# Leman BH Decommissioning Project

# Environmental Impact Assessment

| | |
|---|---|
| Project | Leman BH Decommissioning |
| Originating Company | Shell UK Limited |
| Document Title | Leman BH Decommissioning Environmental Impact Assessment |
| Document Number | Shell: LBT-SH-HX-0702-00003-001. |
| Security Classification | Unrestricted |
| ECCN | |
| Issue Date | 29 July 2015 |

Revision Status

| Rev # | Date of Issue | Status Description | Originator | Checker | Approver |
|---|---|---|---|---|---|
| A01 | 27/07/15 | Issued for submission | J. Spence | L.Leitch, R.Sparreboom, K.Black | R.Sparreboom (PM) L.Leitch (Env. TA2) |
| | | | | | |
| | | | | | |
| | | | | | |

# CONTENTS


**1 INTRODUCTION ..... 5**

1.1 BACKGROUND ..... 5
1.2 SCOPE OF THE EIA ..... 5
1.3 LEGISLATIVE FRAMEWORK ..... 7
1.4 SHELL GROUP STANDARDS ..... 8
1.5 STAKEHOLDER ENGAGEMENT ..... 8
1.6 STRUCTURE OF REPORT ..... 8

**2 PROJECT DESCRIPTION ..... 10**

2.1 INTRODUCTION ..... 10
2.2 DECOMMISSIONING OPTIONS CONSIDERED ..... 11
*2.2.1 Introduction ..... 11*
*2.2.2 Timing of the Leman BH decommissioning ..... 11*
*2.2.3 Potential for re-use ..... 12*
*2.2.4 Removal methods ..... 12*
*2.2.5 Onshore dismantling yard ..... 13*
2.3 DECOMMISSIONING STRATEGY ..... 14
*2.3.1 Schedule of operations ..... 14*
*2.3.2 Leman BT Refurbishment ..... 14*
*2.3.3 Leman BH Pre-Lift operations ..... 15*
*2.3.4 Lifting Campaign ..... 15*
*2.3.5 Onshore dismantling ..... 16*
*2.3.6 Post Decommissioning ..... 17*

**3 ENVIRONMENTAL DESCRIPTION ..... 18**

3.1 INTRODUCTION ..... 18
3.2 SURVEYS IN THE AREA ..... 19
3.3 OFFSHORE PHYSICAL AND CHEMICAL ENVIRONMENT ..... 21
*3.3.1 Meteorology and Hydrography ..... 21*
*3.3.2 Seabed sediments ..... 21*
*3.3.3 Bathymetry and seabed features ..... 21*
3.4 OFFSHORE BIOLOGICAL ENVIRONMENT ..... 22
*3.4.1 Benthos ..... 22*
*3.4.2 EUNIS Biotopes ..... 24*
*3.4.3 Fish ..... 27*
*3.4.4 Marine Mammals ..... 28*
*3.4.5 Annex II Species ..... 29*
*3.4.6 Seabirds ..... 29*
3.5 MARINE CONSERVATION ..... 30
*3.5.1 Annex I Habitats ..... 30*
*3.5.2 Biodiversity Action Plan (BAP) Priority habitats ..... 34*
*3.5.3 Marine conservation Zones (MCZ) ..... 36*
*3.5.4 SPAs with marine components ..... 36*
*3.5.5 Other protected areas ..... 36*
3.6 OTHER SEA USERS ..... 36
*3.6.1 Commercial fisheries ..... 36*
*3.6.2 Oil and gas activity ..... 37*
*3.6.3 Shipping, offshore wind and aggregates extraction ..... 37*
*3.6.4 Shipping ..... 37*
*3.6.5 Offshore Wind Farms ..... 39*
*3.6.6 Aggregate extraction ..... 39*
*3.6.7 Other Subsea Infrastructure ..... 39*

*3.6.8 Military uses* ..... *39*
*3.6.9 Cultural Heritage* ..... *39*
3.7 East Inshore and East Offshore Marine Plan ..... 39

**4 EIA METHODOLOGY ..... 40**

4.1 Impact Assessment Process ..... 40
4.2 Impact Assessment Methodology ..... 40

**5 ASSESSMENT OF IMPACTS ..... 43**

5.1 Introduction ..... 43
5.2 Seabed disturbance and impacts to conservation features ..... 43
*5.2.1 Overview of seabed impacts* ..... *43*
*5.2.2 Seabed footprint of project* ..... *43*
*5.2.3 Impacts to the seabed and benthic fauna* ..... *50*
*5.2.4 Impacts to conservation features* ..... *51*
*5.2.5 Indirect Impacts From re-suspension and re-deposition of sediment* ..... *54*
*5.2.6 Summary of seabed disturbance impact assessment* ..... *55*
*5.2.7 Mitigation measures* ..... *55*
5.3 Energy use/atmospheric emmissions ..... 55
*5.3.1 Impact assessment* ..... *55*
*5.3.2 Mitigation* ..... *57*
5.4 Underwater noise ..... 57
*5.4.1 Impact Assessment* ..... *57*
*5.4.2 Mitigation* ..... *58*
5.5 Accidental events ..... 58
*5.5.1 Vessel Collision* ..... *58*
*5.5.2 Hydrocarbon or chemical spills* ..... *59*
*5.5.3 Dropped objects* ..... *59*
*5.5.4 Mitigation* ..... *59*
5.6 Waste Management ..... 60
*5.6.1 Routine vessel wastes* ..... *60*
*5.6.2 Onshore Dismantling Waste* ..... *60*
*5.6.3 Mitigation* ..... *61*
5.7 Socio-Economic Impacts ..... 61
*5.7.1 Fisheries* ..... *61*
*5.7.2 Oil and Gas activities* ..... *61*
*5.7.3 Shipping and Navigation* ..... *62*
*5.7.4 Offshore Renewables* ..... *62*
*5.7.5 Aggregate Extraction* ..... *62*
5.8 Onshore impacts ..... 63
*5.8.1 Noise* ..... *63*
*5.8.2 Odour from Marine growth* ..... *63*
*5.8.3 Employment* ..... *63*
*5.8.4 Road transport* ..... *63*
*5.8.5 Mitigation* ..... *63*
5.9 Transboundary and cumulative impacts ..... 64
*5.9.1 Transboundary impacts* ..... *64*
*5.9.2 Cumulative impacts* ..... *64*

**6 ENVIRONMENTAL MANAGEMENT SYSTEM (EMS) ..... 69**

6.1 Policy and Strategic Objectives ..... 69
6.2 Organisation, Responsibilities, Resources and Competency ..... 69
6.3 Impact Management ..... 71
6.4 Processes, Assets and Standards ..... 71
6.5 Planning and monitoring ..... 71

6.6 Implementation and Operation ..... 71
6.7 Assurance and Management Review ..... 72
6.8 Leman BH Decommissioning HSSE-SP plan ..... 72
6.9 Contractor interface ..... 72
**7 CONCLUSIONS ..... 73**
7.1 Key environmental sensitivities and Potential Impacts ..... 73
7.2 Transboundary and Cumulative impacts ..... 73
7.3 Concluding remarks ..... 74
**8 REFERENCES ..... 75**
**9 ACRONYMS AND ABBREVIATIONS ..... 79**
**10 APPENDIX A: STAKEHOLDER ENGAGEMENT COMMENTS ..... 81**
**11 APPENDIX B: SABELLARIA ASSESSMENTS AT DELINEATED PATCHES AND ROV TRANSECTS ..... 83**

## Table of Figures

Figure 1-1: Location of Leman BT/BH platforms ..... 6
Figure 2-1: Location of Leman BH/BT platforms ..... 10
Figure 2-2: Leman BH platform (Left) and BT platform (right) ..... 11
Figure 3-1: Leman BH Location ..... 18
Figure 3-2: Survey coverage in the Leman BH Location ..... 20
Figure 3-3 Seabed features surrounding the Leman BH location ..... 23
Figure 3-4: Example still photographs of 'circalittoral fine sand' ..... 25
Figure 3-5: Example still photographs of 'Circalittoral mixed sediments' ..... 26
Figure 3-6: Example still photographs of '*Sabellaria spinulosa* on stable circalittoral mixed sediment' ..... 26
Figure 3-7: Example still photographs of potential 'Piddocks with a sparse associated fauna in sublittoral very soft chalk or clay' ..... 27
Figure 3-8: Sand ridge to the North of the Leman BH/BT ..... 31
Figure 3-9: Habitat assessment results. Delineated potential *Sabellaria* areas and transect patchiness assessment ..... 35
Figure 3-10: Leman BH location in relation to shipping, windfarm developments and aggregate extraction areas ..... 38
Figure 5-1: Area of potential disturbance by a Sheerleg HLV ..... 48
Figure 5-2: Area of potential disturbance by a Large HLV ..... 49
Figure 5-3: Estimated Inventory of decommissioning waste and its fate ..... 60
Figure 6-1: Summary of EMS elements ..... 69
Figure 6-2: Shell UK HSSE and SP Policy ..... 70

# 1 INTRODUCTION

## 1.1 BACKGROUND

### OVERVIEW OF LEMAN FIELD

The Leman gas field, situated in United Kingdom Continental Shelf (UKCS) Block 49/26 was discovered in December 1965 and comprises 3 main complexes, Leman A, B and C. There are also four additional platforms, Leman D and E to the south and Leman F and G to the north (Figure 1-1).

The Shell-operated Leman B complex currently comprises two pairs of bridge-linked platforms, Leman BT/BH and Leman BD/BP. The Leman BT platform (BT) was installed in June 1970 and the Leman BH Living Quarter platform (BH) which is bridge-linked to BT, in February 1981. A third platform, the Leman BK compression platform (BK) which was installed in 1975 and bridge-linked to the north of Leman BT, was decommissioned in 1996.

The Leman BT/BH installation is located in UKCS Block 49/26 in the southern North Sea, approximately 50km from the Norfolk coast and approximately 62 km west of the UK/Netherlands boundary line.

### LEMAN BH DECOMMISSIONING OPPORTUNITY

Leman BH platform originally provided accommodation for crews working on BT and the BK but its current functions are to provide power to BT and helicopter access and shelter for personnel visiting BT/BH.

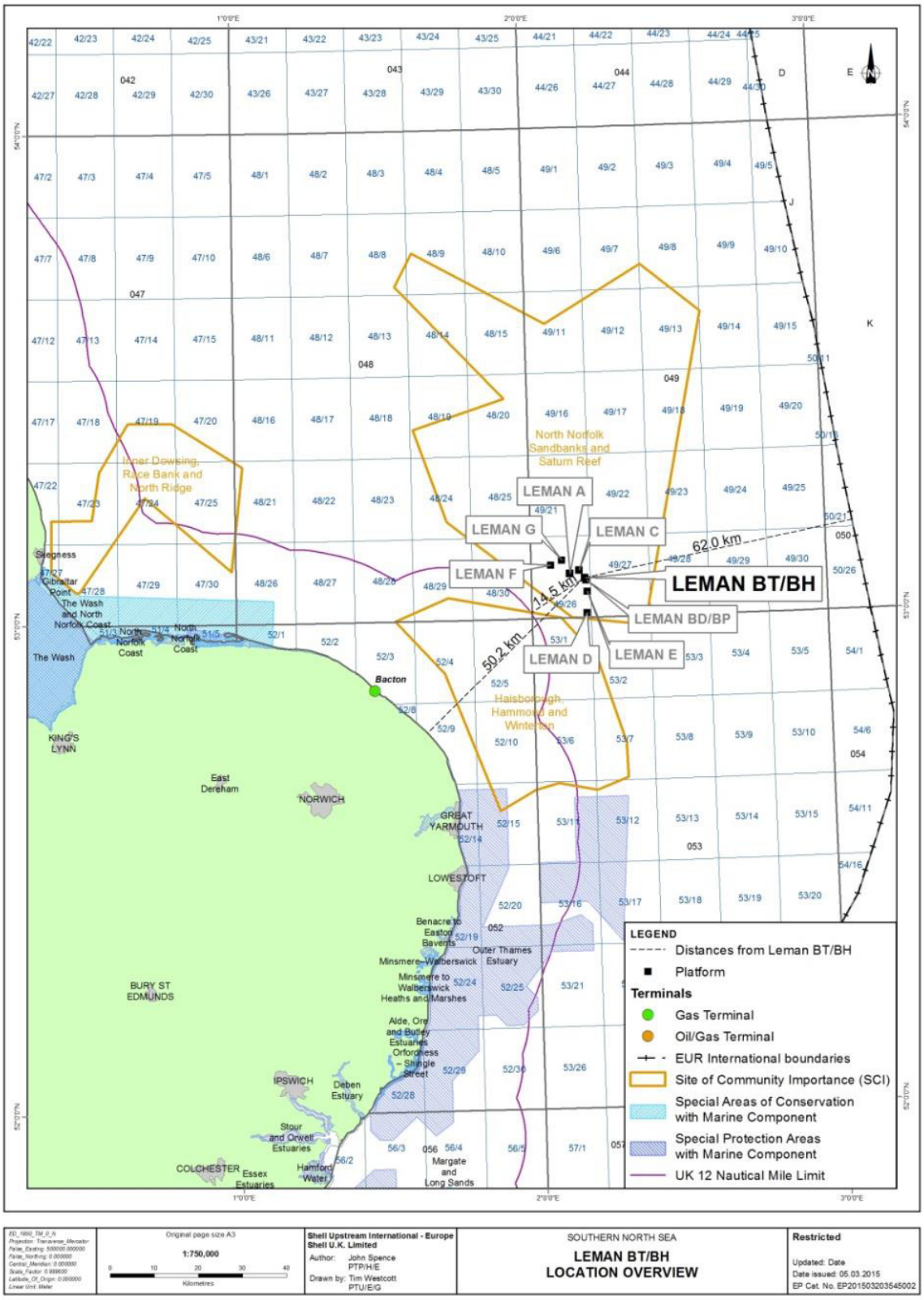
Shell has assessed that the cost of maintaining the structural integrity of the Leman BH platform would be disproportionately high, given its limited functions. Therefore, a decision has been taken to transfer all of the support functions provided by Leman BH over to Leman BT as part of an upgrade to facilities on the BT platform and undertake the early decommissioning of the BH platform.

## 1.2 SCOPE OF THE EIA

This EIA document has been produced to support the Leman BH Decommissioning Programme. It presents the results of an environmental impact assessment (EIA) of the proposed Leman BH platform decommissioning work with emphasis on the potential impact on the conservation features and objectives of the North Norfolk Sandbanks and Saturn Reef Site of Community Interest (SCI). The environmental impact assessment has assessed the potential impacts on the existing environment for the following phases of the decommissioning project:

- Removal and transportation of Leman BH topsides and jacket.
- Onshore decommissioning/waste management

Figure 1-1: Location of Leman BT/BH platforms



## 1.3 LEGISLATIVE FRAMEWORK

The project is subject to the requirements of UK and EU legislation in addition to other international treaties and agreements, such as Oslo-Paris Convention (OSPAR). The relevant legislation pertinent to this project has been reviewed with regard to the environmental obligations. The key regulations are listed in Table 1-1.

Shell will ensure compliance with all relevant legislation and that the proposed operations are in line with the Shell Health, Safety, Security, Environmental and Social Performance (HSSE&SP) Control Framework. Shell will also ensure that all of the required permits and consents are obtained for the Leman BH Decommissioning project or where appropriate, that existing permits are amended or surrendered.

Table 1-1: Key regulations pertinent to the project

| |
|---|
| UK |
| The Petroleum Act, 1998 |
| The Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 (as amended 2007) |
| The Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007 as amended |
| Marine and Coastal Access Act 2009 |
| The Merchant Shipping (Oil Pollution Preparedness, response and Co-operation Convention) Regulations 1998 |
| International |
| OSPAR Decision 98/3 on the Disposal of Disused Offshore Installations |

### The Petroleum Act 1998

The approval of a Decommissioning Programme is required under the Petroleum Act 1998. There is presently no statutory requirement to submit an Environmental Statement (ES) for decommissioning projects. However, under the Petroleum Act 1998, the Decommissioning Programme must accompanied by an EIA for it to be considered for approval by the Secretary of State.

### The Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 (as amended 2007) / The Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007 (as amended)

The Leman BH platform is situated within an offshore Conservation area. Therefore, under these regulations, DECC, in consultation with the Joint Nature Conservation Committee (JNCC) may undertake an 'Appropriate Assessment' of the environmental implications the proposed decommissioning project may have on the conservation objectives of the site.

### Marine and Coastal Access Act 2009

Under these regulations, there will be a requirement to apply for a Marine License for the removal of the platform from the seabed. This application will be made closer to the time of the lifting operations in 2016 and will be supported by this EIA or amendment as required.

### The Merchant Shipping (Oil Pollution Preparedness, Response and Co-operation Convention) Regulations 1998

Under these regulations the operator is responsible for preparing and submitting an Oil Pollution Emergency Plan (OPEP) to DECC. It is the intention that the Leman Field OPEP will cover all decommissioning activities where there is a risk of a hydrocarbon spill. This may be achieved by the incorporation of decommissioning activities into the existing Leman field OPEP, either as an update or an addendum. In July 2015, some changes to the OPEP requirements will come into force, which are relevant to the project. These changes reflect amendments to the OPRC regulations and addition of Offshore Safety Directive (OSD) Requirements. The Offshore Safety Directive Regulator (OSDR) will then become the Competent Authority (CA) for matters concerning OPEPs. The OSDR is a partnership between DECC's Environmental and Decommissioning teams

and the HSE energy division. Under the new requirements, the OPEP covering the proposed decommissioning activities will have to meet the Internal Emergency Response Plan (IERP).

### OSPAR Decision 98/3

The plan to completely remove the Leman BH platform is in accordance with OSPAR decision 98/3, which states that all installations with a jacket weight of less than 10,000 tonnes must be completely removed for re-use, recycling or final disposal on land. As the combined Leman BH jacket and topsides weigh approximately 1,605 tonnes, the complete removal of the Leman BH platform is a statutory requirement.

## 1.4 SHELL GROUP STANDARDS

The Shell Group operates a single global control framework, the Shell Control Framework, which describes how the Group is organized and managed. This includes mandatory standards for Health, Safety, Security, Environment and Social Performance (HSSE-SP).

The requirement for carrying out impact assessment (i.e. integrated environmental, social performance and health) is mandated through the HSSE-SP Control Framework: Impact Assessment Manual. This includes projects such as the proposed Leman BH Decommissioning. The HSSE-SP Control Framework also initiates other requirements. This includes a requirement to meet, as a minimum, environmental performance criteria as set out in Shell's Environment Manual so as to manage potential or actual impacts to biodiversity, greenhouse gas and energy efficiency, waste and water into the environment.

## 1.5 STAKEHOLDER ENGAGEMENT

Engagement with stakeholders will be ongoing throughout the project life. The guidelines produced by Oil and Gas UK (OGUK) titled "Stakeholder Engagement during Decommissioning Activities" have been used to develop the engagement strategy for this project. The guidance explains that the scale, depth and complexity of the engagement should be proportionate to that of the project. As the Leman BH is considered a relatively small scale project, the engagements have been scaled accordingly, with consultations carried out with the DECC, JNCC, and the National Federation of Fishermen's Organisations (NFFO) as well as other stakeholders and statutory consultees as part of the consultation period following the submission of the draft Decommissioning Programme.

All feedback has been recorded, addressed and communicated within this EIA. Table A1 in Appendix A summarises the main issues raised by stakeholders during the early consultation process and provides details on how these were or will be addressed. Formal external consultations will be carried out as required under section 29(3) of the Petroleum Act 1998.

## 1.6 STRUCTURE OF REPORT

This report is presented in the sections outlined in Table 1-2.

Table 1-2: Structure of report

| Section | Title | Description |
|---|---|---|
| 1 | Introduction | Provides a brief overview of the project, in context with Shell's other operations in the Leman Field and gives an overview of the pertinent legislation and approach to stakeholder engagement |
| 2 | Project Description | Describes the planned decommissioning operations and the alternative options considered. |
| 3 | Environment and Social Baseline | Describes the background environmental characteristics and socio-economic activities in the project location. |
| 4 | EIA Methodology | Describes the methods used to assess the significance of the potential impacts and the outlines the definitions adopted for categorising the impacts. |
| 5 | Assessment of Environmental and Social Impacts | Assesses the potential impacts arising from the proposed development including the cumulative and transboundary impacts and details the control measures to be implemented to limit or prevent the potential impacts. |

| Section | Title | Description |
|---|---|---|
| 6 | Environmental Management System (EMS) | Describes environmental management controls in place to ensure implementation of commitments made in the EIA and provides an outline of how Shell will manage the project to ensure protection of the environment during the planned operations. |
| 7 | Conclusions | Summarises the results of the EIA |
| 8 | References | |
| 9 | Abbreviations | |
| Appendix A | Stakeholder Engagement Comments | Summary of the comments received from the Stakeholder Engagements undertaken as part of the EIA. |
| Appendix B | Sabellaria assessments at delineated patches and ROV transects | Detailed figures representing images and assessments of "reefiness" assessment of key *Sabellaria* areas |

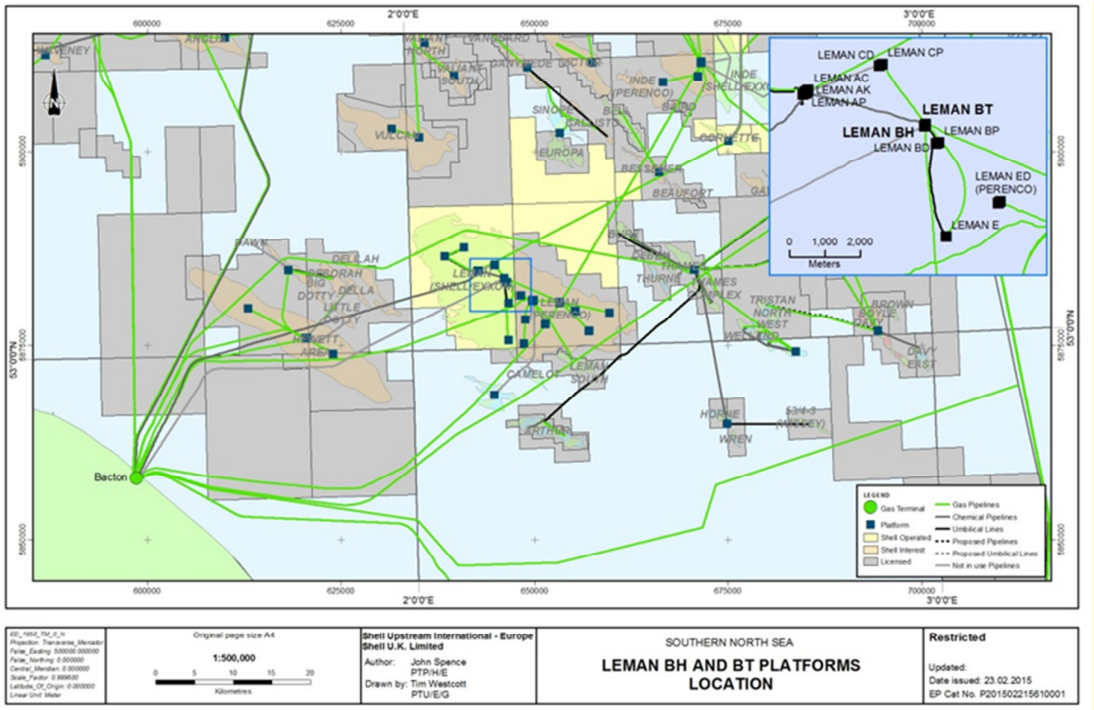
# 2 PROJECT DESCRIPTION

## 2.1 INTRODUCTION

The bridge-linked Leman BT/BH is a Normally Unattended Installation (NUI) with Leman Alpha as the Nodal Installation (Figure 2-1). BT and BH are controlled from the Installation Control Centre (ICC) at Bacton Gas Terminal.

