the likelihood of recovery.

As such, even in a worst-case cumulative scenario, total reef impact from both decommissioning phases would represent only 0.0007% of the SAC. Given that these reefs are believed to be ephemeral in nature [63], this small-scale impact is likely within the range of natural variability. Therefore, no adverse effect on the conservation objectives or status of the SAC is anticipated.

Nonetheless, mitigation measures will be implemented to reduce uncertainty and minimise impacts where possible. These include:

- A dropdown camera and multibeam echosounder (MBES) survey was undertaken between 25 and 26 July 2025. The survey data will be used to inform and optimise the anchor plan, with a goal of avoiding placement of spud cans, anchors, and chains on identified reef areas wherever feasible.
- The survey will also help assess the condition of the reef in areas previously impacted by topside decommissioning, to improve understanding of actual recovery rates and inform future decision-making.
- Repositioning of the jack-up rig will be avoided where possible to minimise repeat seabed disturbance.
- Once the anchor plan is confirmed and survey analysis is complete, an updated seabed disturbance footprint will be calculated and submitted with the Consent to Locate application.

**Sediment dispersion**

It is anticipated that any impacted seabed would be recolonised by benthic fauna typical of the area as a result of natural settlement by larvae and plankton and through the migration of motile animals from adjacent undisturbed benthic communities [17]. Recovery times for soft sediment faunal communities are difficult to predict, although studies have attempted to quantify timescales. The Minerals Management Service quote various sources and report that recolonisation takes 1-3 years in areas of strong currents but up to 5-10 years in areas of low current velocity [50]. Longer recovery times are reported for sands and gravels where an initial recovery phase in the first 12 months is followed by a period of several years before pre-activity population structure is attained.

**Table 7-7: Summary of seabed impacts from the proposed decommissioning option**

| Decommissioning activities | Impact Duration | | | |
|---|---|---|---|---|
| | Suspended sediments | Release of contaminants | Burial and smothering | Change in habitat |
| **Positioning the HLV jack-up rig legs, anchors and chains** | Short-term | Limited | Short-term | Short-term |
| **Pipeline cutting** | Short-term | Limited | Short-term | Short-term |
| **Seabed excavation** | Short-term | Limited | Short-term | Short-term |
| **Jacket pile internal/ external cuttings** | Short-term | Limited | Short-term | Short-term |
| **Jacket removal** | Short-term | Limited | Short-term | Short-term |

Due to the limited nature of the activity, both spatially and temporally, any effects from physical damage to the seabed and the resulting settlement of suspended sediments would be small in nature and duration. As a result, no significant impact on benthic species is expected as a result of the proposed operations.

Sensitivity: High

Magnitude: Minor

**Significance: Minor**

#### 7.3.1.5 Impacts on the North Norfolk Sandbanks and Saturn Reef SAC

Conservation objectives detail the desired state of a European protected site in respect to interest features for which the site has been designated. In respect to The North Norfolk sandbanks and Saturn reef SAC which covers an area of 3,603km$^2$, these protected features include ‘sandbanks which are slightly covered by sea water all the time’ and biogenic reef constructed by *Sabellaria spinulosa.*