The Leman BT provides control of the gas export pipelines running from the Shell operated Leman B, C, D and E platforms as well as the Perenco-operated Leman B Platforms to the Bacton Gas Terminal via the Leman A complex (Figure 2-1). The Leman BH platform provides helicopter access, power supply and shelter for personnel visiting Leman BH and BT.

Figure 2-1: Location of Leman BH/BT platforms




The BH platform is situated in a water depth of approximately 35 m and comprises topsides (990 tonnes), bridge (49 tonnes) and a 4 leg steel jacket (566 tonnes). The Leman BT/BH installation is shown in Figure 2-2.

The main accommodation facilities on the BH platform are now redundant. The power on the BT/BH complex is provided by a 1" subsea electricity cable which runs from Leman BD to BH (approximately 600m). The BH topsides are made up of five levels of which the first and second are connected to BT by the bridge (Table 2-1).

As discussed in Section 1, the functions of the BH platform are planned to be incorporated into the BT platform as part of a BT refurbishment campaign effectively leaving the BH platform redundant.

Figure 2-2: Leman BH platform (Left) and BT platform (right)

Table 2-1: Deck levels of the Leman BH platform

| Platform Level | Detail |
|---|---|
| Level 4 (BH Helideck) | The helideck is placed above the Living Quarter module and is suited to the helicopters operating in the southern North Sea (SNS). There are no refuelling and starting facilities available and no hose reels or fixed firefighting equipment. |
| Level 3 | Level 3 houses redundant living quarters and supports the helideck. |
| Level 2 | Level 2 houses redundant living quarters and the service water tank. It is connected to BT via the two-tier bridge. |
| Level 1 | Level 1 is connected to BT via the two-tier bridge and houses a submersible service water pump and winch; the Unplanned Overnight Shelter (UOS) with 12 beds, the equipment room, muster point and a life raft are on the south side. |
| Level 0 | Cellar deck |

## 2.2 DECOMMISSIONING OPTIONS CONSIDERED

### 2.2.1 Introduction

The consideration of the alternative options leading to the selection of the preferred decommissioning concept is a key element of the environmental assessment process. A clear picture of how the options were selected provides assurance that the decision-making process was comprehensive, balanced and inclusive. This section provides an overview of alternative options considered for the Leman BH decommissioning.

### 2.2.2 Timing of the Leman BH decommissioning

The Leman BH/BT complex was originally planned to be decommissioned at the end of field life in 2031. An intermediate plan was to refurbish (fabric maintenance and painting) the BH/BT complex. However, Shell has taken the decision to streamline the operations for the BH/BT complex by refurbishing only the Leman BT platform. This will involve, amongst other things, transferring all of the functions of the BH platform across to BT, effectively leaving the Leman BH platform redundant. With the BT refurbishment project planned for

2015, an opportunity was identified to remove the redundant Leman BH platform in 2016. This opportunity presents a considerable saving when compared to refurbishing the Leman BH platform and further long-term benefits, most notably, a reduction in the amount of offshore maintenance required.

### 2.2.3 Potential for re-use

The Leman BH topsides were considered for re-use at the Clipper complex as an accommodation module. However, due to the age of the BH platform and its poor condition, the re-conditioning and re-use of the platform for this purpose was not deemed to be feasible. As such, the decision has been taken to dismantle the Leman BH platform onshore for further processing and recycling as discussed in Section 2.3.4.

### 2.2.4 Removal methods

There are two fundamentally different options for removing the Leman BH platform; a piece by piece removal using a combination of a jack up rig and transport barge or a reverse installation method involving two major lifts (platform and jacket) with a Heavy Lift Vessel (HLV).

1. Piece by piece removal

This option was considered and was assessed to present considerably greater technical challenges, increased safety risk, involve more time offshore and have higher associated costs than the alternative as well as an increase in associated atmospheric emissions and collision risk. Therefore this option was discarded.

2. Reverse Installation method

Removal of the platform in two heavy lifts (topsides then jacket) using an HLV was assessed to be a technically proven, cost-effective and safe lifting method for the Leman BH facility. As such, this method has been chosen to undertake the proposed works. At the time of writing, the contract for undertaking the lifting operations has not yet been awarded.

#### HLV options

There are three different types of HLV which could potentially undertake the proposed lifting operations and these are summarised in Table 2-2.

The selection of the HLV to be used for the lifting operations is undergoing a competitive tendering process at the time of writing. At the start of the tendering process, Shell did not have a preferred option. However, having reviewed the received proposals, the Sheerleg HLV is considered the most probable option for undertaking the lifting operations given the reduced physical impact to the seabed and the lower cost. Therefore, the use of a Sheerleg HLV is considered as the base case for this project. However, the use of a conventional HLV has not completely been ruled out and, as such this EIA considers the associated impacts of both options. Due to the associated high costs and possible additional technical restrictions, the use of a DyP HLV is the least preferred option for undertaking the operations. Therefore, the use of a DyP HLV is not considered further in this EIA.

Table 2-2: Types of HLV considered for lifting the Leman BH platform

| HLV Type | Description | Pros | Cons |
|---|---|---|---|
| Moored Sheerleg (Small HLV) | A Sheerleg vessel is effectively a small HLV without a rotating crane. The Sheerleg is technically suited to the relatively small lifts required for BH (heaviest single lift will be ~1000 tonnes). Lifting would be undertaken using Sheerleg crane/winch system. The topsides would likely be transported on a barge and the jacket transported on the crane hook of the vessel This is considered to be a technically sound, safe method given the relatively light weight of the jacket (556 tonnes). | Reduced vessel traffic (no barge/tugs required for transport of jacket)<br>Shorter and fewer anchors than conventional HLV.<br>Lower fuel consumption than conventional or DyP. HLV.<br>Most cost effective option | Anchors will need to be deployed twice.<br>Greater Impact to seabed than Dynamically positioned HLV. |
| Conventional moored HLV | Similar lifting strategy to Moored Sheerleg. Lifting with conventional HLV is undertaken using rotating crane and transportation to shore on barge. Anchor deployment will impact seabed. | Technically proven for this type of lift.<br>More cost-effective than dynamically positioned (DyP) vessel.<br>Anchors are likely to be deployed on one occasion only. | Seabed footprint would be greater than that of Sheerleg HLV.<br>More expensive than Sheerleg HLV. |
| HLV with dynamic positioning | DyP vessels have been previously used in similar areas of the southern North Sea. Lifting and transport would be undertaken in the same way as the moored HLV. | Reduced impact to seabed compared with other options. | Would incur considerably higher costs than other options<br>Added technical challenges due to the shallow water depth and strong currents.<br>Increased fuel consumption and greater associated emissions. |

### 2.2.5 Onshore dismantling yard

The onshore dismantling site/yard has yet to be selected although the following areas have been considered:

- UK
  - Newcastle (Former Swan Hunter Ship Yard)
  - Hartlepool (Seaton Port, Teesside)
  - Great Yarmouth (unconfirmed)
- Netherlands (unconfirmed)

As with the selection of the HLV, the selection of the onshore decommissioning contractor/yard will be subject to a competitive tendering process. The selection process will involve the following:

- The availability of the yard at the time of planned decommissioning
- Capability of the yard
- Appropriate licenses and consents are in place
- Distance from the Leman BH location (a site closer to the platform location would be preferred in order to reduce transit times).
- A UK site is preferable due to the proximity to shore.

The preferred option for the onshore site would be Great Yarmouth as this is the closest potential onshore decommissioning site to the Leman BH, and would require the least transportation time (approximately 6 hours). Although there is currently no established decommissioning yard at Great Yarmouth at the time of writing, it remains a possible option. Potential alternative sites on the UK east coast include established decommissioning yards at Newcastle (former Swan Hunter yard) and at Able Seaton Port (ASP), on Teesside. Shell already has in place a contract with the ASP facility for the dismantling of topsides from Brent Alpha, Bravo and Delta.

A UK location will be preferable, although there is a possibility that a site in the Netherlands may be chosen. If a site in the Netherlands is chosen then there will be associated implications such as the transboundary movement of waste, for which the appropriate permit and consents will be required.

## 2.3 DECOMMISSIONING STRATEGY

### 2.3.1 Schedule of operations

The decommissioning strategy comprises the three key stages, as follows:

- Offshore pre-lifting campaign (coinciding with the Leman BT refurbishment campaign) (Q3 2015);
- Offshore lifting campaign (Q3 2016).
- Onshore dismantling and disposal (Q3 2016 - Q1 2017).

An indicative timeline for the key operations is provided in Table 2 3 below.

Table 2-3: Indicative schedule of operations

| | 2015 | | | | 2016 | | | | 2017 | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Operation/milestone** | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 |
| Submit draft DP/EIA | | | | | | | | | | |
| BT Refurbishment (180 days) (section 3.3.2) | | | | | | | | | | |
| BH Pre-lifting activities combined with BT (120 days) (section 3.3.3) | | | | | | | | | | |
| Platform removal and transport to shore (section 2.3.4) | | | | | | | | | | |
| Onshore dismantling and disposal (Section 2.3.5) | | | | | | | | | | |
| Project Close Out | | | | | | | | | | |

### 2.3.2 Leman BT Refurbishment

The pre-lifting operations at Leman BH will coincide with the BT refurbishment project. During this period, an accommodation rig will be moored on site next to the BT platform within the 500 m safety zone. The BT refurbishment operations are regarded as maintenance activities and are considered to be out-with the scope of this project although the cumulative impacts of these operations have been considered as part of the EIA where appropriate.

The tasks involved in the BT refurbishment are as follows:

- Removal of all redundant equipment and piping from BT
- Removal of upper deck from BT.

- Installation of solar panels at Leman BT to power the remaining equipment (navigation lights, fog horn and leak detection for environmental purposes).
- Installation of a heli-winching platform.
- Installation of a temporary refuge.

### 2.3.3 Leman BH Pre-Lift operations

The pre-lifting campaign at BH will involve the following operations:

- An assessment will be undertaken to ensure that the platform is safe to lift by undertaking a platform survey and inspection and analysing the platforms structural integrity.
- Any loose equipment or materials on the topsides will be either secured in position or removed.
- All hazardous materials such as batteries, residual oil or any residual hydrocarbons (from the redundant diesel tank and generator) will be removed, where possible, and managed as part of the Leman BT refurbishment project.
- The power cable running from the Leman BP/BD platform to the Leman BH will be cut approximately 1m above the seabed under the bottom clamp on the jacket leg. The section of this cable running along the jacket leg through the Leman BH topsides and over the bridge to Leman BT will be removed.
- The power cable will be left *in situ* and remain buried along its length, approximately 600 m to the Leman BP/BD platform. A 1m section of the cable will remain exposed above the seabed within the exiting Leman BT 500m safety zone.
- The interconnecting bridge between the Leman BH/BT will be removed as part of the preparation phase by the crane of the work/accommodation jack-up vessel (without the need of a HLV).
- The pre-lift campaign will involve the installation of pad-eyes on the bridge and topsides for lifting operations.
- Non-destructive testing (NDT) will be undertaken to check the structural integrity of the topsides and jacket. Any observed defects will be remediated by repairs.

The main impact associated with the pre-lift operations is the deployment of the accommodation rig. The assessment of the potential impacts of the deployment of the accommodation rig will be covered under the supporting application for undertaking the BT refurbishment operations. The waste generated during the pre-lifting campaign will also be handled as part of the BT refurbishment project. All of the material which will be removed during the pre-lifting operations will be handled by the environmental waste material yard approved by Shell for its operation in the southern North Sea.

### 2.3.4 Lifting Campaign

A HLV will lift the various platform components in a reversal of the original installation. The Leman BH scope is to remove the Leman BH platform in the following sequence:

1. BH Platform Topsides and Transition Pieces (legs between topsides and jacket).
2. Steel Jacket including 3 m long Pile Sections which are fixed to the jacket legs (will be cut at least 3 m below the mudline and removed in a single lift using HLV).

As discussed in Section 2.4.4, the contract for undertaking the lifting operations is currently subject to competitive tender and has not yet been awarded. Therefore, the vessel size, exact lifting position, number and length of anchors and the mooring alignment has not been confirmed. Furthermore, the exact procedure for undertaking the lift and transportation is also dependant on the type of vessel selected. The base case is that the lifting operations will be undertaken using a small HLV (Sheerleg) which will be moored in position using 4 anchors with anchor lines (steel cables) up to 0.8 km long. However, given that the HLV will not be confirmed until after the EIA has been submitted, the impact assessment will take into account the largest potential HLV which may be considered for undertaking the lifting operations. Therefore, a mooring system consisting of 12 anchors, each 1.6 km long was considered to represent the maximum possible (worst case) footprint to be assessed in the EIA. The estimated time for undertaking the lifting operations is approximately 24 days, of which 11 would be on location at Leman BH.

As discussed in Section 2.4.4, the following two vessel types may be chosen to undertake the proposed lifting operations:

- Large HLV with a 12 point anchor mooring system.
- Small HLV (Sheerleg) with a 4 point anchor mooring system.

#### TOPSIDES REMOVAL AND TRANSPORTATION

The Leman BH topside removal will be achieved by cutting the topsides free of the jacket using flame cutting, to allow the HLV to lift and place the topsides onto a transport barge. The procedure involved may vary according to the type of vessel used and the weather conditions at the time.

Lifting the platform using the small Sheerleg HLV is likely to require the vessel to move off location to load the topsides onto the barge in a sheltered area (such as the outer Harbour of Great Yarmouth). This would require the vessel to drop anchors on two separate occasions. The exact procedure of how the platform topsides would be transferred onto the barge from the Sheerleg has not been determined, but it is likely to be undertaken close to the Quayside and outer decommissioning yard. As this will be within the outer harbour area, it is very unlikely that this operation will involve any further deployment of the HLV anchors due to the potential obstruction it would cause.

If the large HLV is used, the plan would be to deploy the anchors once. There may be safety reasons (e.g. due to bad weather) to move the vessel into a sheltered area to complete the lift onto the barge. Under these circumstances, there may be two anchor deployments undertaken during the lifting operations. One for the lift of the topsides, and a second time for the jacket with anchors dropped in the same anchor locations each time.

#### REMOVAL OF SEDIMENT FROM JACKET LEGS

The platform legs are anticipated to contain uncontaminated natural seabed sediments. Following the removal of the topsides the legs of the jacket will be emptied of sediment to allow access for the internal cutting tool (3 m below the seabed). It is expected that there will be approximately 2.5 $m^3$ of sediment in each of the four legs, totalling 10 $m^3$. This sediment will be fluidised and lifted to the surface using an airlift suction dredge and then re-deposited at the sea surface. As explained above, the deposited sediment will have the same characteristics of the seabed sediments surrounding the platform and will not contain any contaminants.

#### REMOVAL OF JACKET AND TRANSPORTATION

An abrasive cutting tool will then be lowered inside each of the four steel jacket legs (which are open at the top) to cut the piles at a minimum of 3 m below the seabed. The piles will remain inside the jacket structure when removed as they are welded to the inside of the legs. As described in Section 2.3.3, thorough checks will be undertaken during pre-lift operations to ensure the integrity of all of the structures and fastenings. In the case of the sheerleg HLV, it is likely that the jacket and piles will be transported to the onshore dismantling yard on the crane hook of the vessel.

If a large HLV is used, the jacket and piles will likely be placed onto a transport barge for transport to the onshore dismantling yard.

### 2.3.5 Onshore dismantling

The total mass of material to be transported to shore is 1605 tonnes, including 70 tonnes of marine growth. The receiving yard will strip the installation into their components before undergoing further processing as is appropriate for the type of waste material. These materials will then be transported to the appropriate recycling/waste treatment facility.

At the time of writing the locations of the onshore facilities had not been determined but it is likely that these will be based in the UK and will therefore not involve any trans-boundary movement of waste material. However, there remains a possibility that a site in the Netherlands could still be selected. The options considered for the onshore site are discussed in Section 2.2.4.

An indicative inventory of the contaminated/hazardous materials present on the platform is provided in Table 2-4. Where possible, some of these will have been removed during the pre-lifting campaign as described in Section 2.3.3.

Table 2-4: Summary of hazardous waste materials likely to be present on the BH platform

| Material Type | Detail | Preparatory Activity |
|---|---|---|
| On-board hydrocarbon | Fuels and lubricants. It should be noted that the Leman BH platform does not have a hydrocarbon inventory and therefore any oil will only be present in small quantities. Sources of residual hydrocarbons include:<br>Disused power generator<br>Diesel storage tank | Preparation will ensure that any residual oils or lubricants have been removed and that any gases have been vented (none are expected). Any residual fluids will be transported ashore for re use/recycling where possible. These will be stored and transported in appropriately labelled containers. |
| Other hazardous materials | Batteries; Fluorescent tubes containing mercury; Instruments containing radioactive material. | Transported ashore for appropriate treatment and disposal. |
| Original paint coating | These may include Lead-based paints and will be handled during the decommissioning of the platform onshore. | Appropriate safety measures will be taken. |
| Asbestos and ceramic fibre | This will be handled during the decommissioning of the platform onshore. | Appropriate control and management will be enforced. |

The estimated inventory of materials to be removed and their fate is summarised in Table 2-5. In total, approximately 97.5% (totalling 1564.9 tonnes) of the waste material will be recycled or reused were possible. Around 2.2% (35 tonnes) of non-hazardous waste will be disposed of in landfill. In addition, approximately 0.1% (1.5 tonnes) of hazardous material will be recycled. Any hazardous material which cannot be recycled, which is expected to account for 0.3% (around 4.8 tonnes) will either be sent to landfill (asbestos) or incinerated (oil contaminated sand/tank bottom sludge).

Table 2-5: Overview of the waste materials expected at the Leman BH platform

| Inventory | Disposal/fate | Weight (tonnes) | % of total |
|---|---|---|---|
| Steel | Recycled or re-used | 1450.9 | 90.4 |
| Other Non-hazardous | Recycled | 112.4 | 7.0 |
| Other Non-hazardous | Landfill | 35.3 | 2.2 |
| Hazardous | Recycled | 1.6 | 0.1 |
| Hazardous | Landfill/Incineration | 4.8 | 0.3 |

### 2.3.6 Post Decommissioning

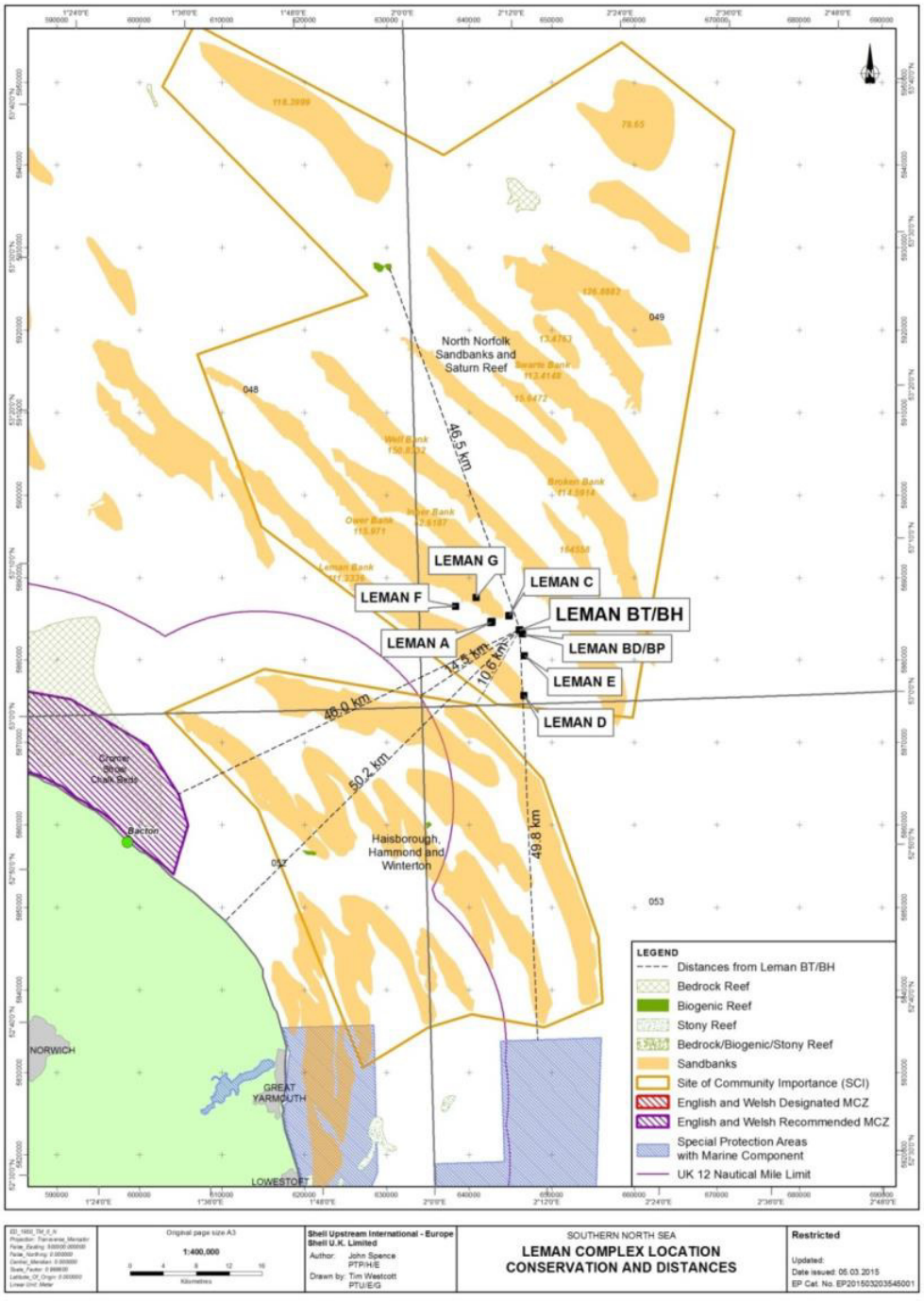
Shell acknowledge that debris removal around the platform location (500m) and pipeline routes (200 m corridor) is a requirement under the DECC decommissioning guidance notes. As the area around the Leman BH platform will remain well within the existing Leman BT 500m safety zone, Shell does not plan to undertake site debris clearance as part of these decommissioning operations. This will be undertaken during the decommissioning of the Leman BT platform. Similarly, the removal of the power cable running from Leman BD to BH will be included in the Decommissioning Programme and EIA for the Leman Field at a later date.

# 3 ENVIRONMENTAL DESCRIPTION

## 3.1 INTRODUCTION

The Leman BH/BT complex is located in Block 49/26 in the southern North Sea, approximately 50 km northeast of the Norfolk coast and approximately 62 km west of the UK/Netherlands boundary line. The Leman BH platform is located within the North Norfolk Sandbanks Site of Community Importance (SCI) (Figure 3-1).

Figure 3-1: Leman BH Location



Where pertinent, this section describes the local environmental and social sensitivities of the southern North Sea with particular focus on the area surrounding the Leman BH/BT platform. The environmental sensitivities have been described over the whole year. This baseline description is based on data acquired from site specific surveys in the area and various other data sources such as studies relating to the wider North Sea.

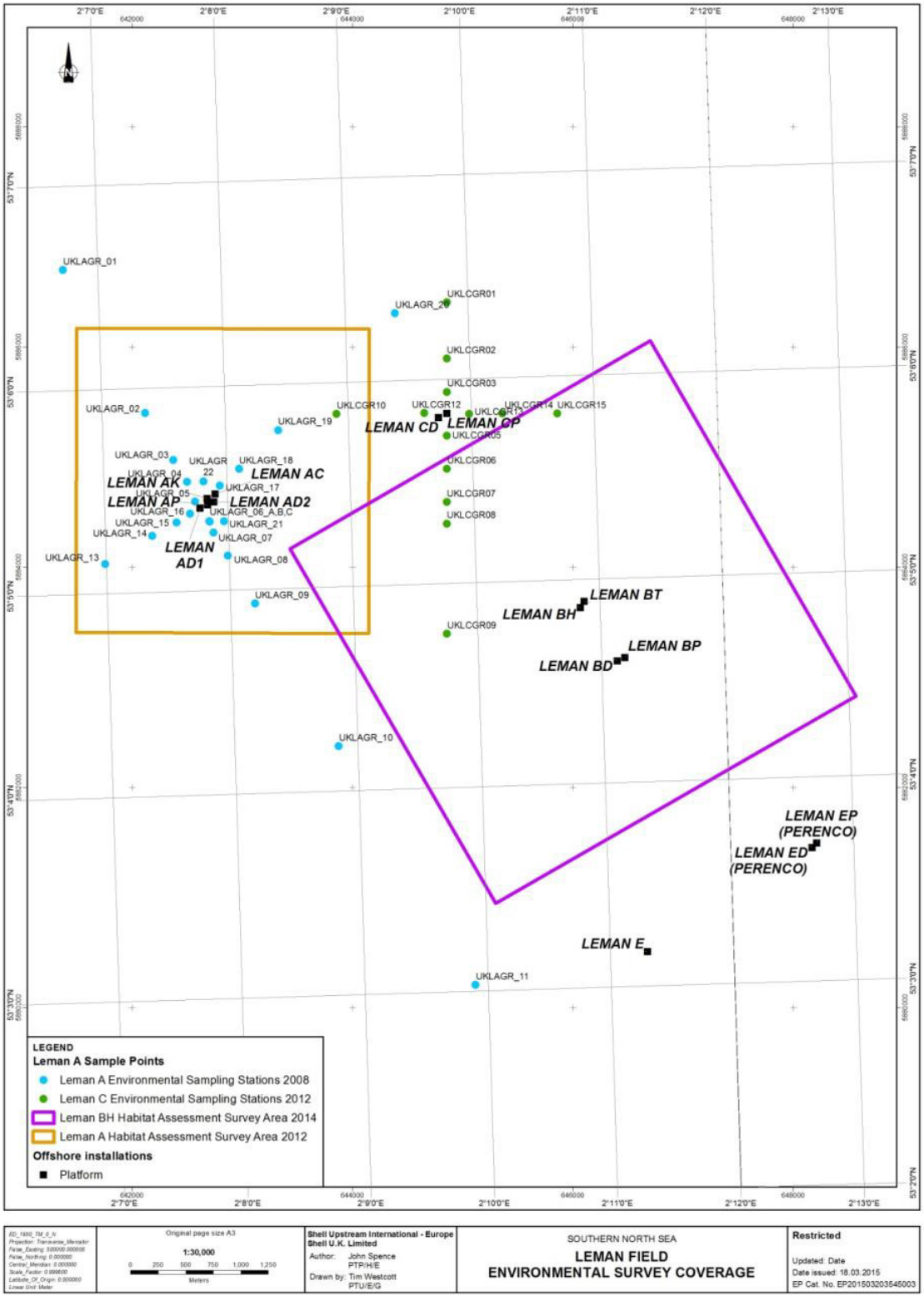
## 3.2 SURVEYS IN THE AREA

Environmental surveys completed specifically for Leman BH/BT as well as existing baseline information available have contributed to the current understanding of the project's environmental baseline. The site-specific environmental data and comparison data from nearby areas have been drawn from the surveys outlined in Table 3-1. An overview of the environmental survey coverage for the Leman field area is provided in Figure 3-2.

**Table 3-1: Relevant Surveys undertaken in the Leman BH/BT area**

| Year | Title | Objectives / data use |
|---|---|---|
| 1. Leman BT/BH Surveys | | |
| 2014 | Leman BH Habitat Assessment (Fugro EMU, 2015) | Habitat assessment was undertaken to ground-truth the data acquired during the 2014 Anchor conditions survey (described below). Environmental camera transects were undertaken in order to characterize the Leman BH survey area which covered the indicative maximum anchor spread of the conventional HLV. In particular the aim was to ground-truth previously delineated areas thought to be potential biogenic reef, and investigate features of interest and areas characteristic of the general background conditions of the site. Potential locations for HLV anchors were also taken into account when prioritizing transect locations. The survey included an assessment of the *Sabellaria* aggregations. Four additional ROV transects, acquired by Subsea 7 in 2012/2013 (see below) were reviewed afterwards to ground-truth areas of high reflectivity close to the BH/BT platform. |
| 2014 | Anchoring conditions survey UKCS BLOCKs 49/26 & 27 (Fugro 2014) | Geophysical data (SSS) was acquired across a 3.6km$^2$ area to characterize bathymetry, seabed features and sediment conditions in order to inform the anchor lay of HLV. The acoustic data was analysed and delineated for potential biogenic reef. |
| 2014 | Leman BH/BT Geophysical survey (Osiris, 2014) | Geophysical survey to assess pipeline condition and debris in immediate vicinity of all pipelines running into the Leman BT/BH facility. High resolution Bathymetry data was used to help delineate areas of high reflectivity identified from the 2014 Habitat assessment. |
| 2012/13 | Pipeline inspection ROV survey campaign (Subsea 7, 2012/2013) | ROV camera footage obtained along four specific pipelines in vicinity of Leman BH/BT to assess the pipeline condition and burial status. The camera footage was used to delineate areas of high reflectivity close to the platform and help ground-truth 2014 geophysical seabed data within 500m of the Leman BH/BT platform. |
| 2. Relevant surveys from nearby areas | | |
| 2012/2013 | Leman Alpha Complex Habitat Assessment Survey (Fugro, 2013) | Ground-truthing survey of the Leman Alpha complex, verifying earlier interpretation of wide-scale acoustic data. The acquired data was combined with previously obtained Acoustic data in 2010 and 2012 respectively. |
| 2012 | Environmental Monitoring Survey Leman C (Fugro EMU, 2013) | The survey was carried out under Shell UK ongoing environmental monitoring program, included sediment contaminant and benthic fauna sampling around Leman C (cruciform 2kmx2km). |
| 2008 | Environmental monitoring Survey, Leman A (Gardline, 2010) | The survey was carried out under Shell UK ongoing environmental monitoring program, included sediment contaminant and benthic fauna sampling around Leman A (cruciform 2.5kmx2.5km). |

Figure 3-2: Survey coverage in the Leman BH Location




Original page size A3
1:30,000
0 250 500 750 1,000 1,250
Meters

Shell Upstream International - Europe
Shell U.K. Limited
Author: John Spence PTP/H/E
Drawn by: Tim Westcott PTU/E/G

SOUTHERN NORTH SEA
**LEMAN FIELD**
**ENVIRONMENTAL SURVEY COVERAGE**

**Restricted**
Updated: Date
Date issued: 18.03.2015
EP Cat. No. EP201503203545003

## 3.3 OFFSHORE PHYSICAL AND CHEMICAL ENVIRONMENT

### 3.3.1 Meteorology and Hydrography

The wind regime in the Leman BH area is dominated by westerly and south-westerly winds for most of the year. Wind speeds typically range from 2 to 8 m/s during the summer months, when the proposed lifting operations are planned to be undertaken. A greater proportion of stronger winds occur during the winter months, averaging between 6 to 14 m/s (Shell, 2007).

The residual surface current at Leman BH generally travels in a north-west to south-east direction at an average speed of approximately 1.5 m/s (Shell, 2015). The shallow waters of the southern North Sea remain well mixed throughout the year due to these tidal currents (OSPAR, 2000). The tidal currents and wave action agitate the water column and prevent the development of a thermocline. This results in a dynamic marine environment, allowing particles within the water column to be readily re-suspended and dispersed (Lee and Ramster, 1981).

Sandbanks and other seabed features can have significant local impacts on currents. Residual currents at the seabed have been observed to move faster over obstacles such as sandbanks, with a reversed current flow around the edges of the obstruction. Studies have also shown that some sandbanks experience a circular residual current regime, with active sandwaves on the flanks of the sandbanks illustrating the prevailing residual current direction (DTI, 2001). This circular current activity is thought to be important in the formation and maintenance of linear sandbank structures.

### 3.3.2 Seabed sediments

The seabed sediments of this area of the southern North Sea can be generally described as comprising sand and gravelly sand (Cameron *et al*, 1992). This description concurs with the general seabed observations made during various surveys in the area which found the seabed to be predominantly comprised megarippled sand with areas of gravelly sand/scour surrounding the Leman BH platform (Fugro EMU, 2014; Osiris 2014).

Although sediment samfples have not been acquired at the Leman BH location, particle size analysis (PSA) from sample stations centred on the Leman C platform, approximately 2 km northeast of Leman BH, showed that the sediment composition was predominantly fine to medium sand, with a greater component of coarse material to the south at Stations 08 and 09 (Figure 3-2) (Fugro EMU, 2013). A more heterogeneous distribution of sediment types was observed to the south of the Leman BH platform including areas of clay outcropping and varying degrees of coarse material. It was also towards the south and west of Leman BH that there appeared to be greater potential for biogenic reef (Fugro EMU, 2014).

The sediment chemistry of samples taken from the Leman C monitoring survey showed that contaminant concentrations for hydrocarbons and metals were generally below background concentrations (or slightly above in the case of some metals) for the southern North Sea as determined by UKOOA (2001) (Fugro EMU, 2013). Leman C 2012 Total Hydrocarbon Concentration (THC) values ranged from 0.5 µg/g to 4.1 µg/g. Leman A 2008 THC values were in the similar range of 1.0-4.3 µg/g, with an exception of a single station located 100 m from Leman A with THC of 7 µg/g (Gardline, 2010).

The BH platform is situated approximately 600 meters to the north of the Leman BD/BP facility where 19 wells were drilled between 1969 and 1971. Any historic contaminated cuttings from these wells would have long since dispersed due to the high energy environment present in this part of the North Sea. This view is supported by environmental monitoring data from the Leman A and Leman C platforms, which showed that THC was consistently lower than the UKOOA mean background concentration for the southern North Sea of 4.3 µg/g (and therefore well below the OSPAR hydrocarbon persistence criteria of 50mg/kg) (Fugro, 2013). This is likely to be indicative of contamination levels across the Leman BH platform.

### 3.3.3 Bathymetry and seabed features

Water depths in the area range from a maximum of 44.2m to the south of the Leman BH/BT facility, to a minimum of 31.6m (Fugro EMU, 2015). The major seabed features in this area of the southern North Sea are the North Norfolk sandbanks, of which the Ower Bank, situated approximately 2.5 km to the northwest of Leman BH, is the closest. A summary of the seabed features including the potential *Sabellaria spinulosa (Sabellaria)* aggregations interpreted from the habitat assessment are shown in Figure 3-3.

Several sediment ridges were observed from survey data surrounding the Leman BH/BT and BD/BP platforms, orientated north-east to south-west and north-west to south-east. The largest observed ridge, situated immediately to the north of the Leman BT platform, had heights up to 3.7 m above the surrounding seabed and localised gradients up to 27° (Fugro EMU, 2015). However, this was not considered to form part of a larger sandbank feature and is distinct from the Ower Sandbank. In addition, megaripples (7 to 20 m) and sand waves (60 to 150 m) oriented north-east to southwest were a distinct seabed feature observed across the survey area. Towards the south a series of escarpments were observed which seemed to coincide with many of the delineated potential *Sabellaria* reef patches (Figure 3-1). Sandbank features and reef habitats are discussed further in Section 3.5.1. There were also 3 probable trawl scars identified to the extreme southeast of the survey area which crossed one of the preliminary delineated *Sabellaria* patches.

The area in the immediate vicinity of the Leman BH and BT platforms showed patches of high reflectivity. The pipeline inspection ROV footage (Subsea 7, 2012/2013) and additional higher resolution geophysical data (Osiris, 2014) showed that these areas of high reflectivity correlated with areas of debris, boulders, likely historic gravel dump and disturbed seabed (Fugro EMU, 2015).

## 3.4 OFFSHORE BIOLOGICAL ENVIRONMENT

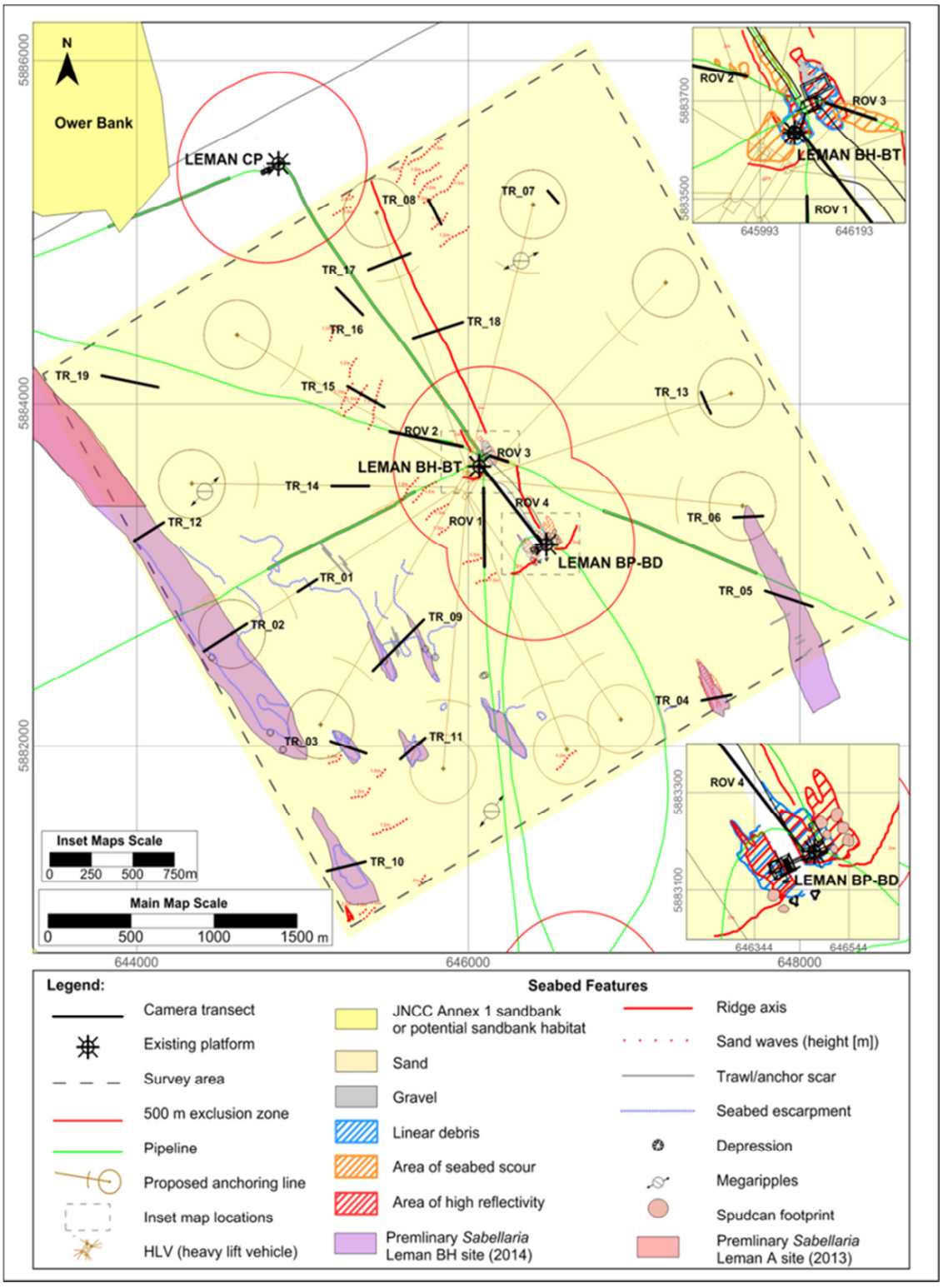
### 3.4.1 Benthos

Data from the nearby Leman C site, located approximately 2 km to the north of Leman BH has been used to indicate the representative infauna (animals living within the seabed) at Leman BH. The most abundant taxa included amphipods (*Bathyporeia elegans*, *Urothoe brevicornis* and *Bathyporeia guilliamsoniana*), and the polychaete *Nephtys cirrosa* which are all known to prefer clean, medium to fine sand with low fines content (Fugro 2013). This infaunal assemblage is consistent with the results of other benthic studies of the wider North Sea area such as those co-ordinated by the International Council for the Exploration of the Sea (ICES) (Kunitzer *et al* 1992; Rees, *et al* 2007). These studies have identified broad classifications of benthic communities in the North Sea. The Leman BH falls within the broad southern North Sea area where the representative infauna is that of mobile medium sands characterised by the polychaetes *Nephtys spp*. and the amphipods *Urothoe sp*. and *Bathyporeia* sp. (Künitzer *et al*., 1992; Rees, *et al* 2007).

Analysis of the camera transects at Leman BH/BT showed that the epifauna (animals living on the seabed) were generally sparse, with areas showing the greatest abundance associated with coarse material or *Sabellaria* aggregations. The most commonly encountered epifauna included seastars (*Asterias rubens*), hermit crabs (Paguroidea), urchins (Echinoidea), hydroids (Hydrozoa) and brittlestars (*Ophiura sp*.) (Fugro EMU, 2015). A similarly sparse epifaunal assemblage was observed at the survey centred on Leman C, which was dominated by motile taxa including brittlestars and sea stars (Echinodermata), flatfish (Pleuronectiformes), and whelks (Gastropoda) (Fugro, 2013).

The most notable constituent of the benthic community from a conservation perspective is the presence of the biogenic reef-forming polychaete *Sabellaria* which is discussed further in Sections 3.4.2 and 3.5.1. The presence of potential *Sabellaria* reef is ecologically significant as it creates a habitat for other benthic organisms and in turn provides food for demersal fish species (Pearce *et al*, 2011a).

Figure 3-3 Seabed features surrounding the Leman BH location




Source: Fugro EMU, 2015

### 3.4.2 EUNIS Biotopes

The habitats within the 3.6 $km^2$ Leman BH survey area were classified within three European University Information Systems (EUNIS) biotope complexes and one tentative EUNIS biotope complex (Table 3-2) (Fugro EMU, 2015). Areas of rippled sand were classified under the biotope 'Circalittoral fine sand' (A5.25). Areas that were observed to contain *Sabellaria* aggregations were classified under the biotope '*Sabellaria spinulosa* on stable circalittoral mixed sediment' (A5.611). In areas of mixed sediment, comprising increased shell material and occasional low-lying *Sabellaria* colonies, the biotope complex 'Circalittoral mixed sediments' (A5.44) was assigned. There was potentially an additional biotope, 'Piddocks with a sparse associated fauna in sublittoral very soft chalk or clay' (A4.231). These are all discussed individually below.

Table 3-2. Biotopes identified within the Leman BH/BT survey Area

| EUNIS Habitat Classification | | | | | Connor *et al.* (2004) classification |
|---|---|---|---|---|---|
| Environment (Level 1) | Broad Habitat (Level 2) | Habitat Complex (Level 3) | Biotope Complex (Level 4) | Biotope (Level 5) | |
| Marine (A) | Sublittoral Sediment (A5) | Circalittoral sand (A5.2) | Circalittoral fine sand (A5.25) | - | (SS.SSa.CFiSa) Circalittoral fine sand |
| | | Sublittoral mixed sediment (A5.4) | Circalittoral mixed sediments (A5.44) | - | (SS.SMx.CMx) Circalittoral mixed sediment |
| | | Sublittoral biogenic reefs (A5.6) | Sublittoral polychaete worm reefs on sediment (A5.61) | *Sabellaria spinulosa* on stable circalittoral mixed sediment (A5.611) | (SS.SBR.PoR.SspiMx) *Sabellaria spinulosa* on stable circalittoral mixed sediment |
| | Circalittoral rock and other hard substrata (A4) | Atlantic and Mediterranean moderate energy circalittoral (A4.2) | Communities on soft circalittoral rock (A4.23) | Piddocks with a sparse associated fauna in sublittoral very soft chalk or clay (A4.231) | (CR.MCR.SfR.Pid) Piddocks with associated fauna in sublittoral peat or clay |

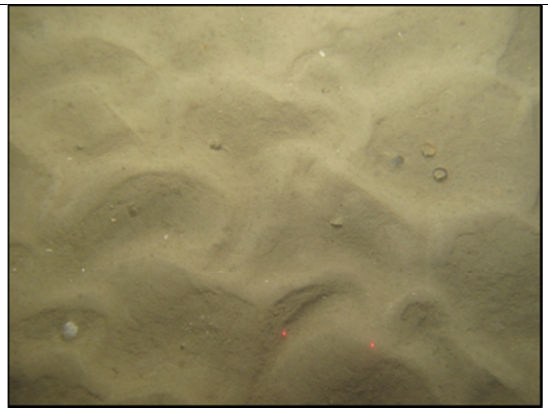
*Note: the greyed out row denotes habitat that was only tentatively identified as occurring in the area*

Source: Fugro EMU, 2015

#### Circalittoral Fine Sand (A5.25)

The biotope complex 'Circalittoral fine sand' occurred intermittently across the majority of the survey area and was observed along all 19 transects and the additional 4 ROV transects. This comprised 'fine to medium rippled sand with shell fragments' and was characterised by low reflectivity side scan sonar (SSS) data. Example photographs of this biotope complex are provided in Figure 3-4. Overall, the abundance of visible epifauna in this area appeared lower than in the other biotopes/biotope complexes observed in the survey area.