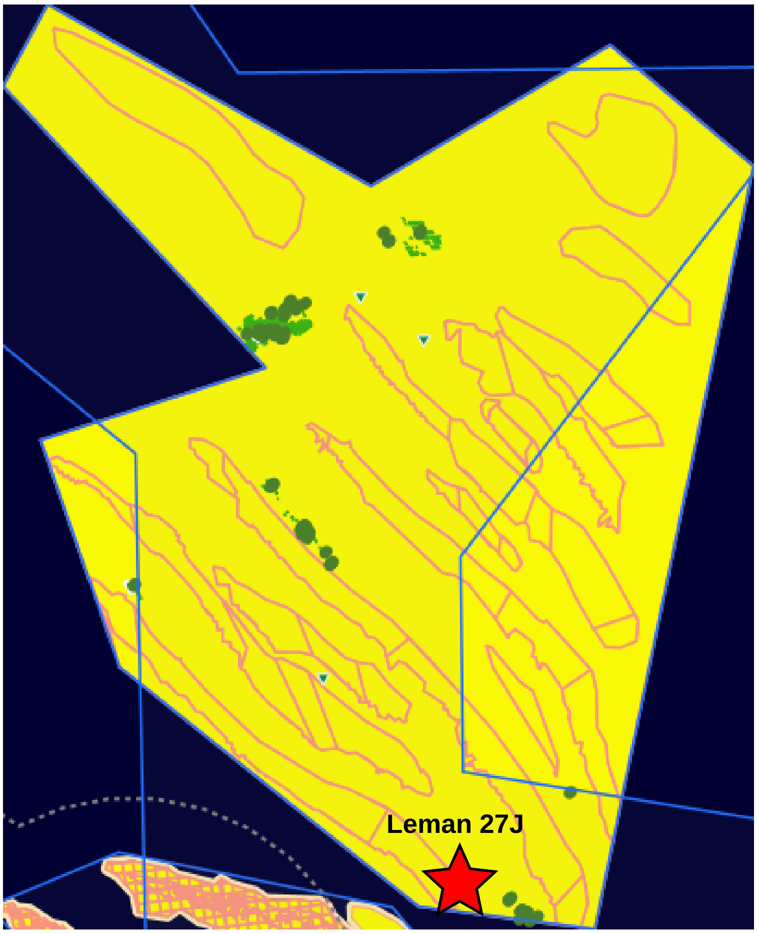
**Annex I Sandbank**

The entirety of the SAC is considered a representative functioning example of the Annex I feature sandbank and viewed as one integrated sandbank system. The acoustic data and analyses conducted as part of the habitat assessment report [60] indicate the presence of physical and ecological conditions typically associated with this Annex I feature (see Figure 32).

A worst case assessment indicates a potential impact on 33,580.79 m$^2$ of sandbank area, which may occur as a result of the Leman 27J jacket decommissioning activities. This represents 0.0009% of the total SAC area. This impact would be very minor and would be temporary.

Removal of the jackets and pipeline would ultimately allow more natural hydrodynamics to resume, filling in the scour hole, allowing the sandbank system in the area to function more naturally. As such, removal of the anthropogenic infrastructure will likely have a positive impact on the North Norfolk Sandbanks and Saturn Reef SAC in the long-term, which is why removal of marine debris has previously been considered a benthic compensation strategy for impacts to the North Norfolk Sandbanks and Saturn Reef SAC [70].

**Figure 32: North Norfolk Sandbanks and Saturn Reef SAC with designated features**




In 2019 A Habitats Regulation Assessment (HRA) was completed by the Department for Business, Energy & Industrial Strategy (BEIS) for the proposed decommissioning of the Viking and LOGGS development. The assessment considered a total physical impact area of sandbanks of 17.28km$^2$ (0.48% of the SAC total area) where it was determined that such activity would not have an adverse effect upon the integrity of the North Norfolk Sandbanks and Saturn Reef SAC [5].

Consequently, it concluded that the sandbanks would progressively recover and any physical impacts will be localised and temporary [5].

**Annex I Biogenic Reefs**

The other protected feature of this SAC are the reefs which may be located in discrete areas around the SAC. However, currently available survey data indicates these to be located mostly in the south and the western extent of the SAC (Figure 32).

The pre-decommissioning environmental survey identified the presence of Annex I reefs within the Leman 27J jacket survey area [60, 61]. The imagery confirmed the presence of *S. spinulosa* tube aggregations within 55% off the imagines analysed, with reefiness ranging from low to medium, displaying both clumps and tube structures. The reefs appeared healthy and covered a significant proportion of the seabed (see Figure 33).

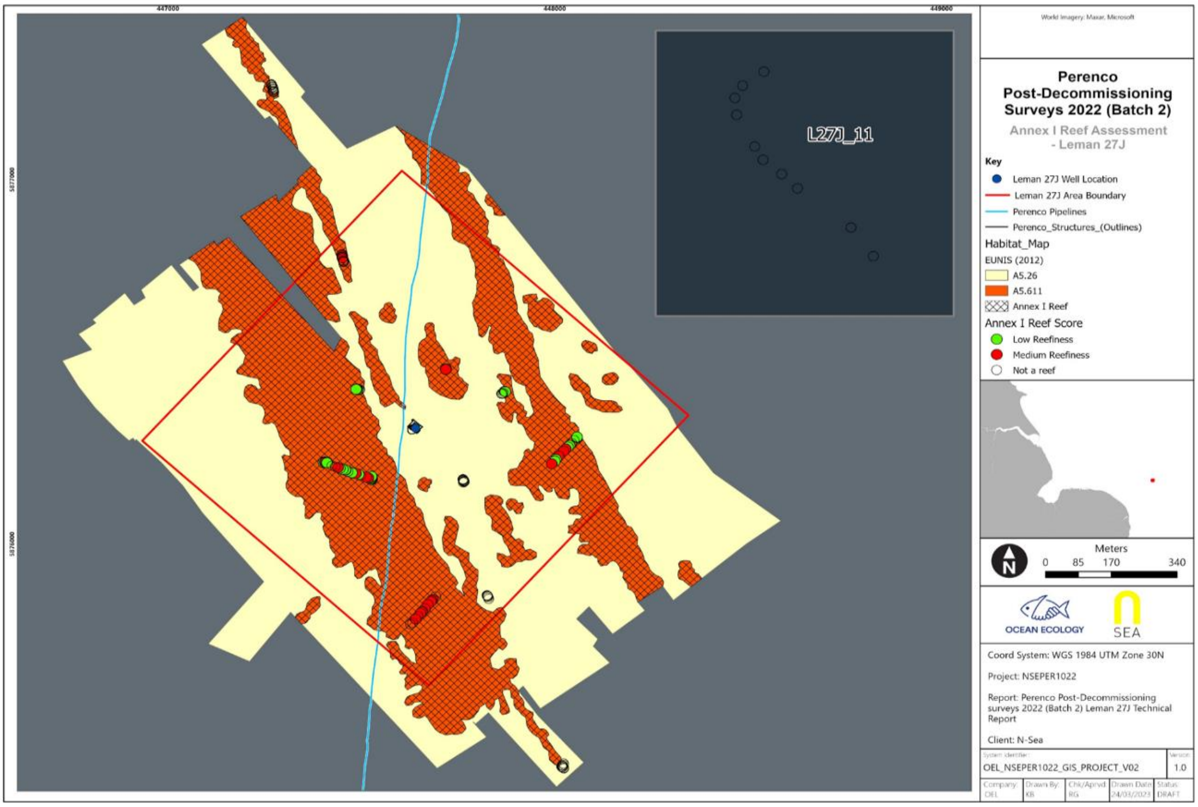
**Figure 33: Examples of Annex I reefs from imagery at pre-decommissioning survey**

Biogenic reefs such as *S. spinulosa* are sensitive habitats, easily impacted by changes to the environment such as poor water quality and increased sediment load, as well as physical damage caused by trawling and dredging activities. It is possible these reefs are being offered protection by the exclusion zones implemented around oil and gas structures. Further, subsea structures associated with oil and gas infrastructure could be sheltering or promoting the growth of biogenic reef by acting as suitable hard substrates in which individuals may propagate and grow in otherwise unsuitable habitat conditions.

Several extensive *S. spinulosa* reef areas have been mapped < 12km to the south and < 20km to southwest of the Leman 27J survey area. This data further extended the northerly range of mapped biogenic reef features for this region and signified an important area of Annex I biogenic reef habitat.

The specific locations of the Annex I reefs were identified during the survey and have been accurately mapped. A detailed representation of these mapped reef locations can be found in Figure 34.

**Figure 34: Location of Annex 1 reefs identified during the Leman pre-decommissioning survey**




The nearest reef area is located approximately 31m northwest of the jacket, positioned outside the decommissioning working area, which involve cutting, excavation and lifting operations. As such, it is assumed that interaction with the reef area would only occur from HLV positioning. As discussed in Section 7.3.1.4, a maximum of 16,615 $m^2$ of reef area is estimated to be impacted which constitutes 2.34% of the local reef area (within 1 km) or 0.0005% of the total SAC area.

*S. spinulosa* do not rely on light penetration for photosynthesis. It is also believed that visual perception is limited and that this species does not rely on sight to locate food or other resources. Experiments [16] and predictive modelling [80] indicate that tube building sabellariids can tolerate a broad range of suspended solids. In fact, decreases in suspended particles that reduce the supply of food or tube-building materials may, however, negatively impact this species [16, 40].

Indirect evidence for the tolerance of *S. spinulosa* for changes in turbidity is provided by the persistence of reefs on the outskirts of aggregate dredging areas [66, 67] which appear unaffected by extraction which is likely to have led to sediment plumes. This also indicate the low sensitivity of *S. Spinulosa* for smothering effect. In areas of high water flow dispersion of fine sediments may be rapid and this will mitigate the magnitude of this pressure by reducing the time exposed.