Figure 3-4: Example still photographs of 'circalittoral fine sand'

| | |
|---|---|
| |  |
| Transect TR08<br>Rippled sand with shell fragments and seastars (*A. rubens*) and unidentified fish. | Transect TR16<br>Rippled sand with shell fragments |

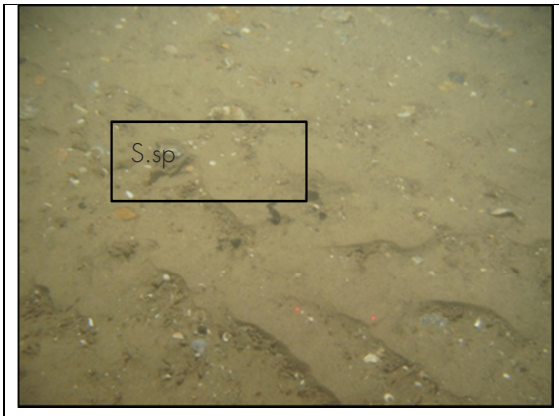
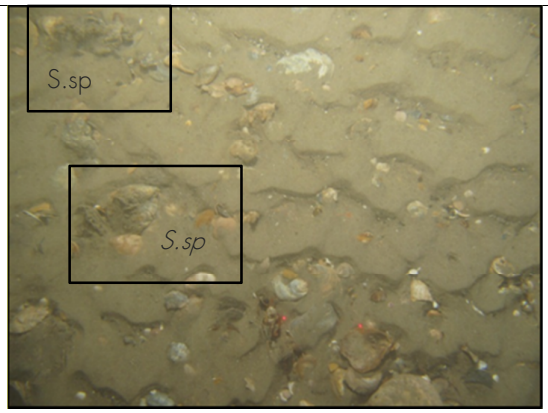
Source: Fugro EMU, 2015.

### CIRCALITTORAL MIXED SEDIMENTS (A5.44)

The biotope complex 'Circalittoral mixed sediments' (A5.44) was observed along 6 out of the 19 transects (transects 4, 5, 6, 7, 12 and19) and ROV transects 1 and 2 (Figure 3-5) (Fugro EMU, 2015). This biotope complex was characterised by increased shell material, shell fragments and occasional gravel and was patchy in nature; often interspersed with areas of other biotopes/biotope complexes, i.e. rippled sand, *Sabellaria* aggregations and outcropping clay/piddocks. Example photographs of this biotope complex are provided in Figure 3-5. Visible epifauna showed minimal variation from the rest of the survey area, although numbers of individuals were thought to be slightly higher compared to the 'Circalittoral fine sand' (A5.25) biotope complex.

Large bivalve shells were observed within this biotope complex, although no living specimens were evident. Higher densities of shells were evident along transects 5, 6, 7 and 19, thought to be predominantly oyster shells, although edible mussel (*Mytilus edulis*) and scallop shells were also observed. Oyster beds are listed as OSPAR Threatened and/or Declining Species and Habitats, Oyster beds are also protected as UK Biodiversity Action Plan (UKBAP) priority habitats and Features of Conservations Interest (FOCI) for the designation of Marine Conservation Zones (MCZ). Despite this, the lack of any live oysters means that the area would not be classified as an '*Ostrea edulis* (native oyster) bed' for which a minimum density of 5 live oysters per square metre is required (OSPAR, 2008).

Figure 3-5: Example still photographs of 'Circalittoral mixed sediments'

| | |
|---|---|
|  |  |
| Transect TR12<br>Rippled sand with shell fragments and small *Sabellaria* colonies. | Transect TR19<br>Rippled sand with shell fragments and small *Sabellaria* colonies. |

Source: Fugro EMU, 2015.

### *SABELLARIA SPINULOSA* ON STABLE CIRCALITTORAL MIXED SEDIMENT (A5.611)

*Sabellaria* aggregations occurred along all transects including the ROV pipeline transects apart from TR08, TR13, TR15, TR16, TR17, TR18 and TR19 (Figure 3-6). Areas which contained either greater than 10% cover of *Sabellaria* or where elevation was greater than 2 cm were classified under the biotope '*Sabellaria spinulosa* on stable circalittoral mixed sediment (A5.611)'. Photographic data showed that the aggregations of *Sabellaria* varied in their elevation and extent, ranging from small (less than 2 cm high) patchily distributed colonies to large (up to 10 cm high) discrete mounds and continuous aggregations (). As *Sabellaria* reef is a conservation feature and Annex I habitat, a full account of the *Sabellaria* aggregations encountered is provided in Section 3.5.1, and example photographs of this biotope are provided in Figure 3-6.

Figure 3-6: Example still photographs of '*Sabellaria spinulosa* on stable circalittoral mixed sediment'

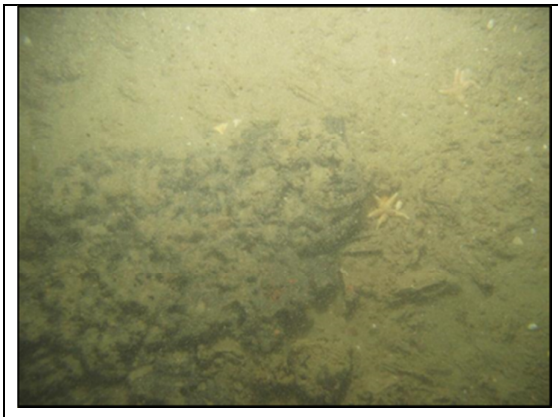
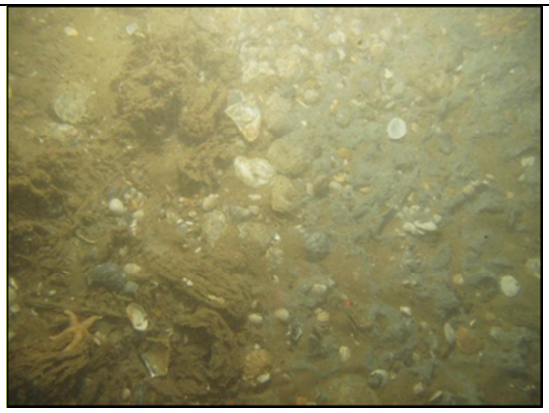
| | |
|---|---|
| | |
| Transect TR10 (delineated *Sabellaria* Patch S2)<br>Rippled sand with shell fragments, outcropping clay and *Sabellaria* aggregations. Other fauna includes seastars (*A. rubens*). | Transect TR12 (delineated *Sabellaria* Patch S1)<br>Rippled sand with shell fragments and *Sabellaria* aggregations, Sea stars (*A. rubens*) |

Source: Fugro EMU, 2015.

PIDDOCKS WITH A SPARSE ASSOCIATED FAUNA IN SUBLITTORAL VERY SOFT CHALK OR CLAY (A4.231)

Outcropping clay and potential piddocks were observed at 8 transects (TR01, TR02, TR03, TR04, TR09, TR10, TR12 and TR19) (Figure 3-7) although these areas were discontinuous and seemed to form part of the mixed circalittoral mixed sediments rather than a discrete biotope. This potential biotope was observed predominantly along transect TR04, with the remaining occurrences generally confined to the west of the survey area. However, these areas did not appear to correspond with any distinctive acoustic signature and it was not possible to delineate the boundary of this biotope from the SSS data. Examples of this potential biotope are shown in Figure 10. It is worth noting that piddock bored chalk and clay is classed as a 'priority habitat' in the UK Biodiversity Action Plan (JNCC, 2015).

**Figure 3-7: Example still photographs of potential 'Piddocks with a sparse associated fauna in sublittoral very soft chalk or clay'**

| | |
|---|---|
|  |  |
| Transect TR03<br>Rippled sand with shell, *Sabellaria* colonies and outcropping clay, sea stars (*A. rubens*) | Transect TR04<br>Sand with shell, *Sabellaria* colonies and outcropping clay, sea stars (*A. rubens*) |

Source: Fugro EMU, 2015

### 3.4.3 Fish

Fish can be categorised as either pelagic or demersal according to the following characteristics:

- Pelagic species occur in shoals swimming in mid-water, typically making extensive seasonal movements or migrations between sea areas. Pelagic species include herring (*Clupea harengus*), mackerel (*Scomber scombus*), blue whiting (*Micromesistius poutassou*) and sprat (*Sprattus sprattus*).
- Demersal species live on or near the seabed and include cod (*Gadus morhua*), haddock (*Melanogrammus aeglefinus*), plaice (*Pleuronectes platessa*), sandeel (*Amodytes sp.)*, sole (*Solea solea*) and whiting (*Merlangius merlangus*).

Common demersal fish observed during camera transects at Leman BH include gobies (*Gobiidea*), dragnets (*Callionymidae*), dogfish (*Scyliorhinus canicula*), and flatfish (*Pleuronectiformes*) (Fugro, 2014).

Leman BH is located within high intensity spawning and nursery grounds for plaice, cod, and mackerel (Coull *et al* 1998, Ellis *et al* 2012) and also falls within the wider spawning and nursery grounds for other important commercial species including whiting, lemon sole, and sandeels. The area also provides spawning grounds for sole as well as nursery grounds for herring and tope (*Galeorhinus galeus*) (Coull *et al* 1998; Ellis *et al*, 2012). Spawning and nursery areas are summarised in Table 3-3.

It should also be noted that sandeel, cod, sole, plaice, herring, and mackerel are listed as UK Biodiversity Action plan (UKBAP) priority species. Of these, the period of the proposed lifting operations coincides with mackerel high intensity spawning.

It should be borne in mind that spawning and nursery grounds are dynamic features of fish life history and are rarely fixed in one location from year to year. Therefore, the data shown in Table 3-3 provides only a broad indication of fish spawning grounds (CEFAS, 2001).

Table 3-3: Spawning and nursery grounds for fish species in Block 46/26

| Species | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Nursery area | UKBAP Priority Species |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cod | S | S* | S* | S | | | | | | | | | Yes | Yes |
| Plaice | S* | S* | S | | | | | | | | | S | Yes | Yes |
| Sprat | | | | | S* | S* | S | S | | | | | Yes | No |
| Mackerel | | | | | S* | S* | S* | S | | | | | Yes | Yes |
| Lemon Sole | | | | S | S | S | S | S | S | | | | Yes | No |
| Sole | | | S | S | S | | | | | | | | No | Yes |
| Whiting | | S | S | S | S | S | | | | | | | Yes | No |
| Herring | | | | | | | | | | | | | Yes | Yes |
| Sandeels | S | S | | | | | | | | | S | S | Yes | Yes |
| Tope | | | | | | | | | | | | | Yes | No |
| Key: S = Spawning; S* = Peak spawning | | | | | | | | | | | | | | |

Source: Coull *et al.* (1998); Ellis *et al.* (2012)

### 3.4.4 Marine Mammals

CETACEANS

The southern North Sea has a relatively low density of cetaceans compared with other areas of the North Sea, with only harbour porpoise (*Phocoena phocoena*) and white-beaked dolphin (*Lagenorhynchus albirostris*) considered to regularly occur (DECC, 2009).

The harbour porpoise is by far the most frequently-occurring species in Block 49/26 and has been recorded in low densities in May, August and December (UKDMAP, 1998). The distribution of harbour porpoise in the North Sea has historically been concentrated in the central and north western North Sea, but there is evidence to suggest that the south-western North Sea is becoming increasingly important for this species (MCRI, 2011). High densities of harbour porpoise have been observed in March within the wider area (Quadrant 49) (UKDMAP, 1998). .

The distribution of white-beaked dolphin in the North Sea is concentrated in the central and northern North Sea and the species is generally only present in low densities in the southern North Sea (Reid *et al* 2003). White-beaked dolphin have been observed in Quadrant 49 in moderate densities in April and low densities in May, but none of these sightings occurred in Block 49/26 (UKDMAP, 1998). Generally, the majority of offshore sightings for this species in UK waters occur in the period from June to October (Reid *et al* 2003).

PINNIPEDS

There are colonies of harbour seals (*Phoca vitulina*) and grey seals (*Halichoerus grypus*) along the Wash and Norfolk coast respectively. Although these species typically remain close to the shore, harbour seals may forage up to 50 km from their haul-out sites and grey seals may forage over 100 km from their haul-out sites (SCOS, 2013). Therefore, it is possible that both grey and harbour seals could potentially occur in the vicinity of the platform. The Sea Mammal Research Unit (SMRU) has produced seal density maps which indicate that mean harbour seal densities range of 1 to 5 individual in the 25 $km^2$ area surrounding the Leman BH platform (Jones *et al*, 2013). The same data indicate similar or lower densities of grey seals.

### 3.4.5 Annex II Species

Annex II species are defined under the EU Habitats and Species Directive as "species of community interest whose conservation requires the designation of Special Areas of Conservation (SAC)". The Annex II species most likely to occur in the area of the Leman BH platform are harbour porpoise, harbour seals and grey seals.

As discussed above, the most likely of these to occur in the area of the Leman BH platform is the harbour porpoise which has been recorded in low densities at various times of the year in the project area. It is also worth mentioning that the harbour porpoise is listed is a non-qualifying (Grade 4) feature of the of the Haisborough, Hammond and Winterton SCI, situated approximately 10.3 km to the south of the Leman BH platform (JNCC, 2014). However, harbour porpoise is not listed as a feature of the North Norfolk Sandbank and Saturn Reef SCI and it would seem that based on the available data, the Leman BH area is not of particular importance to harbour porpoise.

Pinniped species (harbour and grey seals) are also listed as Annex II species and can potentially occur in the area. However, for reasons described above, both harbour and grey seals of are only ever likely to be present in the area for a limited duration and in very low densities (Jones, 2013; SCOS, 2013).

### 3.4.6 Seabirds

The most commonly recorded seabird species in the Leman BH area include the auks (guillemot (*Uria aalge*), razorbill (*Alca torda*) and puffin (*Alca arctica*), kittiwake (*Rissa tridactyla*), gannet (*Morus bassanus*), fulmar (*Fulmarus glacialis*) and terns (especially common (*Sterna hirundo*), little (*Sternula albifrons*) and sandwich (*Sterna sandvicensis*) (Stone *et al*, 1995).

During the breeding season, generally between March and June, large numbers of seabirds congregate in coastal breeding colonies. The North Norfolk coast SPA, situated approximately 73 km to the west of the Leman BH platform, supports nationally important numbers of nesting terns at this time. In autumn and winter, they become less attached to their nesting sites and range considerable distances in search of food. Recent data from the JNCC indicate that UK breeding populations of terns in England have remained stable over the last 30 years although there has been a downward trend in sandwich and common tern chicks fledged since 2000 (JNCC, 2014).

Seabird vulnerability to surface pollution varies throughout the year with peaks in late summer after breeding when the birds disperse into the North Sea, and during the winter months with the arrival of over-wintering birds. To assess the relative risk for different species, the JNCC Seabirds at Sea Team (SAST) has developed an index to assess the vulnerability of bird species to the threat of oil pollution. The vulnerability index is based on the following parameters:

- the amount of time spent on the water;
- total bio-geographic population;
- reliance on the marine environment; and
- potential rate of recovery.

The seasonal vulnerability of the seabirds in the Leman BH area based on the JNCC block-specific vulnerability data is presented in Table 3-4. Vulnerability of seabirds at sea to surface pollution in UKCS Block 49/26 ranges from low to moderate from January to November and rises to high in December (JNCC, 1999). As such, the period of peak seabird vulnerability in the immediate area is out-with the period of lifting operations, which will take place in the summer months. This pattern of low to medium seabird vulnerability in the summer months is also observed at all the surrounding blocks with the exception of 52/05 which has high vulnerability in August (Table 3-4).

Table 3-4: Seabird vulnerability in UKCS Blocks surrounding Leman BH/BT

| Block | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 49/26 | 4 | 3 | 3 | 4 | 3 | 4 | 4 | 3 | 4 | 3 | 4 | 2 |
| 49/27 | 4 | 3 | 3 | 4 | 3 | 4 | 4 | 3 | 4 | 3 | 4 | 2 |
| 49/21 | 4 | 2 | 2 | 4 | 3 | 4 | 4 | 3 | 4 | 3 | 4 | 2 |
| 49/22 | 4 | 2 | 2 | 4 | 3 | 4 | 4 | 3 | 4 | 3 | 4 | 2 |
| 48/25 | 4 | 2 | 2 | 4 | 3 | 4 | 4 | 3 | 4 | 2 | 2 | 2 |
| 48/30 | 4 | 3 | 3 | 4 | 3 | 4 | 4 | 3 | 4 | 2 | 2 | 2 |
| 52/05 | 4 | 3 | 3 | 4 | 3 | 4 | 4 | 2 | 3 | 2 | 2 | 2 |
| 53/01 | 4 | 3 | 3 | 4 | 3 | 4 | 4 | 3 | 4 | 3 | 4 | 2 |
| 53/02 | 4 | 3 | 3 | 4 | 3 | 4 | 4 | 3 | 4 | 3 | 4 | 2 |

| Key: | |
|---|---|
| 1 | Very high |
| 2 | High |
| 3 | Moderate |
| 4 | Low |

Source: JNCC (1999)

## 3.5 MARINE CONSERVATION

### 3.5.1 Annex I Habitats

The Leman BH platform is situated within the North Norfolk Sandbanks and Saturn Reef Site of Community Interest (SCI), which has been designated for both its sandbanks and biogenic reef habitat. The latter is created by aggregations of the tube worm *Sabellaria* which consolidate to form a solid structure that rises from the seabed. The SCI has been graded B ('good conservation value') in terms of the quality of its sandbank habitats and A ('excellent') with regards to the quality of the *Sabellaria* reef (JNCC, 2012a). Haisborough, Hammond and Winterton SCI which is situated approximately 10.3 km to the south of Leman BH, is also designated for its sandbanks and biogenic reef. The location of these areas in relation to Leman BH is shown in Figure 3-1.

SANDBANKS

Sandbanks are the largest bedforms on the Europrean continental shelf and those of the southern North Sea include some of the most notable examples in the world (Cameron *et al*, 1992). The North Norfolk Sandbanks are considered the best example of open sea, tidal sandbanks in a moderate current strength in UK waters (JNCC, 2010). In total, thirteen discrete sandbank areas have been delineated by the JNCC within the SCI with a combined area of approximately 1,069 $km^2$ (JNCC, 2014). The location of these sandbanks is shown in Figure 3-1. The summits of the sandbanks are in waters less than 20 m deep, with the base of the banks in waters of around 40m deep. The banks are elongated, orientated roughly parallel to the coast and the tidal currents.

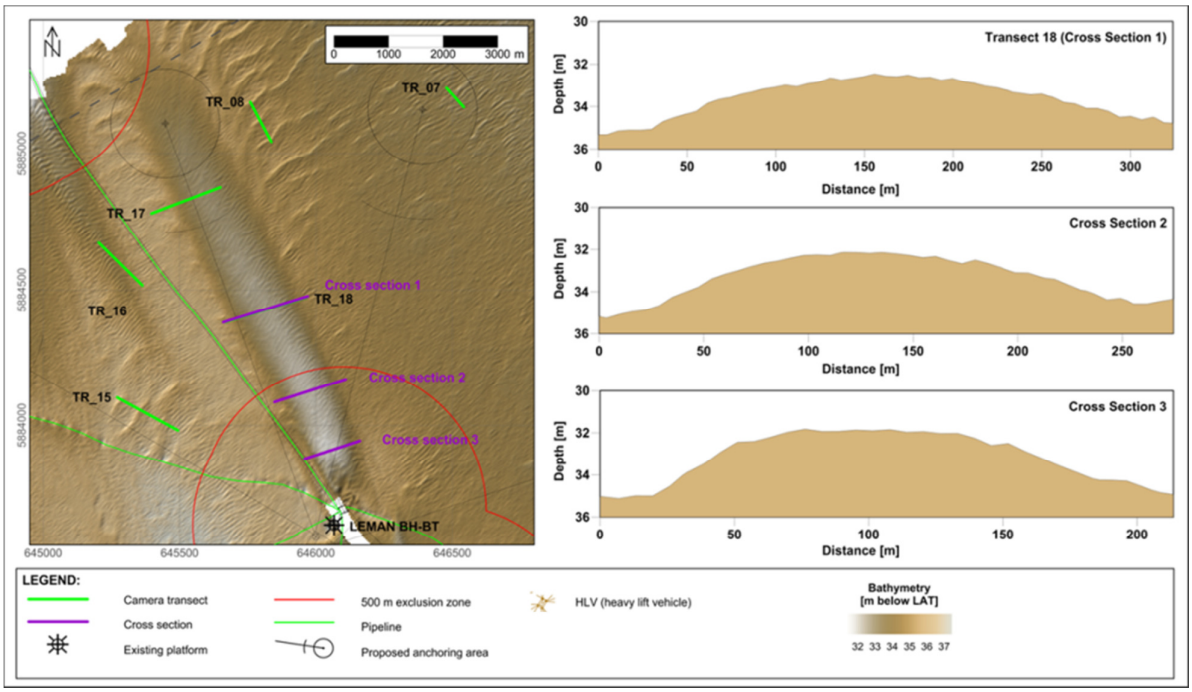
Leman BH installation lies within close proximity to a number of JNCC delineated Annex I sandbank or potential sandbank habitats. The nearest sandbank to the Leman BH is the Ower bank which is situated 2.5 km to the northwest (Figure 3-1 and Figure 3-9).