As a result, no direct impact on this protected feature is expected to occur. Any indirect impact from the suspension of sediments in the water column are not expected to have any significant impact due to the small scale nature of the activity and the highly mobile water currents in the area.

There are no set thresholds at which impacts on site integrity are considered to be adverse. This is a matter for interpretation on a site-by-site basis, depending on the designated feature and nature, scale and significance of the impact [5].

While the proposed operations will cause limited seabed impact, this will be temporary, occur over a very limited area and as a result is not expected to cause any significant impacts on the wider area or to protected species/habitat including on the protected features of the North Norfolk Sandbanks and Saturn Reef SAC.

In the long-term, removal of the anthropogenic infrastructure will likely have a positive impact on the North Norfolk Sandbanks and Saturn Reef SAC. Removal of marine debris allows the North Norfolk Sandbanks and Saturn Reef SAC to return to more natural sediment transport and benthic cover. As such, removal of marine debris has previously been considered as a benthic compensation strategy for impacts to the North Norfolk Sandbanks and Saturn Reef SAC [70].

Sensitivity: Very High

Magnitude: Minor

**Significance: Minor**

Proposed cut locations for infrastructure to be removed will be carefully planned to avoid excessive disturbance from excavation. The cutting of pipeline will be carried out using a diamond wire saw to prevent deposition or garnet. Proposed internal pile cuts will be carefully planned to avoid excessive seabed disturbance and prevent excessive deposition of garnet.

Selection of optimal de-burial technology will reduce seabed impact.

### 7.3.2 Underwater Noise Emission

The impact of underwater noise on marine life is influenced by several factors, including the nature of the sound (such as its type, strength, frequency range, and duration), the physical properties of the surrounding environment that affect how sound travels, the hearing capabilities of the affected organisms, and how these elements align across time and space.

Marine animals rely on sound for essential activities such as navigation, communication, and locating prey detection [52, 78, 69]. Therefore, the introduction of anthropogenic underwater noise can affect marine species by disrupting their capacity to perceive and utilise sound. These impacts can vary from obscuring natural communication and triggering minor behavioural changes to long-term disturbances, physical harm, or even death [62].

Potential effects from noise vary depending on the sensitivity of the receptor and its proximity to the sound source.

#### 7.3.2.1 Sources of Potential Impact

Noise emissions associated with the preferred decommissioning option are those generated from underwater cutting activities, excavation equipment, and operation of the HLV.

**Vessel operations**

The decommissioning operation will involve the use of a single HLV for a total of 24 days (20 on location) and an MSV for 5 days.

Large vessels, such as those exceeding 100m in length typically produce sound pressure levels between 180 and 190 dB re 1 μPa. In comparison, medium-sized support vessels (50-100m long) generate sound levels ranging from 165 to 180 dB re 1 μPa [62]. Then use of the HLV dynamic positioning thruster and the cranes operations (mechanical strain) are anticipated to be the main source of underground noise.

Noise levels from the HLV positioning are expected to be comparable to other shipping activities in the project area. The UKCS Blocks 49/27 is classified as having ‘high’ shipping density, and the operation is not expected to significantly increase noise in the surrounding area. Any contribution to cumulative noise impact as a result of the project activity is anticipated to be minimum.

**Cutting operations**

Underwater cutting will be limited to two cuts using a diamond wire saw or hydraulic shears on PL207. Additionally, four cuts will be performed on each of Leman 27J piles approximately 3m below the seabed level using internal abrasive cutting. In total, 7 underwater cuts are expected during decommissioning activities.

Underwater noise emissions from the proposed external or internal cutting tools are not expected to cause significant disturbance to marine fauna, as the tool use will be limited to 7 cuts, intermittently and for a short duration.

EA’s of previous decommissioning activities using similar cutting methods have indicated that associated noise levels from these operations fall far below those which may be considered significant in their potential to impact marine fauna.

**Excavation operations**

No excavation is expected to be required for cutting and removal of the pipeline as it is currently exposed. However, if excavation is required excavation equipment, such as MFE, would be required to expose sections of the pipeline prior to cutting, as well as to achieve a cutting depth of 3m below the mudline if internal cutting is not feasible.

MFE generate noise primarily from their hydraulic systems and high-velocity water jets used to displace seabed material. There is very little information available on underwater sound generated by this tool. Although MFE contribute to the overall underwater noise emissions, they are relatively quiet compared to any dredging operations. Seabed excavation operations will be limited to Leman 27J location and emit continuous mid-level noise for a short period of time, resulting in overall low underwater noise disturbance.

**Post-decommissioning surveys**

Verification of seabed clearance will be provided to OPRED following the completion of post-decommissioning surveys. The proposed method for clear seabed validation will be through non-intrusive methodologies such as Side Scan Sonar (SSS) or ROV.

The high frequency sound produced by SSS in relatively shallow waters (<200 m) is outside the hearing range of marine mammals and attenuates rapidly. The risk of injury or disturbance from the operation of this type of equipment is considered negligible, and no mitigation is required [33].

#### 7.3.2.2 Impacts on Southern North Sea SAC

The Leman 27J jacket is located within the boundaries of the Southern North Sea SAC. The SAC is designated for the protection of Annex II species harbour porpoise, a cetacean species that is particularly responsive to noise. The site covers an area of 36,951km$^2$ and supports an estimated 17.5% of the UK North Sea MU population of harbour porpoises. The SCANS aerial survey estimates the harbour porpoise density near Leman 27J at 0.6027 individuals per km$^2$.

The southern part of the SAC, where the Leman field is located, covers an area of 12,687km$^2$ and supports persistently high densities of harbour porpoises during the winter (October – March), which may overlap in time with the Leman 27J decommissioning campaign.

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 [35]:

- 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.

Based on this, the relatively low noise equipment and the limited extent of activities, any noise disturbance caused by the proposed decommissioning activities, in combination or individually, will not have the potential to became significant or cause detriment to the conservation objectives of the harbour purpose and the Southern North Sea SAC.

Additionally, the JNCC assessed the potential pressures on the Southern North Sea SAC harbour porpoise from anthropogenic underwater sound, determining the relative risk of impact to be medium [36].

While decommissioning operations will generate some noise through the use of vessel, subsea cutting, excavation, and post-decommissioning surveys, the noise levels expected to be generated are significantly below the threshold for causing injury or disturbance to Annex II species in the Southern North Sea.

Sensitivity: Very High

Magnitude: Minor

**Significance: Minor**

Effective operational planning will minimise vessel time in the area. Cutting activities will be planned and carried out efficiently to prevent excessive noise generation.

Any required post-decommissioning surveys will be scheduled and planned efficiently to minimise vessel operation time. If required, geotechnical survey equipment will be selected based on the lowest sound volume capable to achieving required survey results. Standard mitigations for minimising impacts on marine mammals will be employed where required.

Internal cutting techniques will be considered as the preferred options for the jacket piles, as they generate less noise and reduce the need for using MFE. For external cuts, the diamond wire saw or hydraulic shears is the preferred subsea cutting tool.

### 7.3.3 Cumulative and Transboundary Impacts

The closest transboundary line (UK / Netherlands) is located approximately 60 km E of the Leman 27J jacket location, and as such it is assumed that the potential for transboundary impacts will be nil. While there is the potential for finer sediments to remain in suspension for longer after seabed disturbance activities and potentially travel further from the working area before settling, this is expected to be insignificant.

As part of the EIA process, the potential impacts of the proposed project must be considered in conjunction with other proposed or ongoing projects or plans.

The Leman field is situated in an area of high oil and gas and shipping activity. At the time of writing, the only activity scheduled within the near vicinity is the Leman 49/28-1 & 49/27-5 Well Abandonment in the UKCS blocks 49/27 and 49/28. The well abandonment operations are scheduled to commence in Q1 2025 and will not overlap in time with the decommissioning of Leman 27J jacket and pipeline. No other significant oil & gas activity (decommissioning, drilling) is known to take place in the surrounding area.

The reef system around the installation may be subject to a cumulative impact from the proposed disturbance for these decommissioning works and any damage that occurred during the topside decommissioning in November 2024. However, as discussed in Section 7.3.1.4, recovery of *Sabellaria spinulosa* reefs is typically rapid and over 95% of the local reef would remain thus enabling easier recolonisation.

A dropdown camera and MBES survey was undertaken between 25 and 26 July 2025. The survey data will be used to inform and optimise the anchor plan, with a goal of avoiding placement of spud cans, anchors, and chains on identified reef areas wherever feasible. The survey will also help assess the condition of the reef in areas previously impacted by topside decommissioning, to improve understanding of actual recovery rates and inform future decision-making. Once the anchor plan is confirmed and survey analysis is complete, an updated seabed disturbance footprint will be calculated and submitted with the Consent to Locate application.