The habitat survey identified a sand ridge approximately 3 to 4 m extending from just north of the Leman BT platform to the edge of the survey area. The topography of this feature is shown in cross section in Figure 3-8. The sand ridge was also investigated by video transects and was not considered to form part of a larger sandbank feature. Analysis of the video transects crossing this feature (transects TR17 and TR18), shown in Figure 3-8, did not reveal any significant changes in epifaunal coverage or composition across the feature.

Furthermore, the highest point of this sand ridge was well below 20m water depth and therefore did not fall within the classification criteria for Annex I habitat 'sandbanks which are slightly covered by seawater all the time'.

A review of the Outer Dowsing to Smiths Knoll Admiralty Chart (No. 1503) also indicated that this ridge did not form part of a larger shallow sandbank and was distinct from the nearest large sandbank, the Ower Bank which is situated approximately 1.5 km to the west of the northern most part of this feature (Fugro EMU, 2015). In addition, there were three other smaller sand ridges identified from the geophysical data, situated to the south of the Leman BH/BT platform. These were also not considered to form part of larger sandbank features.

Figure 3-8: Sand ridge to the North of the Leman BH/BT




Fugro EMU, 2015

## SABELLARIA SPINULOSA REEFS

*Sabellaria* are polychaete worms that form fragile sand-tubes which consolidate together to create a solid structure rising above the seabed. Although *Sabellaria* is found widely distributed in UK waters, commonly forming 'crusts' as groups of individuals on sandy or coarser sediments or rock, significant elevated reef structures are rare (JNCC, 2010). *Sabellaria* aggregations are known to be temporally unstable, but it is generally accepted that although single reefs may grow and decline within several years, broad areas that support reef generation typically remain so until hydrographical conditions change (Jones *et al*, 2000). One such area of stable reef is the Saturn Reef situated within the North Norfolk Sandbanks and Saturn Reef SCI, approximately 46.5 km to the north west of the Leman BH platform (Figure 3-1).

Reefs formed by *Sabellaria* are of interest due to the high levels of biodiversity that they support. A recent study demonstrated that *Sabellaria* reefs perform a number of important ecosystem services (Pearce *et al*, 2011b). Most notably, *Sabellaria* reefs have been shown to increase the abundance of benthic fauna which, in addition to the reef-building worms themselves, are utilized as a source of food by some demersal fish species. The influence of biogenic reefs on benthic fauna however, depends on the sedimentary conditions they are found in. *Sabellaria* reefs have a much greater influence on benthic macrofauna in sandy environments which support a less diverse faunal assemblage such as those found across much of the Leman BT/BH area.

### Assessment of *Sabellaria* aggregations

In order to identify any seabed habitats or conservation features which may potentially be impacted by the proposed operations, an environmental habitat assessment covering an area of 3.6 $km^2$ centred on the Leman BH platform was undertaken in 2014. The habitat assessment comprised of two surveys, a geophysical survey (Fugro, 2015) followed by an environmental camera transect survey (Fugro EMU, 2015). The first survey acquired SSS and Multibeam Bathymetry data which were used to delineate preliminary *Sabellaria* aggregations based on the reflectivity of the seabed (Fugro, 2015). These data were used as the basis to undertake a ground-truthing camera transect survey which assessed the presence and quality of any *Sabellaria* aggregations present as well as identifying any other seabed habitats present in the area (Fugro EMU, 2015).

The habitat assessment identified a total of sixteen predicted *Sabellaria* patches, most of which were investigated by video transects. The delineated patches within the survey area ranged in area coverage from 3,697 $m^2$ to 353,060 $m^2$ and are presented in Table 3-6 and Figure 3-9. It should be noted that the delineated areas denote regions of increased *Sabellaria* occurrence and not continuous reef.

An assessment to identify the status of the potential biogenic reefs present was undertaken using the JNCC guideline criteria (Gubbay, 2007) for the determination of the 'reefiness' of *Sabellaria* to aid assessment of the *Sabellaria* aggregations within the Leman BH survey area (Table 3-5).

Table 3-5: 'Reefiness' assessment criteria

| | Not a reef | Low | Medium | High |
|---|---|---|---|---|
| Elevation (mean tube height) (cm) | <2 | 2 - 5 | 5 - 10 | >10 |
| Patchiness (% Cover) | <10% | 10-20% | 20-30% | >30% |
| Estimated Area ($m^2$) | <25 | 25 - 10,000 | 10,000 - 1,000,000 | > 1,000,000 |

Source: Gubbay, 2007

*Sabellaria* aggregations were observed along 13 of the 19 camera transects. The location of delineated *Sabellaria* aggregations and the 19 camera transects is shown in Figure 3-9. Further details of the assessment carried out at the delineated areas are provided in Appendix B (Figures B1, B2 and B3). These aggregations were predominantly observed towards the west and south of the survey area; however the presence of small patches in other parts of the survey area suggested that small isolated aggregations and low-lying *Sabellaria* colonies may be present across the site. Example photographs of *Sabellaria* aggregations observed are shown in Figure 3-6. In addition to the delineated areas, there were 3 small 6 - 34 $m^2$ patches of *Sabellaria* observed along transects TR07, TR14, and TR19, which were originally proposed to investigate delineated background conditions (Table 3-6). The overall assessment results and the delineated areas are indicated in Figure 3-9.

The ground-truthing transect data showed a good correlation with the predicted *Sabellaria* boundaries from the SSS data. The transect data also tied in well with the areas of *Sabellaria* identified during the nearby Leman A habitat assessment survey where an extensive area of *Sabellaria* reef was previously found approximately 2 km to the west of the Leman BH platform (Fugro, 2013).

It can be seen in Figure 3-9 that the largest *Sabellaria* boundary, S1, overlaps with the possible extension of the boundary identified from the previous Leman A habitat assessment, suggesting the presence of a single continuous patch spanning both survey areas. The overall combined area coverage of this patch is estimate at 870,950 $m^2$ (Table 3-6) which is just short of falling within the 'High' criteria for area coverage. However it should be considered that the delineations of the Leman BH aggregations in 2014 were not completely consistent with those from 2013, indicating that the extent of *Sabellaria* in this patch had changed during this period. This is most likely caused by temporal variation rather than a result of anchoring operations undertaken within the Leman A Field in 2014 as the distance would have been too great to have caused the observed temporal difference (Fugro EMU, 2015).

A summary of the reefiness assessment for the delineated potential *Sabellaria* areas is provided in Table 3-6.

The *Sabellaria* observed in the survey area showed varied morphology, ranging from low-lying (less than 2 cm) colonies to medium elevation (up to 10 cm) discrete mounds and areas of continuous aggregation. 11 out of the 16 delineated *Sabellaria* boundaries scored 'medium' for area coverage. The analysis of the video footage showed that these *Sabellaria* aggregations were of 'low' to 'medium' elevation (only 3 of these areas showed 'medium' elevation) and generally low in terms of patchiness. These results suggest that while there are likely to be areas of reef within the project area, the aggregations forming the reef structures are generally very patchy in their distribution (only one observation was assessed as 'medium reefiness' against the patchiness criteria). None of the delineated *Sabellaria* areas were assessed to have 'medium' "reefiness" for all three criteria and there were no potential reef areas assessed to have a 'high' score for any of the "reefiness" criteria from the 2014 habitat assessment. Despite this, it is noteworthy that these aggregations have the potential to increase to a larger size, given the apparent suitability for the accumulation of reef structures in this particular area. Therefore, the potential impacts on these habitats will be considered in detail within this EIA.

Table 3-6: Summary of Reefiness assessment for *Sabellaria* areas with defined (delineated) boundaries

| Patch | Area [$m^2$] | Range in Elevation | Range in Patchiness | Transect(s) |
|---|---|---|---|---|
| S1 | 353,060 | Not a reef - medium | Not a reef - medium | TR_02 and TR_12 |
| S1/P9* | 870,950 | Not a reef - high | Not a reef - high | TR_02 and TR_12 |
| S2 | 75,020 | Low - medium | Low | TR_10 |
| S3 | 14,850 | Low | Low | TR_03 |
| S4 | 28,810 | Not ground-truthed | | |
| S5 | 17,460 | Low | Not a reef - low | TR_11 |
| S6 | 17,250 | Low | Low | TR_09 |
| S7 | 23,550 | Not a reef - low | Not a reef - medium | TR_04 |
| S8 | 152,190 | Not a reef - low | Not a reef - low | TR_05 and TR_06 |
| S9 | 4,931 | Medium | Low | TR_09 |
| S10 | 3,697 | Not ground-truthed | | |
| S11 | 13,780 | Low | Not a reef | TR_09 |
| S12 | 13,360 | Low | Low | TR_02 |
| S13 | 7,157 | Not a reef to medium | Not a reef to low | TR_01 |
| S14 | 3,944 | Not ground-truthed | | |
| S15 | 8,410 | Not ground-truthed | | |
| S16 | 24,980 | Not ground-truthed | | |
| Reef assessment** | | Not a reef | Low / Medium | High |

*Patch S1/P9 is a combined area noted from the Leman A and Leman BH geophysical surveys with Leman BH boundaries taking precedence in overlaps with the Leman A boundaries. Reefiness measures for this patch are taken from multiple years.

**The colour coding for the reef assessment is only applied here to area ($m^2$) criteria, given the variation in the elevation and patchiness across the *Sabellaria* patches.

Fugro EMU, 2015

There were also *Sabellaria* aggregations observed along each of the four ROV pipeline inspection transects (ROV1, ROV2, ROV3 and ROV4) (Subsea 7, 2012 & 2013). These transects were used to ground-truth the areas of seabed within the 500 m safety zone which were not investigated by camera transects during the habitat assessment (Table 3-7). These were out-with the delineated *Sabellaria* boundaries identified in the 2014 surveys and are shown in Figure 3-9. A summary of the assessments carried out at the ROV sites are provided in Figure B4 of Appendix B. The vast majority of these comprised small patches of sparse low-lying

crusts and isolated clumps. However, one aggregation observed along ROV 2 to the north west displayed both 'high' elevation and patchiness in the reef assessment although this patch only encompassed an 8 m long stretch of the ROV transect (Fugro EMU, 2015). There was also a single patch of medium patchiness along transect ROV 2, approximately 3 m in length. In addition to these, there were another three notable *Sabellaria* patches observed along ROV 1 to the south of the Leman BH platform which showed medium patchiness and measured 18 m, 2m and 15m in length respectively.

The *Sabellaria* aggregations along the pipeline routes from the 2012/3 surveys appeared confined to the raised elevation associated with the pipelines as no additional patches of *Sabellaria* could be delineated from the high resolution geophysical data (Osiris, 2014). This could be due to the small patch size not being resolved in the SSS data or degradation of the aggregations in the intervening two-year period between acquiring the ROV video data and geophysical data (Fugro EMU, 2015).

Table 3-7: Reefiness assessment for non-delineated *Sabellaria* observed from ground - truthing data

| Transect | Extent of *Sabellaria* [m]* | Range of Elevation | Range of Patchiness |
|---|---|---|---|
| 2014 Seabed Camera Transects | | | |
| TR_14 | 11 | Not a reef | Not a reef |
| TR_7 | 6 | Medium | Low |
| TR_19 | 34 | Not a reef | Not a reef |
| 2012/2013 Pipeline survey ROV Data | | | |
| ROV1 | 267 | None - low | None - medium |
| ROV2 | 242 | None - high | None - high |
| ROV3 | 113 | Not a reef | Not a reef |
| ROV4 | 131 | None - low | None – low |
| * Extent of *Sabellaria* is the distance between the first and last incidences of *Sabellaria* on the transect, and may potentially include areas of no noted *Sabellaria* in-between recorded aggregations. | | | |

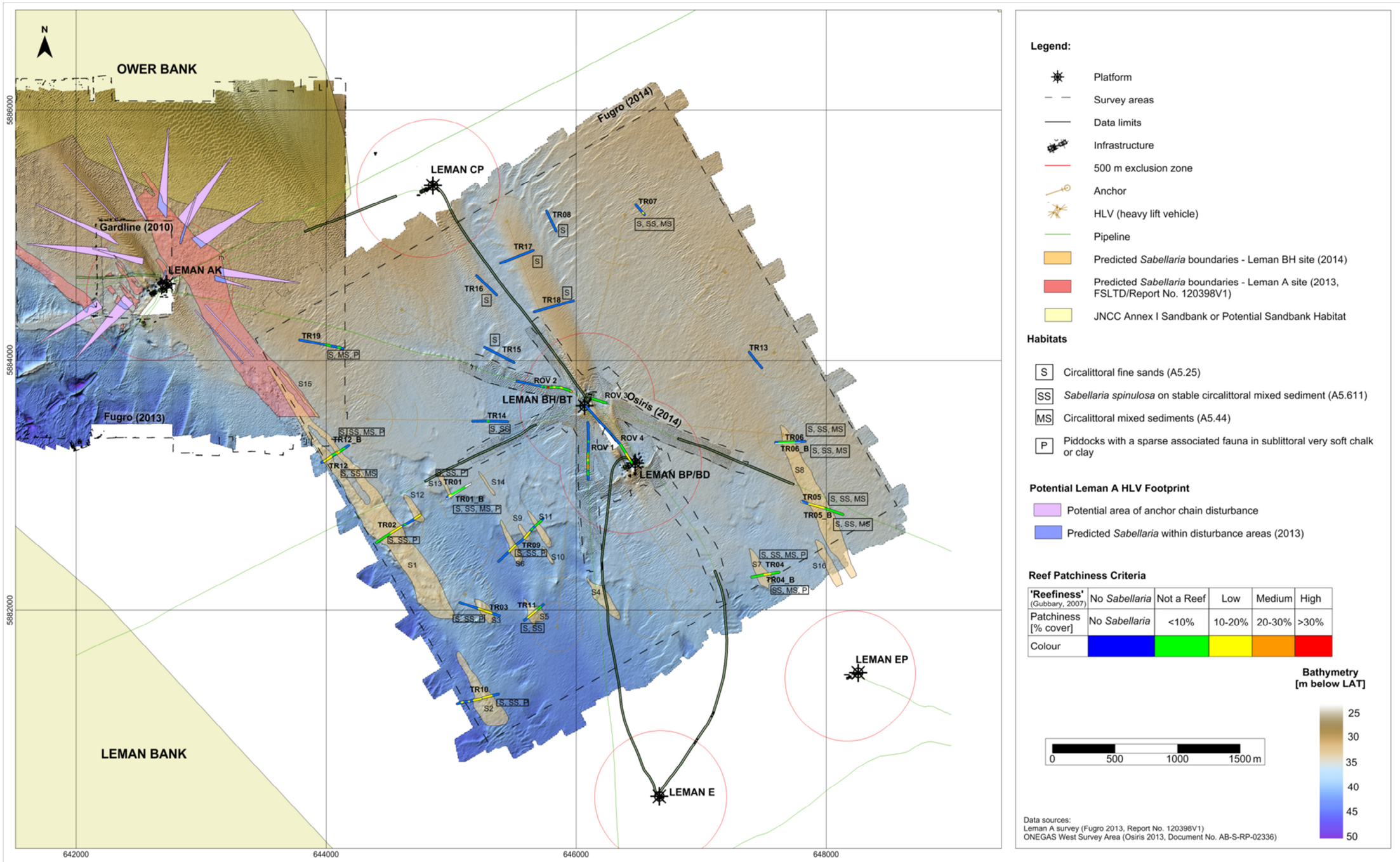
Fugro EMU, 2015; Subsea 7 (2012 &2013).

### 3.5.2 Biodiversity Action Plan (BAP) Priority habitats

As well as Sandbanks and *Sabellaria*, there was an indication that the potential biotope 'Piddocks with a sparse associated fauna in sublittoral very soft chalk or clay' was present in the vicinity of the Leman BH area. This habitat is listed as a UK Biodiversity Action Plan (UKBAP) priority habitat as well as a feature of conservation importance (FOCI). However, areas of outcropping clay were generally small and sparsely distributed throughout the site, being predominantly observed along transect TR04 and to the west of the survey area. Therefore, the existence of this biotope was inconclusive from the available survey data (Fugro EMU, 2015).

The presence of oyster shells in the camera footage could suggest the possibility of oyster beds in the area (see 3.4.2). Despite this, no live specimens were observed. There is the possibility that these may be the remains of historic oyster colonies in this part of the southern North Sea or that these have originated elsewhere and have accumulated at the present location through sediment transport. In either scenario, there does not appear to be any UK BAP/FOCI oyster beds in the area.

Figure 3-9: Habitat assessment results. Delineated potential *Sabellaria* areas and transect patchiness assessment




Source: Fugro EMU, 2015

### 3.5.3 Marine conservation Zones (MCZ)

MCZs are selected to protect a range of broad-scale habitats and threatened, rare or declining species and habitats termed Features of Conservation Importance (FOCI) (JNCC, 2014). These features incorporate habitats and species included on the OSPAR list of Threatened and / or Declining Species and Habitats, in addition to those included in the UK Biodiversity Action Plan (UKBAP) Priority List.

There are two recommended Marine Conservation Zones (rMCZs) around the Norfolk coastline. The nearest of these is the Cromer Shoal Chalk Beds, located approximately 46 km to the southwest of the Leman BH platform (Figure 3-1). This site is included in Tranche 2 of the MCZ implementation programme and is currently under consultation with results not expected until January 2016 (DEFRA, 2015). In addition, The Wash Approach rMCZ, located approximately 70 km to the west of Leman BH is on hold from being designated as there is currently insufficient information to support its designation (The Wildlife Trusts, 2015).

### 3.5.4 SPAs with marine components

There are a number of Special Protection Areas (SPAs) with marine components along the Norfolk coastline. These include the Outer Thames SPA, which supports important numbers of red-throated divers and the North Norfolk Coast a designated SPA and Ramsar site which supports nationally important breeding colonies of terns and wading birds and waterfowl overwintering sites respectively (JNCC, 2014). However, these SPAs sites are both situated >50km from the project location.

### 3.5.5 Other protected areas

Within this coastal region there are numerous Sites of Special Scientific Interest (SSSIs), Local Nature Reserves (LNR) and RSPB reserves.

## 3.6 OTHER SEA USERS

### 3.6.1 Commercial fisheries

The North Sea is divided into a series of numbered divisions and rectangles by ICES (International Council for the Exploration of the Sea). The project area lies within ICES Rectangle, 35F2.

The recent 2013 landings dataset for this rectangle is undisclosed as it is probable that the total landings were made by fewer than five fishing vessels. However, it is possible to assess the landings for 2012 for this rectangle. The fishery in this region is dominated by the year round demersal fishery targeting plaice (*Pleuronectes platessa*), dab (*Limanda limanda*) and turbot (*Scophthalmus maximus*) and the shellfish fishery which comprises mainly of *Nephrops sp.* (Table 3-8). Pelagic landings are low in the immediate area. Overall, the fishing intensity, quantity of landings and their economic value can be considered to be low in this region compared to other areas of the North Sea (Scottish Government, 2014; Kafas *et al* 2012). The shellfish fishery, which is the most important in terms of commercial value in the southern North Sea, is mainly focussed in more inshore waters to the west. To put it in context, shellfish landings (tonnes and value) in these areas can exceed those in the Leman BH area by up to two orders of magnitude (100 times) (Scottish Government, 2014). The main demersal fisheries in the North Sea are concentrated to the north where landings are again far greater in terms of both landings (tonnes) and value than that found at the Leman BH location (Scottish government, 2014).

Table 3-8: Total annual landings and value in ICES rectangle 35F2 in 2012

| Year | Landings (tonnes) | Value (£) |
|---|---|---|
| Demersal | 28.7 | 68,860 |
| Shellfish | 7.7 | 20,800 |
| Pelagic | 0 | 0 |

### 3.6.2 Oil and gas activity

As indicated in Figure 1-1, the Leman BH/BT complex is situated in an area of extensive offshore oil and gas activity. The closest platform to Leman BH is the BD/BP NUI installation, approximately 610 meters to the south-east. There has been historic drilling at Leman BD/BP with around 19 wells drilled over 40 years ago.

There are manned installations relatively close by including the Leman CD/CP platforms and the Leman A complex, situated 2.1 km and 3.5 km to the north-west respectively. These platforms are all operational and linked by a network of subsea gas production pipelines.

The closest non-Shell operated platforms are the Perenco-operated Leman ED and EP platforms, situated approximately 3 km to the southeast. A summary of the nearest platforms to Leman BH is given in Table 3-9.

Table 3-9: Nearest Oil and Gas platforms to Leman BH

| Installation | Status | Operator | Distance From Leman BH (km) |
|---|---|---|---|
| Leman BD/BP | Active | Shell | 0.6 |
| Leman CD/CP | Active | Shell | 2.1 |
| Leman A Complex | Active | Shell | 3.5 |
| Leman ED/EP | Active | Perenco | 3.0 |

The Perenco-operated Thames platform and associated field tie-backs, situated approximately 24km to the east of Leman BH, is being planned for decommissioning. The offshore heavy lift operations and subsea well abandonment campaigns for this decommissioning are planned to take place between summer 2015 and summer 2017 in various stages and will therefore coincide with the proposed Leman BH decommissioning operations.

There are also nine pipelines and an umbilical present within the immediate vicinity of the Leman BH/BT complex. These are summarised in Table 3-10.