Even in a worst-case cumulative scenario, where the reef disturbance area is totally separate, leading to a larger overall impact area, total reef impact from both decommissioning phases would represent only 0.0007% of the SAC. Given that these reefs are believed to be ephemeral in nature [63], this small-scale impact is likely within the range of natural variability. Therefore, no adverse effect on the conservation objectives or status of the SAC is anticipated for cumulative impacts.

In the long-term, removal of the anthropogenic infrastructure will likely have a positive impact on the North Norfolk Sandbanks and Saturn Reef SAC. Removal of marine debris allows the North Norfolk Sandbanks and Saturn Reef SAC to return to more natural sediment transport and benthic cover. As such, removal of marine debris has previously been considered a benthic compensation strategy for impacts to the North Norfolk Sandbanks and Saturn Reef SAC [70].

The disturbance of seabed over Leman jacket infrastructure has the potential to temporarily suspend sediments in the local area. However, this impact will be small in extent, localised, and short term, with no lasting impact on the water column or nearby sediments.

### 7.3.4 Residual Impact

Localised seabed impact will occur as a result of the proposed decommissioning activities. The extent of this impact will be managed to be as low as reasonably possible.

Considering the above assessment and mitigation measures, it has been determined that the decommissioning of the Leman jacket and pipeline is unlikely to pose a significant hazard to other users of the area or a significant impact on local ecology.

# 8 ASSESSMENT CONCLUSIONS

Following detailed review of the proposed decommissioning option, the environmental sensitivities present in the area and potential impacts the environment it has been determined that the decommissioning of Leman 27J jacket and pipeline will not present any significant impacts.

The impacts associated with the decommissioning option are well understood and managed through the implementation of established mitigation measures. The impacts with potential to be significant was associated with seabed disturbance and underground noise. However, following further assessment, these have been determined not to be significant following the implementation of the stated mitigation measures. Overall, the decommissioning option presented within this report is determined as not having a significant impact.

In addition, this EA is considered by PUK to be in alignment with the objectives and marine planning policies of the East marine plan area.

Based on the assessment findings of this EA, including the identification and subsequent application of appropriate mitigation measures it is considered that the proposed decommissioning activities do not pose any significant impact to environmental or societal receptors within the UKCS or internationally.

# 9 ENVIRONMENTAL MANAGEMENT

This section describes the arrangements that will be put into place to ensure that the mitigation and other measures of control, including the reduction or elimination of potential impacts are implemented and conducted effectively. This section also serves to outline the key elements of relevant corporate policies and the means by which PUK will manage the environmental aspects of the Leman pipelines decommissioning operations.

## 9.1 Introduction

PUK hold ISO 14001 standard certification. Additionally, PUK operate under a SEMS, which forms part of the PUK Operating Management System (POMS). The POMS provide the framework for PUK to achieve safe and reliable operations day-in and day-out and ensures compliance with PUK's HSSE Policy.

In addition to enabling the implementation of identified mitigation and control measures, the SEMS provides the means to monitor the effectiveness of these measures through check and environmental performance. The SEMS, by design, will enable PUK to control activities and operations with a potential environmental impact and provide the assurance on the effectiveness of the environmental management.

## 9.2 Scope of the SEMS

The SEMS provides the framework for the management of Health, safety and Environmental (HSE) issues within the business. This SEMS is intended for application to all of PUK's activities as directed under the OSPAR recommendation 2003/5, promoting the design, use and implementation of EMS by the Offshore Industry. PUK, as a business, is centred on oil and gas exploration activities both onshore and offshore, with the offshore components of their business including seismic and drilling operations. As a relatively small operator PUK intend to resource such projects through the utilisation of contractors, should these not be available within the business itself.

The SEMS focuses on:

- Clear assignment of responsibilities;
- Excellence in HSE performance;
- Sound risk management and decision making;
- Efficient and cost-effective planning and operations;
- Legal compliance throughout all operations;
- A systematic approach to HSE critical business activities; and
- Continual improvement.

## 9.3 Principle of the SEMS

The following sub-sections describe the principles followed though the utilisation of the SEMS.

### 9.3.1 Improvement Programmes and the Management of Change

The purpose of employing an improvement programme is to:

Ensure the continuous development of the PUK policy commitment.

Introduce changes and innovations that ensure the achievement of performance standards where current performance is below expectations.

The SEMS also makes provision for the management of change. Changes may occur for a number of reasons, and at a number of levels. A 'management of change' procedure specifies the circumstances under which formal control of change is required to ensure that significant impacts remain under control and/or new impacts are identified, evaluated, and controlled.

### 9.3.2 Roles and Responsibilities

PUK will review existing environmental roles and responsibilities for staff participating in the Leman 27J Jacket & Pipeline DP. These will be amended and recorded in individual job descriptions to ensure that they take into account any changes required for the management of the impacts identified in this EA.

### 9.3.3 Training and Competence

The competence of staff with environmental responsibilities is a critical means of control. The SEMS, in conjunction with the Human Resources department of PUK allows for the appointment of suitably competent staff. The development and implementation of training programmes facilitates understanding and efficient application.

### 9.3.4 Communication

Internal environmental communication generally employs existing channels such as management meetings, minutes, poster displays, etc. External communication with stakeholders and interested parties is controlled through a communication programme. This establishes links between each stakeholder, the issues that are of concern to them, and the information they require to assure them that their concerns and expectations are being addressed. This EA and the consultation process that informed its production will be used to design the ongoing communication programme. Communication and reporting will employ information derived from the monitoring programme.

### 9.3.5 Document Control

The control of the SEMS documents is managed in the PUK Document Control System.

### 9.3.6 Records

Records provide the evidence of conformance with the requirements of the SEMS and of the achievement of the objectives and targets in improvement programmes. The PUK SEMS specifies those records that are to be generated for these purposes, and controls their creation, storage, access, and retention.

### 9.3.7 Monitoring and Audit

Checking techniques employed within PUK's SEMS are a combination of monitoring, inspection activities and periodic audits.

The requirement for monitoring and inspection stems from the need to provide information to a number of different stakeholders, but primarily regulators, and PUK management. As such, there is a requirement for the results of monitoring and inspection to be integrated with the PUK internal and external communication programme.

Monitoring and inspection activities focus on:

- Checks that process parameters remain within design boundaries (process monitoring);
- Checks that emissions and discharges remain within specified performance standards – (emissions monitoring); and
- Checks that the impacts of emissions and discharges are within acceptable limits (ambient monitoring).

#### 9.3.8 Incident Reporting and Investigation

The PUK SEMS stipulates documented procedures to control the reporting and investigation of incidents.

#### 9.3.9 Non-confidence and Corrective Action

The checking techniques outlined above are the means of detecting error or non-conformances. PUK's SEMS includes procedures for the formal recording and reporting of detected non-conformance, the definition of appropriate corrective action, the allocation of responsibilities and monitoring of close out.

#### 9.3.10 Review

PUK's SEMS includes arrangements for management review. This provides the means to ensure that the SEMS remains an effective tool to control the environmental impacts of operations, and to re-configure the SEMS in the light of internal or external change affecting the scope or significance of the impacts. Of particular importance is the role management review plays in the definition and implementation of the improvement programme, and the management of change.

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## Appendix A - Air Emissions Assessment

The following assumptions were used in this assessment:

Emission factors (EF) for offshore vessel use have been taken from the Environmental and Emissions Monitoring System, Atmospheric Emissions calculations (Offshore Energies UK (OEUK) & DESNZ] - default EF for diesel consumption plant operations engines.

100% combustion efficiency.

Sulphur content of fuel gas is 6.4ppm weight.

Diesel specific gravity: 0.88te/m$^3$ (average).

Fuel consumption for jacket removal expected HLV: 5m$^3$/24hrs (Quayside), 20m$^3$/24hrs (Transit), 15m$^3$/24hrs (Dynamic positioning/On location).

Fuel for PL207 removal expected: Multi-Service Vessel (MSV) 20 te/24 hours.

Emissions from onshore waste transportation and treatment has not been accounted.

Operations for the Leman 27J jacket is expected to last 20 days for jacket removal, 2 days for transportation between shore and other assets, and 2 days for activities at quayside (mobilisation/demobilisation).

Operations for the PL207 removal is expected to last 5 days.