Table 3-10: Pipelines and Umbilicals in the vicinity of the Leman BH/BT complex

| Pipeline/Umbilical | From | To | Status |
|---|---|---|---|
| 30" gas pipeline (S0601) | Leman BT (Perenco) | Leman BT (Shell) | Active |
| 24" gas (S0405) / 4" MEG (S1002) pipelines | Leman BP | Leman BT | Active |
| 24" gas pipeline (S0406) | Leman D | Leman BT | Active |
| 30" gas pipeline (S0202) | Leman BT | Bacton | Abandoned |
| 30" gas (S0407)/ 4" MEG (S1003) pipelines | Leman BT | Leman AP | Active |
| 24" gas pipeline (S0404) | Leman CP | Leman BT | Active |
| 1"electrical power cable (S0811) | Leman CP | Leman BH | Abandoned |

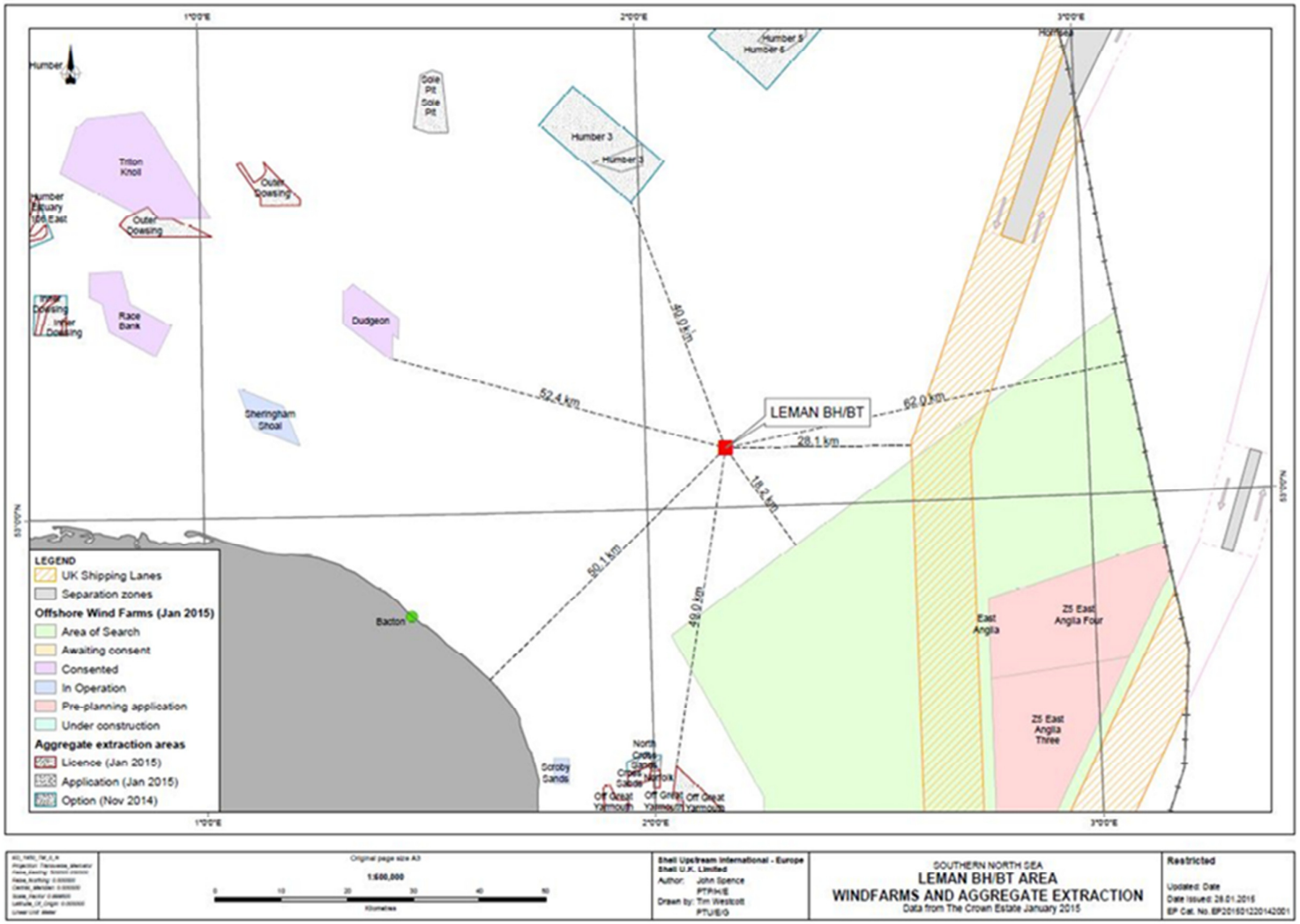
### 3.6.3 Shipping, offshore wind and aggregates extraction

The offshore southern North Sea is subject to quite high levels of activity from non-oil and gas related industries, including shipping, renewable energy (wind farms) and aggregate extraction. Figure 3-10 provides an overview of where these industries operate in relation to the Leman BH platform.

### 3.6.4 Shipping

There are busy merchant shipping routes using well-defined channels passing relatively close to the Leman Field. The main UK shipping lane passes the Leman BH/BT complex approximately 28 km to the east (Figure 11). The Leman BT/BH is within a 10 km corridor which is generally avoided by merchant vessels due to the long-established oil and gas surface infrastructure, associated safety zones and the presence of shallow sandbanks (Anatec, 2005; 2013). Shipping studies show that densities and associated collision frequencies are highest for infield vessels (Anatec 2005). This is expected as these vessels operate in close proximity to the installations (Anatec, 2005).

Figure 3-10: Leman BH location in relation to shipping, windfarm developments and aggregate extraction areas




Source: Crown Estate, 2015

### 3.6.5 Offshore Wind Farms

There are two offshore wind farm areas in the vicinity of the Leman Field. The closest is the East Anglia Wind Farm search area, leased to Vattenfall and Scottish Power Renewables and is located approximately 18 km to the southwest. The East Anglia Four Wind Farm is situated approximately 48 km to the southeast of Leman BH and is currently in the pre-planning stage. The infrastructure planning application is expected to be submitted to the planning inspectorate in Q4, 2016 (Planning Inspectorate, 2015). Therefore, there are no offshore operations likely to be undertaken at this site during the Leman BH decommissioning operations.

The other nearby wind farm is the Dudgeon Wind Farm consented area, located approximately 52 km to the west (Figure 3-10) (Crown Estate, 2015). The offshore works are planned to commence in Q1 2016 and therefore, may be under way during the proposed decommissioning (Dudgeon offshore, 2014).

### 3.6.6 Aggregate extraction

Within the boundaries of the North Norfolk Sandbanks and Saturn Reef SCI, there are areas of interest for marine aggregate extraction. The nearest of these to the Leman BH platform is the Humber 3 aggregate extraction option area, situated approximately 40 km to the north (Figure 3-10). This site is an option area only and not an active dredging site. There is also a an aggregate extraction licenced area off Great Yarmouth, which is managed by Hanson UK, situated approximately 49 km to the south of Leman BH (Crown Estate, 2015).

### 3.6.7 Other Subsea Infrastructure

The nearest non-oil and gas subsea infrastructure to the Leman BH platform is an active telecommunication cable situated approximately 15km to the east which runs from North (offshore North Sea) to south (Lowestoft) (Kingfisher, 2014).

### 3.6.8 Military uses

There is a military Practice and Exercise area (PEXA) situated approximately 50 km to the north of Leman BH. This area is used by the Royal Air force (RAF) and is therefore an area of intense aerial activity.

### 3.6.9 Cultural Heritage

There are many shipwrecks and obstructions in the North Sea. Shipwrecks (especially warships) and submerged aircraft with historical or cultural significance may be considered as underwater cultural heritage sites according to the Convention for Protection of Underwater Heritage, 2001. There was a wreck identified in 1970, situated about 1.45 km to the northeast of the Leman BH platform which was considered of no importance and therefore not charted (UKHO, 2014). Although a number of objects were identified in the surrounding area of Leman BH from side scan and bathymetry data, none of these were construed to be potential wrecks.

## 3.7 EAST INSHORE AND EAST OFFSHORE MARINE PLAN

The East Inshore and East Offshore Marine Plans were the first plans produced for English seas, and entered into force in April 2014. The aim of the marine plans are to help ensure the sustainable development of the marine area through informing and guiding regulation, management, use and protection of the marine plan areas. Any decisions made in the marine plan areas must still be compliant with relevant legislation and regulations; the marine plans complement rather than replace such requirements.

The Plan sets out 11 objectives that need to be met in order to deliver the vision for East Marine Plan Areas in 2034. The objectives are supported by cross-sectorial and sector-specific policies. The purpose of the policies is to provide direction or guidance on how decisions should be made to ensure the plan objectives are met. The Plan policies in general apply to new, rather than existing, developments, uses and management measures. However, they may also apply in the review of existing activities or measures.

The proposed project has been assessed against the marine plan objectives and cross-sectorial and sectorial policies. The results of this assessment have been reflected in this EIA.

# 4 EIA METHODOLOGY

## 4.1 IMPACT ASSESSMENT PROCESS

Scoping is an integral part of the IA process, the aim of which is to identify matters that should be covered in the detailed IA. The process of scoping has involved assessing the Leman BH project's possible impacts, deciding which impacts are likely and significant and what mitigation measures can be put in place. The key stages which have been undertaken in accordance with the Shell HSSE-SP Control Framework as part of the impact assessment include:

- Impact Assessment Screening
- HSSE-SP Control Framework Check (Environmental and SP)
- Stakeholder Engagement plan
- Scoping ENVID workshop and report
- Impact Assessment Scoping

The initial scoping of possible impacts associated with the Leman BH project has identified those impacts thought to be potentially significant, those thought to be not significant and those whose significance is yet to be clarified (uncertain). Those considered to be not significant are eliminated; those in the uncertain category are added to the initial category of other potentially significant impacts. This refining of focus onto the most potentially significant impacts will continue throughout the IA process and through all phases for the Leman BH project. This allows the flexibility to adapt to any new issues, for example the discovery of additional impacts arising from detailed baseline studies resulting in the investigation of new impacts, alternatives and mitigation measures as necessary.

The potential environmental and social impacts associated with the project were identified during the Scoping Environmental Issues Identification (ENVID) Session and are listed below:

Primary impacts requiring a comprehensive assessment:

- Seabed disturbance (especially anchors and anchor chains)
- Accidental events

Other impacts which should be considered as part of the EIA:

- Socio-economic factors (offshore and onshore)
- Underwater noise (e.g. from cutting operations)
- Atmospheric emissions (e.g. vessels)
- Waste management (offshore and onshore)
- Cumulative effects (e.g. with Leman BT refurbishment)
- Marine planning (east offshore marine plan)

## 4.2 IMPACT ASSESSMENT METHODOLOGY

The EIA builds upon the scoping findings by assessing the significance of the potential impact(s) so that measures can be taken to eliminate or reduce such impacts through design or operational measures (control and/or mitigation). The significance of any potential impact is determined through the use of an impact/risk assessment approach which employs the standards assessment methodology of:

| | | | | |
|---|---|---|---|---|
| Likelihood of occurrence (Frequency/duration, probability) | X | Magnitude of Impact (Consequence) | = | Significance of Impact (or risk in the case of accidental events) |

The significance of impact for planned operations or risk of accidental events for each identified aspects were evaluated using the Impact Significance/ Risk Assessment Matrix presented below (Table 4-1: Impact Significance/Risk Assessment Matrix). The predefined likelihood criteria (frequency, duration or probability) rated A to E are further explained in Table 4-2, while the magnitude of the consequences criteria for each of the categories are defined in Table 4-3.

The highest consequence rating score of any of the categories was used to determine the final consequence rating. Although this is a semi-quantitative approach, by drawing on multidisciplinary input and overall best judgement (based on experience and expertise), a consistent methodical approach to "predict and evaluate" is adopted across the project.

Table 4-1: Impact Significance/Risk Assessment Matrix

| Magnitude | Environmental Impact | Stakeholder Concern | Likelihood (frequency, duration or probability) | | | | |
|---|---|---|---|---|---|---|---|
| | | | A | B | C | D | E |
| 0 | No effect | No public interest | VL | VL | VL | VL | VL |
| 1 | Slight /negligible effect | Individual concerns | VL | VL | L | L | L |
| 2 | Minor effect | Local concerns | VL | L | L | M | M |
| 3 | Moderate effect | Regional concerns | L | L | M | M | H |
| 4 | Major effect | National concerns | L | M | M | H | H |
| 5 | Severe effect | International concerns | M | M | H | H | H |

Table 4-2: Likelihood criteria (Frequency/Duration or Probability)

| Likeli-hood | Planned Operation (frequency/duration) | Accidental Event – Unplanned (probability) |
|---|---|---|
| A | One off event over lifetime of development for < 24 hours | Never Heard of in the Industry - Extremely remote<br>$< 10^{-5}$ per year<br>Has never occurred within industry or similar industry but theoretically possible |
| B | One off event over lifetime of development over several days duration<br>OR<br>Once per year for <24 hours | Heard of in the Industry - Remote<br>$10^{-5}$ - $10^{-3}$ per year<br>Similar event has occurred somewhere in industry or similar industry but not likely to occur with current practices and procedures |
| C | Regular over less than 3 years<br>OR<br>Intermittent over more than 3 years | Has happened in the Organisation or more than once per year in the Industry - Unlikely<br>$10^{-3}$ - $10^{-2}$ per year<br>Event could occur within lifetime of 10 similar facilities. |
| D | Continuous emission or permanent change over less than 5 years<br>OR<br>Regular over more than 3 years | Has happened at the Location or more than once per year in the Organisation - Possible<br>$10^{-2}$ - $10^{-1}$ per year<br>Could occur within the lifetime of the development |
| E | Continuous emission or permanent change over more than 5 years | Has happened more than once per year in the Location - Likely<br>$10^{-1}$ - >1 per year<br>Event likely to occur more than once on the facility |

Table 4-3: Magnitude Criteria

| Level | Definition | Environmental Impact | Stakeholder Concern |
|---|---|---|---|
| 0 | No effect | An enhancement of some ecosystem or population parameter. | No public interest or positive public support.<br>An enhancement in the availability or quality |
| 1 | Slight effect (negligible) | Slight environmental damage contained within premises.<br>Effects unlikely to be discernible or measureable.<br>No contribution to trans-boundary or cumulative effects | No noticeable stakeholder concern and only limited public interest.<br>A possible short-term decrease in the availability or quality of a resource, which is unlikely to be noticed by persons utilising it, or those who live in the immediate area, and does not affect their wellbeing. |
| 2 | Minor effect | Minor environmental damage, but no lasting effects.<br>Change in habitats or species which can be seen and measured but is at same scale as natural variability.<br>Unlikely to contribute to trans-boundary or cumulative effects | Issues that might affect individual people or businesses or single interests at the local level.<br>Some local public awareness and concern.<br>A short-term decrease in the availability or quality of a resource likely to be noticed by persons utilising it, but does not affect their wellbeing. |
| 3 | Moderate effect | Limited environmental damage that will persist or require cleaning up.<br>Widespread change in habitats or species beyond natural variability with recovery likely within 1-2 years following cessation of activities, or localised medium-term degradation with recovery in 2-5 years.<br>Impact on status of locally important sites or species.<br>Possible minor trans-boundary effects.<br>Possible contribution to cumulative effects. | Regional/local concerns at the community or broad interest group level.<br>Decrease in the availability of a resource to the extent of affecting over 1-2 years the well-being of the persons utilising that resource.<br>Possible but unlikely effect on human health, but may cause or be perceived to cause a nuisance. |
| 4 | Major effect | Severe environmental damage that will require extensive measures to restore beneficial uses of the environment. Widespread degradation to the quality or availability of habitats and/or wildlife requiring significant long-term restoration effort.<br>Recovery likely within 2-5 years following cessation of activities.<br>Moderate-minor impact on the conservation objectives of internationally /nationally protected sites, habitats or populations.<br>Moderate trans-boundary effects or contribution to cumulative effects anticipated. | National public concern and extensive national media interest likely.<br>Well established and widely held areas of concern in national society.<br>Decrease in the availability or quality of a resource to the extent of affecting over 2-5 years the wellbeing of the persons utilising that resource.<br>Potential moderate impact on human health. |
| 5 | Massive effect (severe) | Persistent severe environmental damage that will lead to loss of commercial, recreational use or loss of natural resources over a wide area.<br>Widespread long-term degradation to the quality or availability of habitats and/or wildlife with recovery not expected for an extended period (>5 years) or that cannot be readily rectified.<br>Major impact on the conservation objectives of internationally/nationally protected sites, habitats or populations.<br>Major trans-boundary effects expected.<br>Major contribution to cumulative effects. | International public concern and extensive international media interest likely.<br>Well established and widely held areas of concern in society, including perception of threat to the global environment.<br>Decrease in the availability or quality of a resource to the extent of affecting over 5+ years the wellbeing of the persons utilising that resource e.g. loss off fishing access or recreational use.<br>Potential major effect on human health. |

# 5 ASSESSMENT OF IMPACTS

## 5.1 INTRODUCTION

As described in Section 4.2, the potential environmental and social impacts of the proposed operations were identified using a scoping matrix to evaluate interaction of planned and unplanned activities with the environmental and social receptors. An overview of the key aspects and impacts and potential significance for the proposed operation are provided in Table 5-1. This forms the basis for the assessment of impacts discussed in the subsequent sections.

Table 5-1: Potential Aspects and Impacts

| | Atmosphere | Benthos | Fish/Shellfish | Birds | Marine Mammals | Conservation Sites | Commercial Fisheries/ other users of the sea | Shipping (Traffic) | Water / land contamination | Onshore Communities |
|---|---|---|---|---|---|---|---|---|---|---|
| Physical presence (HLV, support vessels) | | M | L | | | M | L | VL | | |
| Energy use/Atmospheric emissions (Offshore and onshore) | VL | | | | | VL | | | | VL |
| Noise generation (underwater noise) | | | L | | L | | | | | |
| Accidental Events (Collisions/spills/dropped objects) | | L | | L | | L | L | L | L | VL |
| Waste generation (Offshore and onshore) | | | | | | | | | L | L |

## 5.2 SEABED DISTURBANCE AND IMPACTS TO CONSERVATION FEATURES

### 5.2.1 Overview of seabed impacts

The Leman BH decommissioning activities have the potential to impact the benthic environment in the following ways:

Direct physical disturbance by:

- HLV anchor and anchor lines (Sections 5.2.2);
- Removal of the BH jacket (Section 5.2.2);

Indirect impacts caused by:

- The re-suspension of sediments caused by the direct physical disturbance (Section 5.2.5);
- The re-deposit of sediment from the jacket footings at the sea surface (Section 5.2.5).

### 5.2.2 Seabed footprint of project

A moored HLV will be used to lift the BH jacket and topsides (Section 2.3.3). As it is uncertain which HLV will be used, this impact assessment accounts for the following two potential scenarios:

(1) Small moored HLV (Sheerleg) (Base Case)
(2) Large moored HLV (Worst case)

In either case, the HLV will be located immediately next to the Leman BH platform in two positions – a working position close to the platform, and a stand-off position. The final position of the HLV will be determined in consultation with the selected HLV contractor. To maintain position during the lifting operations, the vessel will use either a 4 or 12 anchor mooring spread, depending on the HLV selected.

When the anchor pattern is initially laid out, it is expected that each anchor will be dragged for some distance before it is finally set. When the HLV moves between its stand-off and working position, it will do so within this fixed anchor pattern. The anchor locations will not change but the anchor wires will move. It is assumed that when a HLV moves within its anchor pattern, the wires will drag across the seabed causing direct physical disturbance to the seabed as well as sediment re-suspension and settlement. There will also be physical seabed disturbance caused by the removal of the jacket.

The seabed footprints for each of these scenarios are described below followed by an assessment of the potential impacts to the seabed, benthic communities and the conservation features of the North Norfolk Sandbanks and Saturn Reef SCI.

### SHEERLEG HLV (BASE CASE)

Small moored HLV (Sheerleg) will require four anchors to maintain its position. The proposed anchor configuration for the Sheerleg HLV has yet to be determined. The four anchors could potentially be aligned anywhere within the 850 m radius of the Leman BH platform as shown in Figure 5 1. For assessment of the worst-case scenario, one of the anchors (anchor No.3) was hypothetically positioned to impact the delineated Sabellaria area S11 to the south-south-west of the Leman BH (Figure 5 1). The remaining three anchors were positioned at 90° and 180° angles to this 'worst-case' anchor 3.

The footprint assessment of the deployment of the Sheerleg HLV for the lifting operations is based on the following assumptions:

- A mooring configuration of four anchors;
- The HLV will be located immediately to the southwest of the Leman BH platform;
- Anchors to be deployed twice. Anchors and anchor wires will be positioned in the same location on each deployment (2 deployments);
- Each anchor is 6 m wide. When the anchor pattern is initially laid out, it is expected that each anchor will be dragged for up to 50 m before it is finally set. Thus, a conservative 10 m x 50 m (500 $m^2$) corridor of disturbance has been assumed for each anchor;
- The anchor wire length of 800 m with 2/3 of the length positioned on the seabed.
- No anchor buoys used;
- The vessel will move 60 m to the southwest between working and stand-off positions;
- The seabed will be swept by anchor wires while the vessel moves between stand-off and working positions;
- Anchor wires 1 and 3 will show very little movement as these have been positioned in line with the movement of the vessel. As such, a seabed disturbance corridor of 10 m has been assumed for these wires;
- The area of physical disturbance by the Sheerleg anchors may also overlap with non-delineated Sabellaria aggregations recorded on pipelines S0407 (ROV2) and S0406 (ROV1) (Section 3.5.1). However, as the anchor wires have to provide a minimum of 10 m clearance over the pipeline, potential disturbance to these sporadic aggregations is highly unlikely and has not been quantified.

A summary of the seabed footprint potentially impacted by each of the Sheerleg HLV anchors and anchor lines is provided in Table 5-2. The indicative worst case anchor alignment for the Sheerleg HLV could potentially impact 30,341 $m^2$ of seabed, of which, only 99 $m^2$ would encroach upon Sabellaria area S11. The actual area of impact from the anchors wires will be dependent on the location of the anchor positions and may vary from the areas indicated in Table 5-2.

Table 5-2: Quantification of the area impacted by the Sheerleg HLV

| Anchor | Anchor wire Disturbance Area (m2) | | Anchor Disturbance Area (m2) | | Total area of disturbed seabed (m2) | Predicted Sabellaria area impacted (m2) |
|---|---|---|---|---|---|---|
| | Area of Seabed | Potential *Sabellaria* disturbance | Area of Seabed | Potential *Sabellaria* disturbance | | |
| 1 | 5,333 | 0 | 500 | 0 | 5,833 | 0 |
| 2 | 8,831 | 0 | 500 | 0 | 9,331 | 0 |
| 3 | 5,333 | 0 | 500 | 99 | 5,833 | 99 |
| 4 | 8,844 | 0 | 500 | 0 | 9,344 | 0 |
| **TOTAL** | **28,341** | **0** | **2,000** | **99** | **30,341** | **99** |

LARGE HLV (WORST CASE)

As with the Sheerleg HLV, the placement of anchors and anchor chains of the large HLV will cause disturbance to the seabed and associated benthic fauna. The impact assessment of the deployment of the large HLV for the lifting operations is based on the following assumptions:

- A mooring configuration of 12 anchors;
- The HLV will be located immediately to the southwest of the Leman BH platform;
- Anchors will be deployed once;
- Each anchor is 6 m wide. When the anchor pattern is initially laid out, it is expected that each anchor will be dragged for up to 50 m before it is finally set. Thus, a conservative 10 m x 50 m (500 $m^2$) corridor of disturbance has been assumed for each anchor (same as Sheerleg HLV);
- The anchor wire length is 1600 m with 2/3 of the length positioned on the seabed;
- No anchor buoys used;
- The vessel will move 150 m north to south between working and stand-off positions;
- The seabed will be swept by anchor wires while the vessel moves between stand-off and working positions.
- The vessel location and anchor positions assumed for the assessment represent a worst case scenario and therefore the area impacted may vary from that shown in Table 5-3 and Figure 5-2.