**Table 10-1: Vessel days and fuel consumption for all Leman 27J jacket and pipeline decommissioning operations**

| **Vessel activity** | Diesel consumption /24hrs (m$^3$) | Vessel days | Diesel (m$^3$) | Total diesel (te) |
|---|---|---|---|---|
| HLV offshore days (Transit) | 20.0 | 2 | 40.0 | 35.2 |
| HLV offshore days (Onsite) | 15.0 | 20 | 300.0 | 264.0 |
| HLV days (Quayside) | 5.0 | 2 | 10.0 | 8.8 |
| MSV | 23 | 5 | 114 | 100 |
| | **Total** | **29** | **464** | **408** |

**Table 10-2: Total offshore emissions from HLV diesel consumption**

| **Aspect** | **Total Fuel Use (te)** | **Emissions (te) Note 1** | | | | | | | **$CO_2e$ Note 2** |
|---|---|---|---|---|---|---|---|---|---|
| | | **$CO_2$** | **CO** | **$NO_X$** | **$N_2O$** | **$SO_2$** | **$CH_4$** | **VOC** | |
| Vessels | 408.00 | 1305.60 | 6.41 | 24.24 | 0.09 | 1.63 | 0.07 | 0.82 | 1331.44 |

Note 1: EEMS Atmospheric Emissions factors (OEUK&DESNZ)

Note 2: Values for the non-carbon dioxide ($CO_2$) Green House Gases (GHG), methane ($CH_4$) and nitrous oxide ($N_2O$), are presented as $CO_2$ equivalents ($CO_2e$), using Global Warming Potential (GWP) factors from the Intergovernmental Panel on Climate Change Fifth assessment report (GWP for $CH_4$ = 28, GWP for $N_2O$ = 265).

A quantitative comparison between the predicted $CO_2e$ emissions generated during the proposed decommissioning operations and the local, regional and UK total $CO_2e$ emissions has been made in. Although there will be a short term and localised increase in emissions from the proposed operations, the total emissions will contribute a small percentage to the offshore and UK total $CO_2e$ emissions <0.0086% and <0.00031%, respectively).

**Table 10-3: Comparison of $CO_2e$ emissions from the proposed operations**

| Emission Source | Estimated $CO_2e$ Emissions (te) Note 1 |
|---|---|
| Leman 27J decommissioning operations | 1331.44 |
| UKCS Offshore $CO_2$ Emissions for 2021 Note 2 | 15,030,000.0 |
| UK Net $CO_2$ Emissions 2021 Note 3 | 426,500,000.0 |

Note 1: EEMS Atmospheric Emissions factors (OEUK&DESNZ)
Note 2: Based on total offshore emissions from OEUK (2022).
Note 3: Based on UK net total $CO_2$ emissions for 2021 (DESNZ, 2023).

The Climate Change Act 2008 (as amended) requires the government to set legally-binding 'carbon budgets' to act as stepping-stones towards the 2050 Net Zero target. These carbon budgets restrict the total amount of GHG that the UK can emit over five-year periods, ensuring continued progress towards the UK's long-term climate target. Table 10-4 details the carbon budget of relevance to the proposed Leman 27J jacket and pipeline decommissioning operations and confirms whether the UK is on track to meet these climate targets.

**Table 10-4: UK Carbon Budgets (HM Government, 2021)**

| Carbon Budget | Carbon Budget Level | Reduction Below 1990 Levels | Due to Meet Target |
|---|---|---|---|
| 4th carbon budget (2023 to 2027) | 1,950 million te $CO_2e$ | 51% by 2025 | Off track |

Table 10-5 presents the predicted $CO_2e$ emissions generated from the proposed decommissioning operations against the fourth UK carbon budget. It can be seen from this that the $CO_2e$ emissions generated during the operations, contribute only a very small amount to the fourth UK carbon budget, equal to ca. 0.0000683% of the UK budget.

**Table 10-5: Comparison of the proposed operations $CO_2e$ emissions against relevant UK carbon budgets**

| Emission Item | Carbon Accounting Period |
|---|---|
| | 4th Carbon Budget (2023 to 2027) |
| UK Carbon Budget $CO_2e$ Target | 1,950,000,000te $CO_2e$ |

| Emission Item | Carbon Accounting Period |
|---|---|
| | 4th Carbon Budget (2023 to 2027) |
| $CO_2e$ Emissions Generated from Leman 27J Jacket and pipeline decommissioning operations | 1331.44te $CO_2e$ |
| % of UK Carbon Budget $CO_2e$ emitted during Leman jacket decommissioning operations | 6.83e-5% |

To minimise the emissions generated, PUK will look to reduce vessel time in the field as far as practicable. In addition, PUK's contractor selection process will aim to ensure that the engines, generators and other combustion plant on the HLV are maintained and correctly operated to ensure that they work as efficiently as possible.

Given the above, the impact to the environment from atmospheric emissions has been scoped out from further assessment.