The indicative worst case impacts from the large HLV show that only three of the twelve anchors may impact on delineated *Sabellaria* aggregations (Figure 5-2; Table 5-3). The total predicted area of seabed disturbance for the anchor pattern is 405,817 $m^2$, of which 5,024 $m^2$ will overlap with the delineated *Sabellaria* aggregations. The areas of seabed and delineated *Sabellaria* patches impacted by the anchors and anchor wires are outlined in Table 5-3 and Figure 5-2.

Table 5-3: Quantification of the area impacted by the Large HLV anchors

| Anchor | Anchor Wire Disturbance Area ($m^2$) | | Anchor Disturbance Area ($m^2$) | | Total area of disturbed seabed ($m^2$) | Predicted Sabellaria area impacted ($m^2$) |
|---|---|---|---|---|---|---|
| | Area of Seabed | Potential *Sabellaria* disturbance | Area of Seabed | Potential *Sabellaria* disturbance | | |
| 1 | 30,573 | 0 | 500 | 0 | 31,073 | 0 |
| 2 | 19,965 | 0 | 500 | 0 | 20,465 | 0 |
| 3 | 4,656 | 0 | 500 | 0 | 5,156 | 0 |
| 4 | 27,451 | 1,203 | 500 | 0 | 27,951 | 1,203 |
| 5 | 45,223 | 2,817 | 500 | 500 | 45,723 | 3,317 |
| 6 | 53,297 | 0 | 500 | 0 | 53,797 | 0 |
| 7 | 46,145 | 0 | 500 | 0 | 46,645 | 0 |
| 8 | 18,214 | 0 | 500 | 0 | 18,714 | 0 |
| 9 | 13,062 | 0 | 500 | 0 | 13,562 | 0 |
| 10 | 37,527 | 0 | 500 | 0 | 38,027 | 0 |
| 11 | 50,645 | 0 | 500 | 0 | 51,145 | 0 |
| 12 | 53,059 | 4 | 500 | 500 | 53,559 | 504 |
| TOTAL | 399,852 | 4,024 | 6,000 | 1,000 | 405,817 | 5,024 |

REMOVAL OF BH JACKET

The four jacket piles will be cut at around 3 m below the seabed. The removal of the jacket and piles will cause localised disturbance to the seabed in the immediate vicinity of the platform legs. In particular the holes left behind following the removal of the four jacket piles, each covering an area of approximately 0.82 $m^2$ per pile (based on a diameter of 1.02 m) will likely naturally back fill with the surrounding sediment leaving four shallow depressions (Table 5-4).

Table 5-4: Quantification of the seabed depressions following removal of Jacket piles

| Jacket pile | Area of seabed depression ($m^2$) | Potential *Sabellaria* disturbance ($m^2$) |
|---|---|---|
| 1 | 0.82 | 0 |
| 2 | 0.82 | 0 |
| 3 | 0.82 | 0 |
| 4 | 0.82 | 0 |
| TOTAL | 3.28 | 0 |

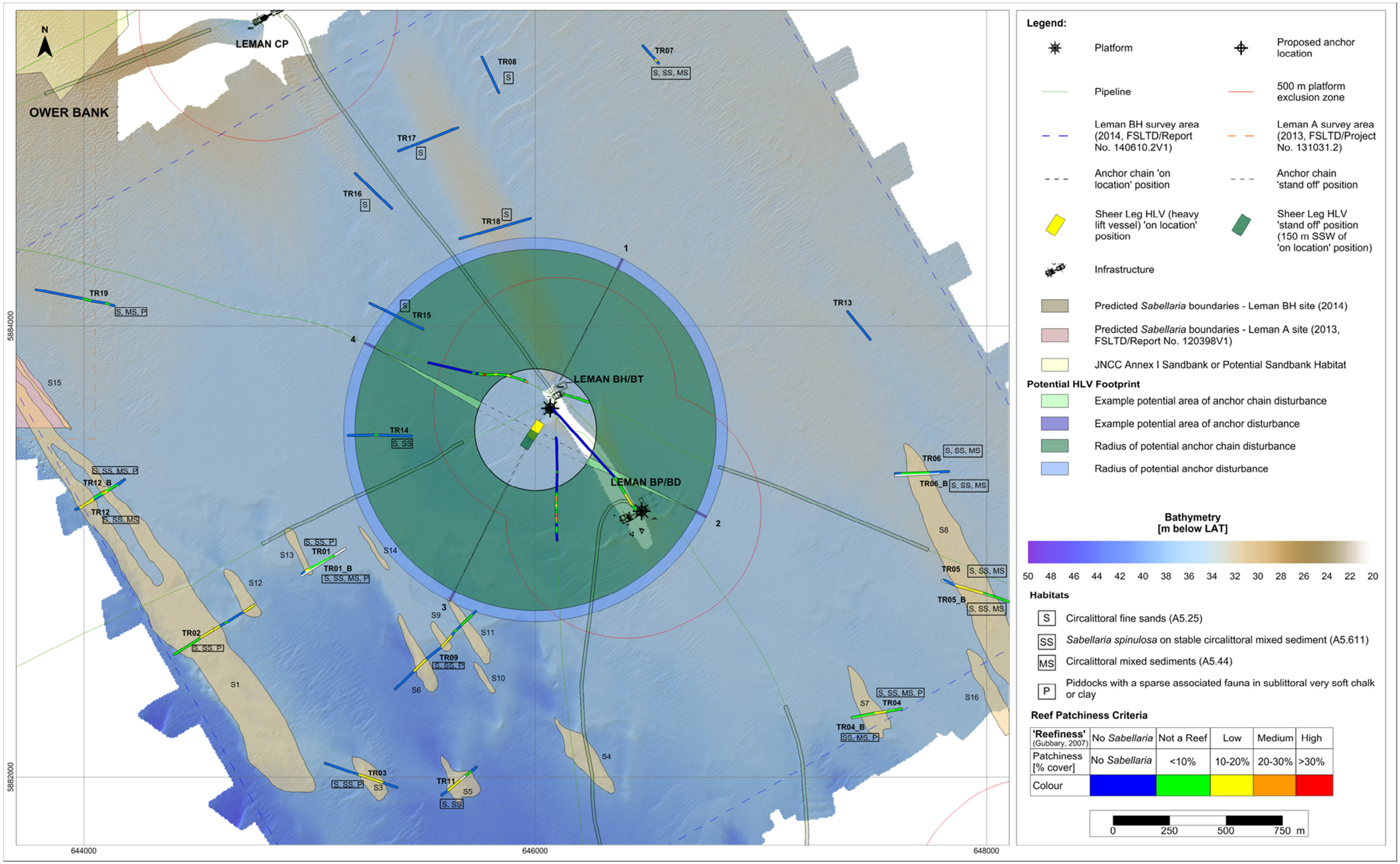
There were no delineated *Sabellaria* areas identified within 500 meters of the platform. Therefore, it is considered very unlikely that the removal of the platform jacket will cause any significant impact to biogenic reef features. Furthermore, the high areas of reflectivity in the immediate vicinity of the Leman BH platform were correlated with scour and debris rather than *Sabellaria* aggregations (Fugro EMU, 2015). Although there remains the potential for *Sabellaria* aggregations to occur in the vicinity of the platform, it is thought unlikely that large aggregations or reef structures will be present in the immediate vicinity of the platform.

While the presence of *Sabellaria* aggregations next to the Leman BH jacket cannot be ruled out, it should be noted that *Sabellaria* reefs, which rely on suspended sand grains to form dense aggregations, are considered unlikely to form on jackets of offshore structures (OGUK, 2013).

The total area of seabed disturbance from the removal of the platform will be very small (<4m$^2$) and, as such, any associated impacts will be highly localised. In addition there is no evidence of conservation features in the immediate vicinity of the jacket legs. Therefore, the seabed disturbance as a result of the removal of the jacket is considered low and not considered further in this EIA.

The direct seabed impacts associated with the HLV anchors and anchor lines will be discussed further in Sections 5.2.3 and 5.2.4 and the indirect impacts associated with the jacket removal are discussed in Section 5.2.5.

Figure 5-1: Area of potential disturbance by a Sheerleg HLV




**Legend:**

- Platform
- Proposed anchor location
- Pipeline
- 500 m platform exclusion zone
- Leman BH survey area (2014, FSLTD/Report No. 140610.2V1)
- Leman A survey area (2013, FSLTD/Project No. 131031.2)
- Anchor chain 'on location' position
- Anchor chain 'stand off' position
- Sheer Leg HLV (heavy lift vessel) 'on location' position
- Sheer Leg HLV 'stand off' position (150 m SSW of 'on location' position)
- Infrastructure
- Predicted *Sabellaria* boundaries - Leman BH site (2014)
- Predicted *Sabellaria* boundaries - Leman A site (2013, FSLTD/Report No. 120398V1)
- JNCC Annex I Sandbank or Potential Sandbank Habitat

**Potential HLV Footprint**

- Example potential area of anchor chain disturbance
- Example potential area of anchor disturbance
- Radius of potential anchor chain disturbance
- Radius of potential anchor disturbance

**Bathymetry [m below LAT]**

50 48 46 44 42 40 38 36 34 32 30 28 26 24 22 20

**Habitats**

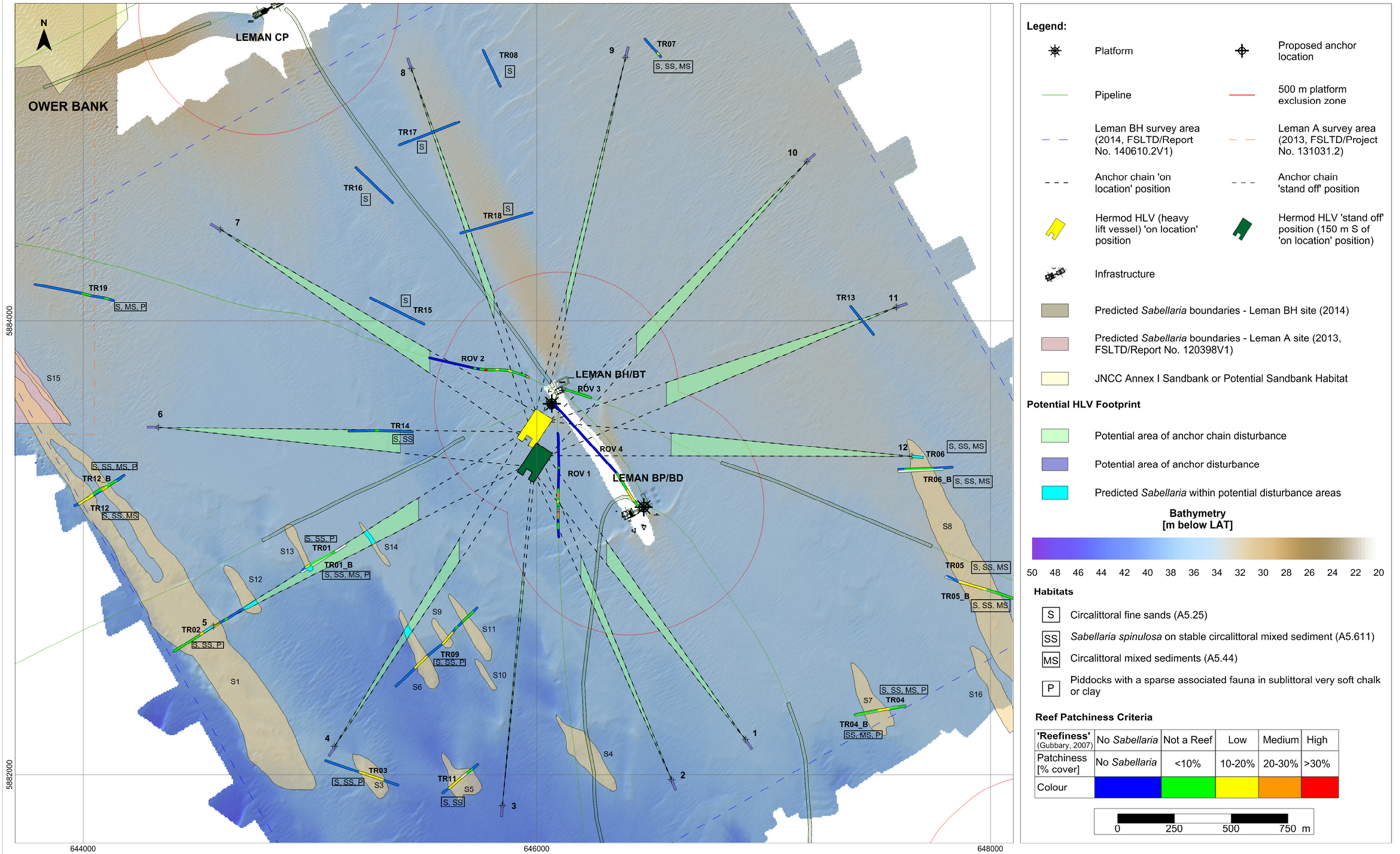
- S — Circalittoral fine sands (A5.25)
- SS — *Sabellaria spinulosa* on stable circalittoral mixed sediment (A5.611)
- MS — Circalittoral mixed sediments (A5.44)
- P — Piddocks with a sparse associated fauna in sublittoral very soft chalk or clay

**Reef Patchiness Criteria**

| **'Reefiness'** (Gubbary, 2007) | No *Sabellaria* | Not a Reef | Low | Medium | High |
|---|---|---|---|---|---|
| Patchiness [% cover] | No *Sabellaria* | <10% | 10-20% | 20-30% | >30% |
| Colour | | | | | |

0 250 500 750 m

Figure 5-2: Area of potential disturbance by a Large HLV




**Legend:**

- Platform
- Proposed anchor location
- Pipeline
- 500 m platform exclusion zone
- Leman BH survey area (2014, FSLTD/Report No. 140610.2V1)
- Leman A survey area (2013, FSLTD/Project No. 131031.2)
- Anchor chain 'on location' position
- Anchor chain 'stand off' position
- Hermod HLV (heavy lift vessel) 'on location' position
- Hermod HLV 'stand off' position (150 m S of 'on location' position)
- Infrastructure
- Predicted *Sabellaria* boundaries - Leman BH site (2014)
- Predicted *Sabellaria* boundaries - Leman A site (2013, FSLTD/Report No. 120398V1)
- JNCC Annex I Sandbank or Potential Sandbank Habitat

**Potential HLV Footprint**

- Potential area of anchor chain disturbance
- Potential area of anchor disturbance
- Predicted *Sabellaria* within potential disturbance areas

**Bathymetry [m below LAT]**

50 48 46 44 42 40 38 36 34 32 30 28 26 24 22 20

**Habitats**

- S — Circalittoral fine sands (A5.25)
- SS — *Sabellaria spinulosa* on stable circalittoral mixed sediment (A5.611)
- MS — Circalittoral mixed sediments (A5.44)
- P — Piddocks with a sparse associated fauna in sublittoral very soft chalk or clay

**Reef Patchiness Criteria**

| **'Reefiness'** (Gubbary, 2007) | No *Sabellaria* | Not a Reef | Low | Medium | High |
|---|---|---|---|---|---|
| Patchiness [% cover] | No *Sabellaria* | <10% | 10-20% | 20-30% | >30% |
| Colour | | | | | |

0 250 500 750 m

### 5.2.3 Impacts to the seabed and benthic fauna

PHYSICAL IMPACTS

The anchors and anchor lines will be present on the seabed for a short duration (up to two weeks), therefore the physical disturbance of seabed scouring by the lines will be temporary. However, the movement of the anchor lines on the seabed is likely to cause temporary scarring which will persist beyond the period of operations. The longevity of the physical scars or depressions in the seabed is dependent on the type and energy of the local benthic environment. Scars in higher energy, sandy or shallow environments, such as those seen at the Leman BH location, may rapidly disappear following initial disturbance as has been observed for similar impacts from trawled fishing gear (Løkkeborg, 2005). Previous survey data at the Leman BH/BT platforms suggest that the depressions left by the jacket piles will disappear within 10 years as there is no evidence of historic depressions immediately to the north of the Leman BT platform where the former Leman BK platform was removed in 1996/97 (Gardline, 2006, Osiris, 2014 and Fugro, 2015).

The area of seabed directly disturbed by the anchors and anchor lines (up to 405,817m$^2$) is considered to be relatively small compared to the surrounding undisturbed seabed in the vicinity of the Leman Field. In addition, given the short period of the proposed operations and the naturally high energy hydrographic conditions present in the area, the physical impacts to the seabed are considered to be of low significance.

However, the physical impact of the anchors and anchor lines have the potential to temporarily modify the habitats found on the seabed and therefore impact the fauna present. The biological impacts arte discussed below.

The physical disturbance to the seabed also has the potential to cause an increase in the suspended sediments in the water column. The indirect impact resulting of sediment resuspension is discussed in Section 5.2.5.

BIOLOGICAL IMPACTS

The most frequently encountered biotope during the habitat survey was "Circalittoral fine sand". The fauna in this biotope is dominated by infaunal amphipods and polychaetes which are typical of mobile sandy sediments and are resistant to the type of seabed disturbance that would be caused by the proposed operations.

The epifaunal abundance across most of area was relatively low. However, epifaunal abundance increased to the southeast and southwest of the Leman BH platform, where the seabed deepened and a more heterogeneous mixed sediment was encountered (Fugro EMU, 2015). Associated with these areas of mixed sediment were aggregations of *Sabellaria*. In areas with a higher proportion of *Sabellaria*, the biotope "*Sabellaria spinulosa* on stable circalittoral mixed sediments" was observed. These areas had the greatest abundance of epifauna identified during the Leman BH habitat assessment. The fauna associated with *Sabellaria* included various echinoderms, hermit crabs (Paguroidea), flatfish (pleuronectiformes) and hydroids.

Although many mobile species found in the area such as the larger crustaceans and flatfish will be able to move away from the disturbance, slow moving epifauna such as echinoderms and sessile epifauna including any *Sabellaria* aggregations within the immediate vicinity of the anchor footprint will be directly impacted. As such, the impacts of the anchor and anchor lines may incur mortality and some limited modification of the habitats.

Due to the heterogeneity of the sediments in the area, the type of fauna impacted by the proposed operations will vary between areas. The most common seabed habitat in the Leman Field comprises unconsolidated mobile sands which are dominated by faunal species resilient to seabed disturbance. Furthermore, there are large areas of relatively undisturbed seabed habitat adjacent to the impacted area which will facilitate the re-colonisation and recovery processes. Therefore, the biological impact to areas of sandy seabed directly disturbed by the proposed operations is expected to be minor with a very good chance of biological recovery following the platform removal.

The impacts to more sensitive habitats such as *Sabellaria* reef, have been assessed in more detail (Section 5.2.4).

### 5.2.4 Impacts to conservation features

The conservation objectives of the North Norfolk Sandbanks and Saturn Reef SCI are to restore the Annex I Sandbanks which are slightly covered by seawater all the time and the Annex I Reef to Favourable Condition (JNCC, 2012b). The potential for the Leman BH project activities to impact the SCI conservation objectives and other Features Of Conservation Interest (FOCI) are discussed below.

IMPACTS TO ANNEX I SANDBANKS

The worst case scenario anchor and anchor lines are not expected to overlap any Sandbank features which fall within the classification criteria for Annex I habitat 'sandbanks which are slightly covered by seawater'. The nearest delineated Sandbank area is the Ower sandbank situated approximately 2.5 km to the North east of the BH platform. Therefore the proposed operations are not considered to have any impacts to the conservation objectives associated with Annex 1 Sandbanks.

IMPACTS TO ANNEX I BIOGENIC REEF

*Sabellaria* reefs and associated biological communities have been assessed to be moderately sensitive to physical disturbance or abrasion (JNCC, 2012a). This type of disturbance is generally associated with demersal trawling gear but it is also the primary disturbance expected to result from the temporary deployment of the HLV anchors.

This section discusses vulnerability of *Sabellaria* to physical disturbance and considers the impacts to the delineated *Sabellaria* areas for each of the HLV anchoring scenarios and in the wider context of the SCI area.

Sheerleg HLV

The deployment of the Sheerleg HLV anchors has the potential to impact approximately 99 $m^2$ (0.7%) of predicted *Sabellaria* area S11 (Table 5-5; Figure 5-1). The ground-truthing at the S11 area showed that it had <10% patchiness (not a reef) and low elevation (2 to 5 cm).

Table 5-5: *Sabellaria* patches potentially impacted by Sheerleg HLV anchors and anchor lines

| *Sabellaria* Patch | Area of delineated *Sabellaria* ($m^2$) | Potential Area impacted ($m^2$) | % of Delineated patch impacted |
|---|---|---|---|
| S11 | 13,780 | 99 | 0.7 |

Source: Fugro EMU, 2015

The radius of potential impact of the Sheerleg HLV also falls within areas where *Sabellaria* aggregations were identified along pipeline ROV survey transects ROV 1 and ROV 2 (Table 3-7). The aggregations showed variable patchiness and elevation, the majority formed low-lying crusts <2cm high (not a reef), although larger aggregations with low to high (>10cm) elevation were also observed. Only five discrete patches were observed to have moderate to high elevation and/or patchiness, the longest of which was 18 m long. All of the aggregations observed along the ROV transects were confined to the raised elevation associated with the buried pipelines. It should be borne in mind that the HLV anchor configuration will be set up to ensure that pipelines and other subsea infrastructure are avoided, therefore the *Sabellaria* aggregations associated with the pipelines are unlikely to be directly disturbed by the Sheerleg HLV anchors.

Away from the pipelines *Sabellaria* abundance was expected to be similar to background levels across the site, with small isolated colonies of <2cm in height, although this cannot be confirmed without extensive ground-truthing data (Fugro EMU, 2015). The high resolution geophysical data showed areas of high reflectivity within 500 m of the platform. These areas were correlated with anthropogenic disturbance rather than *Sabellaria* aggregations (Fugro EMU, 2015; OSIRIS, 2014; Subsea 7, 2012, 2013).

While there is a potential for some impact to *Sabellaria* aggregations as a result of the deployment of the Sheerleg HLV, these are expected to be limited to small isolated colonies rather than reef structures. Therefore, the potential impact to biogenic reef resulting from the Sheerleg HLV anchor and anchor wires is expected to be very low.

### Large HLV (Worst Case)

The areas of potential delineated *Sabellaria* reef which may be impacted by the worst case anchor placement are outlined in Table 5-6 below. The total predicted area of seabed disturbance for the large HLV anchor pattern is 405,817 $m^2$ of which, 5,024 $m^2$ will overlap delineated *Sabellaria* aggregations. Details of each of the potentially impacted *Sabellaria* areas are shown in Table 5-6.

**Table 5-6: Sabellaria patches potentially impacted by Large HLV**

| Delineated Sabellaria Patch | Area of delineated *Sabellaria* patch ($m^2$) | Area of *Sabellaria* impacted ($m^2$) | % of Delineated patch impacted** |
|---|---|---|---|
| S1/P9 | 870,950* | 555 | 0.06 |
| S6 | 17,250 | 1,203 | 6.97 |
| S8 | 152,190 | 504 | 0.33 |
| S12 | 13,360 | 1,039 | 7.77 |
| S13 | 7,157 | 508 | 7.10 |
| S14 | 3,944 | 1,215 | 30.81 |
| Total | - | 5,024 | - |

* Patch S1/P9 is a combined area noted from the Leman A and Leman BH geophysical surveys.

**the % of total Sabellaria in SCI is provided in Table 5-7.

Sources: Fugro EMU, 2015; Fugro, 2013

At 870,950 $m^2$, the combined *Sabellaria* area S1/P9 is the largest continuous area of predicted reef in the Leman Field. However, this area is highly variable in the quality of the reef structures present. The survey data indicates that the S1/P9 *Sabellaria* area may have a more stable, high quality reef to the north, out-with the area of the proposed anchor disturbance. The areas of reef impacted by the proposed worst case anchor pattern are more like to be of 'low' to 'medium' quality in terms of elevation and patchiness (Fugro EMU, 2015). Furthermore, the impact to the patch S1/P9 amounts to 555 $m^2$ which is only 0.06%, of the total combined S1/P9 area. As such, the extent of the impact to Area S1/P9 area is considered to be very minor.

The anchors may also potentially cross five other delineated *Sabellaria* areas (S6, S8, S12, S13 and S14). The ground-truthing data show that the aggregations present in these areas range from 'not a reef' to 'low' quality with regards to elevation and patchiness and in the case of S14, also 'low' in terms of area coverage.

None of the potentially impacted areas (with the exception of the combined S1/P9 area from the 2014 survey) have been assessed to represent 'high' quality reef in terms of area coverage, elevation or patchiness. Despite this, it should be considered that aggregations within these areas all have the potential to form significant reefs over time, given the apparent suitability of this particular location for the formation *Sabellaria* reef structures.

### Area Impacted in the context of the SCI

The area of delineated *Sabellaria* impacted compared with the predicted *Sabellaria* presence in the Leman Field and the wider SCI is presented in Table 5-7.

The total area of delineated Sabellaria aggregations identified from the Habitat Assessments undertaken at Leman BH and Leman A was 1,740,340 $m^2$, of which, only 5,024 $m^2$ (0.29%) would be potentially directly impacted by the worst case anchor placement (Table 5 7). Furthermore, those areas disturbed within the delineated area have been assessed to be mainly of 'low' reef quality with only small areas of 'medium' reef quality with regards to the elevation and patchiness. As there will be a large proportion of the predicted Sabellaria area remaining out-with the 'worst case' project footprint (99.7%), the project activities will not cause any irreparable damage or removal of potential reef features.

The deployment of the Sheerleg HLV (base case) has the potential to impact up to 0.0008% of the total delineated *Sabellaria* within the North Norfolk Sandbanks and Saturn Reef SCI.

The associated impact of a large HLV to the predicted *Sabellaria* reef is also expected to be very small when compared to the wider SCI (0.04%). While there will be some disturbance to discrete *Sabellaria* aggregations, only a very small proportion of these will be impacted by the worst case scenario for anchor and anchor lines.

Table 5-7: Estimated impact to *Sabellaria* areas within SCI

| HLV Type | Area of delineated *Sabellaria* impacted ($m^2$) | Total *Sabellaria* Area in Leman Field ($m^2$) | % of Sabellaria area impacted in Leman Field | Total *Sabellaria* Area In SCI ($m^2$) | % of *Sabellaria* area In SCI |
|---|---|---|---|---|---|
| Sheerleg HLV (Base Case) | 99 | 1,740,340 | 0.006 | 12,530,000* | 0.0008 |
| Large HLV (Worst Case) | 5,024 | | 0.29 | | 0.040 |
| * based on the total JNCC *Sabellaria* area inside the North Norfolk and Saturn Reef SCI of10.57 $km^2$ (Elwood, 2013) in combination with the total known *Sabellaria* within the SCI identified from project data (1.96 $km^2$) (See Table 5-9) | | | | | |

### Vulnerability of *Sabellaria* to seabed disturbance

Jackson and Hiscock (2008) suggest that *Sabellaria* has an 'intermediate' tolerance to abrasion and physical disturbance but a 'high' ability to recover from such disturbances. This view is supported by observations of *Sabellaria* aggregations in areas subject to disturbance (such as wave action). The ability to recolonize following disturbance is achieved through high recruitment rates and an ability to settle rapidly on new substrates (Jackson & Hiscock, 2008; OSPAR, 2013). For example, areas damaged during winter storms have been seen to be re-colonised over the following summer (Jackson & Hiscock, 2008). Similarly, *Sabellaria* have been shown to have good recovery potential having been observed to colonise a dredge site within 6 months of cessation of extraction activities (Pearce et al, 2013).

There is evidence to suggest that the main spawning event for *Sabellaria* occurs around February with likely colonization between February and April and a secondary spawning event occurring at the beginning of winter (Pearce et al., 2011a). Therefore, the proposed lifting activities, which are planned for summer 2016, will occur outside the main spawning period, thus avoiding the time of peak larval abundance and its settlement.

Pearce et al. (2011a) suggest that disturbance may trigger the spawning of *Sabellaria*, which would indicate another adaptation to physical disturbance. Another study on large reefs goes further still by suggesting that the ecological functions and ecosystem services provided by *Sabellaria* reefs such as a shelter for other species, a feeding resource, or a seabed stabiliser, are unaffected by anthropogenic disturbance unless the reefs are irreparably damaged or removed (Pearce et al. 2011b).

### IMPACTS TO UK BAP /FOCI

As described in Section 3.4.2, the UK BAP priority habitat, piddock-bored chalk and clay, was possibly present in the area, although the results were not conclusive. The transects where these habitats may have been observed included TR01, TR02 and TR09, which are all within or close to the worst case HLV footprint (anchors 4 and 5). If present, these habitats could be potentially disturbed by the large HLV. As the survey data on the presence and distribution of this habitat was inconclusive, the possible impact is difficult to quantify other than to acknowledge that it may occur. Given the relatively small area affected and the short term, localised disturbance that may occur, any potential impact to these features, if present, is expected to be minor.

### 5.2.5 Indirect Impacts From re-suspension and re-deposition of sediment

It is expected that the Leman BH removal activities will result in sediment re-suspension and re-settlement around the edges of the project footprint. These indirect impacts are expected to occur from the following two activities:

- The re-suspension of sediments caused by anchor deployment and jacket removal.
- The re-deposition of sediment from the jacket piles at the sea surface (See section 2.3.4);

These operations have the potential to increase suspended sediments in the water column and smother benthos.

The sediment in the area of the Leman BH is expected to comprise mainly medium sand and shell fragments, similar to that found at Leman C. As there have been no historic drilling activities at the Leman BH/BT complex, the contaminant concentrations within the sediments are expected to be similar to background concentrations for the Southern North Sea. The sediment encountered within the Leman BH jacket footings/piles is anticipated to have the same characteristics as the surrounding seabed.

The sediment which was forced into each of the four piles during jacket installation, estimated to be approximately 2.5 $m^3$ for each pile and totalling 10 $m^3$, will be dredged and released at the sea surface to allow access for the cutting tool. The release of sediments will produce a plume of mixed sediments in the water column with the larger material falling to the seabed much more rapidly (usually within a few hundred metres) than finer-grained material. Given the expected composition of the material released (medium sand), the majority of the suspended sediments will be expected to settle within approximately 1 km of the project location (Gubbay, 2003).

The Leman BH/BT platform complex is situated in a high energy environment which is naturally subject to wave action and a high sediment load, therefore the impact of increased suspended material is expected to be very minor. *Sabellaria* relies on suspended particles to aid tube growth and can retract inside the tubes to protect their sensitive respiratory and feeding apparatus. As a consequence, *Sabellaria* is tolerant to smothering and increased suspended sediment (Jackson and Hiscock, 2008). This is evident from observations of thriving *Sabellaria* aggregations in close proximity to ongoing aggregate extraction operations where the increase in suspended sediments is considerably higher than those expected at the Leman BH (Pearce *et al.* 2007, 2011). In addition, the dominant infaunal species, such as polychaetes and amphipod crustaceans, are also resistant to smothering by re-suspended sediments and if buried, will work their way to the seabed surface, simultaneously re-working the re-settled sediments.

In addition the period of proposed operations coincides with the period of high intensity spawning of mackerel which is recognised as a UKBAP priority species. Mackerel spawn in the water column and are therefore unlikely to be impacted by direct seabed disturbance but may be impacted by increased suspended sediments in the water column through abrasion, clogging of gills and preventing development of eggs and larvae (Birtwell, 1999). However, it should be considered that the area which will be affected is extremely small in relation to the wider area available for mackerel spawning. Thus, it is expected that spawning mackerel will easily be able to avoid the area. Furthermore, given that the proposed operations are relatively short in duration and only partially overlap the mackerel spawning period, it is considered unlikely that large numbers of spawning mackerel will be present in the area during operations. Therefore, the potential impacts to mackerel are considered to be negligible.

The release of 10 $m^3$ of sediment from the sea surface is expected to settle quickly and the resulting impact is expected to be limited to the area around the platform. Similarly, the impacts associated with the re-suspension of sediments from physical disturbance will be short in duration and limited in spatial extent. Therefore, the impacts resulting from the re-suspension of sediments during sediment re-deposit, anchoring and lifting activities are considered very low.

### 5.2.6 Summary of seabed disturbance impact assessment

While the whole anchor footprint lies within the North Norfolk Sandbanks and Saturn Reef SCI, It has been assessed that the conservation objectives for biogenic reefs will not be affected by the proposed works. There will be no permanent physical loss of habitat associated with the proposed activities and the identified *Sabellaria* areas will main relatively undisturbed by the anchoring operations at BH (for both the base case and worst case). Therefore, following the removal of the anchors, rapid recovery and recolonization is expected. The potential impacts to *Sabellaria* reef from either of the two scenarios considered are limited in extent and the direct impacts will be temporary (approximately11 days). Furthermore, the *Sabellaria* aggregations which will be potentially impacted are of low reef quality.

In summary, it has been assessed that the proposed Leman BH operations will not significantly affect the extent, structure, integrity, quality, and ecosystem services provided by the *Sabellaria* aggregations identified within the wider Leman area or the Ower sandbank.

The cumulative impacts of other offshore operations on the conservation objectives are discussed in Section 5.9.2.

Overall, the direct seabed disturbance from the proposed operations is considered to be low. The seabed disturbance resulting from the removal of the BH Jacket piles and the secondary impacts of sediment re-suspension and re-deposition have been assessed to be negligible.

### 5.2.7 Mitigation measures

As discussed, the removal of the BH platform and jacket is most likely to be undertaken by the Sheerleg HLV which will have a much-reduced (>13 times) direct seabed impact than a Large HLV. The locations of the potential *Sabellaria* areas denoted from the survey data will be used to optimise the anchor configuration so as to minimise the impacts to biogenic reefs. It is anticipated that there will be a wide area of seabed available for anchor deployment options which do not have *Sabellaria* aggregations. Where possible, Shell will aim to deploy the anchors of the Sheerleg HLV at the same locations on both anchoring occurrences to minimise the disturbance.

It is also worth noting that some of the anchor lines which will be crossing live pipelines will have midline buoys. Therefore the anchor wire disturbance will in fact be less than is presented in Figure 5-1. This would further reduce the potential impact to the *Sabellaria* aggregations. Finally, should a large HLV be chosen to undertake the works, it is likely that there would only be a single anchor deployment rather than the two for the Sheerleg HLV, although as discussed in Section 2.2.3, it is unlikely that a large HLV will be selected.

The removal of the Leman BH platform (and BT refurbishment) will reduce the overall infrastructure footprint in the SCI and will also result in less maintenance work and associated anchoring operations. This will increase the chances of *Sabellaria* recovery and restoration of the habitat in the longer term.

## 5.3 ENERGY USE/ATMOSPHERIC EMMISSIONS

### 5.3.1 Impact assessment

Atmospheric emissions will be produced as a result of the fuel consumed by offshore vessels for lifting, transportation, anchor handling and guarding. The main environmental effects of the emission of gases to the atmosphere are:

- Direct or indirect contribution to global warming (CO, $CO_2$, $CH_4$ and $N_20$); and
- Contribution to photochemical pollutant formation, local air pollution and acid rain ($NO_x$, $SO_x$, VOCs).

An overview of the atmospheric emissions based on using a large HLV during the proposed decommissioning operations is presented in Table 5-8 below.

Diesel consumption of the HLV is estimated to be around 30 tonnes per day when on location. The maximum total consumption for the HLV, including the transit to and from the shore (assuming maximum transit times of 13 days) is approximately 980 tonnes of diesel. This is a conservative estimate as this fuel consumption is based on the largest potential HLV that could be considered for the proposed operations. There will also be atmospheric emissions from the guard vessel, anchor handling vessel and the tugs for towing the transport barges. The total emissions from the proposed offshore operations are quantified in Table 5-8 below. The calculations are made according to IoP (2000) guidance.

**Table 5-8: Estimated vessel use, fuel use and gaseous emissions**

| | | | HLV | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Diesel Conversion Factors (tonne/gas per tonne/ fuel) | Transit | Working On Site | Anchor Handling Vessel | Guard Vessel | Tugs for Towing Transport barges | Total Emissions (Tonnes) |
| Total Number of days | | | 13 | 11 | 6 | 11 | 6 | |
| Daily diesel consumption (Tonnes/day) | | | 50 | 30 | 15 | 3 | 15 | |
| Total diesel Consumption (Tonnes) | | | 650 | 330 | 90 | 33 | 90 | |
| Emissions (Tonnes) | $CO_2$ | *3.2* | 2080 | 1056 | 288 | 105.60 | 90.00 | 3,619.6 |
| | CO | *0.008* | 5.20 | 2.64 | 0.72 | 0.26 | 0.72 | 9.54 |
| | NOx | *0.059* | 38.35 | 19.47 | 5.31 | 1.95 | 5.31 | 70.39 |
| | $N_2O$ | *0.00022* | 0.14 | 0.07 | 0.02 | 0.01 | 0.02 | 0.26 |
| | $SO_2$ | *0.004* | 2.60 | 1.32 | 0.36 | 0.13 | 0.36 | 4.77 |
| | $CH_4$ | *0.0002* | 0.13 | 0.07 | 0.02 | 0.01 | 0.02 | 0.25 |
| | VOC | *0.002* | 1.30 | 0.66 | 0.18 | 0.07 | 0.18 | 2.39 |
| 2013 UK offshore oil and gas exploration and production related emissions | | | | | | | | 5,000,000 |
| Total project $CO_2$ emissions as % of 2013 UK offshore oil and gas emissions | | | | | | | | 0.072 |

Emissions from the HLV and associated vessels may result in slight short term reduction of the air quality in the immediate vicinity of the operations. Up to 3,620 tonnes of $CO_2$ will be emitted to the atmosphere during the operations. This would be equivalent to about 0.072% of the total $CO_2$ emissions generated by UK oil and gas related activities (excluding flaring and venting) in 2013 (UK Government, 2015a). Therefore, the contribution to the worldwide levels of atmospheric emissions is negligible. In addition, due to the exposed and generally windy conditions offshore, the gaseous emissions would disperse rapidly after release, ensuring there was no local cumulative effect of pollutants. Therefore the environmental impact of associated atmospheric emissions is considered to be very low.

There will also potentially be an increase in atmospheric emissions from the onshore dismantling processing operations. The energy and associated emissions generated by cutting operations are considered to be relatively low, as indicated in the Institute of Petroleum Guidance (IoP, 2000).

Dismantling the BH topsides and steel jacket will involve the use of diesel-powered construction equipment and generators. The atmospheric emissions generated from the dismantling yard are expected to be within the same range as that of regular operations at the site. However, if the operations are undertaken from a

new location which has not previously been used for decommissioning, then there may potentially be an associated short term increase in atmospheric emissions above the normal background levels for the area. In Shell will ensure that any atmospheric emissions would be within the permitted levels for the yard. Due to the relatively small scale of the proposed decommissioning operations any increase is expected to be minor. The receiving dismantling site will have in place the relevant environmental permits to manage emissions and this will be verified by Shell before material begins transportation to the selected waste yard.

Although Shell recognises that the onshore processing of decommissioning materials will result in increased atmospheric emissions, the impact from these is expected to be very low. Furthermore, the majority of the waste materials processed onshore, including all the steel, will be recycled which typically requires less energy and produces less atmospheric emissions, than the new manufacture of such materials (IoP, 2000).

### 5.3.2 Mitigation

All vessel movements will be optimized. All engines, generators and other combustion plant on the vessels will be maintained and correctly operated to ensure that they were working as efficiently as possible to minimise emissions. To minimise the time required offshore, the topsides and jacket will each be removed with a single lift. The design of the removal programme will ensure that the time between the various lifting activities is reduced as far as is practicable to minimise total HLV time offshore. The HLV transit time is a major factor in the amount of emissions generated. The intention of the project is to select a dismantling location close to the Leman BH location (e.g. Great Yarmouth), if possible, which will optimise time, reduce fuel consumption and the associated emissions.

## 5.4 UNDERWATER NOISE

### 5.4.1 Impact Assessment

Noise generation will arise from a number of project activities including vessel movements and abrasive cutting operations, all of which, either cumulatively or independently, have the potential to impact marine mammals in the vicinity of the proposed operations. A variety of vessels will be used during the proposed decommissioning activities (e.g., HLV, tugs, anchor handling vessels and guard vessels). Every vessel has a unique noise signature, which changes with ship speed and the load being carried.

Of these sound sources, the underwater noise produced by the HLV itself is expected to be the most prominent sound source throughout the decommissioning operations. The average underwater sound levels produced by the HLV, which is expected to be equivalent to a moderate to large commercial vessel, will be up to around 180 dB re 1µPa-m (Richardson *et al*, 1995).

Underwater abrasive jet cutting will also be undertaken which will emit sound at a different frequency and level to the HLV. However the noise from cutting will be very short in duration and localised. Moreover, the jet cutting will be undertaken approximately 3m below the seabed, therefore the output of this sound source will be absorbed to a large extent by the seabed rather than being directly emitted through the water column.

Southall *et al* (2007) attempted to develop a set of injury thresholds for individual marine mammals exposed to discrete noise events. These criteria aim to set threshold values above which the continual exposure to significant sound levels, or brief sound pulses with extremely high noise levels, could create permanent hearing impairment in marine mammals. For the type of non-pulse underwater noise generated by the HLV and other associated vessels, the sound pressure level to elicit temporary hearing loss (Temporary Threshold Shift, (TTS)), was set at 224 dB re 1µPa for cetaceans, and at 212 dB re 1µPa for pinnipeds (Southall *et al*, 2007). Bearing in mind the range of underwater sound produced by the HLV (i.e. 160-190 dB re 1µPa-m), it seems very unlikely that the proposed operations could cause auditory damage to either cetaceans or pinnipeds.

The proposed operations may evoke some behavioural responses, especially in small cetaceans, which rely on sound for echolocation as well as communication. The noise generated by vessels can cause significant elevation of ambient noise over a broad frequency (Hermannsen *et al*, 2014). Therefore, there is the

potential to cause acoustic masking; a decreased ability for the species to detect signals due to the increased background noise.

The cetacean species most likely to be present in the area is the harbour porpoise. This species is regarded as a high frequency species with an auditory band-with of approximately 200 Hz to 180 kHz (Southall *et al*, 2007). The frequency of the sound emitted by the HLV is expected to be mainly within the 100 Hz – 15 kHz range (Hunt, 2007) which partially overlaps the lower hearing range of the harbour porpoise. However, it should be considered that harbour porpoise has its most sensitive hearing between 80 and 140 kHz, therefore, the potential impact as a result of masking is expected to be minor. Furthermore, given the short duration of the noise, any impacts are expected to be limited to small changes in the behaviour of individual animals such as avoidance in the immediate vicinity of the HLV. The potential for in-combination effects of sound emissions from other vessels and activities in the Leman Field has also been considered. The combination of these sources has the potential to increase the level of disturbance to any marine mammals in the vicinity of the operations but it is not expected that these will be significant given the short duration of the proposed operations.

Overall, given the temporary nature of the operations and the relatively low numbers of cetaceans and seals expected to be present in the area during the proposed operations, the significance of the potential impacts are considered to be low.

### 5.4.2 Mitigation

The HLV time offshore will be limited to a maximum of approximately 24 days, of which around 11 days will be on location at the Leman BH/BT complex, thus the noise generated during decommissioning will be very limited in duration. Furthermore, the selection of an anchored HLV will ensure that less noise is generated than by an HLV held in position using dynamic positioning (DP). As the associated impact is considered to be low, no further mitigation has been considered.

## 5.5 ACCIDENTAL EVENTS

Accidental events that may arise during the Leman BH Decommissioning Project which have been considered in this EIA were vessel collisions, hydrocarbon and chemical spills and dropped objects.

### 5.5.1 Vessel Collision

Throughout decommissioning activities there will be an increase in the number of vessels operating in the Project area. This could result in loss of access to the area for other vessels and an increase in the risk of vessel collisions. The impacts to shipping and navigation are discussed separately in Section 5.7.

The Project site is located within Block 49/26, which has a high level of shipping activity. However as discussed in Section 3.6.3.1, shipping intensity is concentrated in well-defined shipping lanes out with the Leman Field system.

The presence of installations in and around the Leman complex, together with shallows due to sandbanks, means that merchant vessels tend to avoid the Leman complex location (Anatec, 2013). A vessel collision risk assessment has been carried out for the Leman BH/BT facility (Anatec, 2005). In general, the collision frequency (powered and drifting combined) for the Leman BH and BT platforms was assessed to be very low. Fishing vessels were shown to be at a higher collision risk than merchant vessels (0.00014 per year) whereas infield vessels had the highest risk of collision (0.0005 per year). The nearest shipping lane is situated approximately 1.8 km to the southwest of the Leman BH platform. It runs between Leman/Camelot to Great Yarmouth and is used by around 130 vessels per year. As such, it is expected that there will be ample room around the platform to allow safe navigation for infield oil and gas vessels as well as commercial and fishing traffic. Standard methods of communication will be used to notify shipping of activity at the BH/BT installation through the Notices to Mariners system via the UKHO.

In conclusion, given the relatively short duration of the lifting operations and the relatively low vessel traffic in the immediate area, the risk of a vessel collision is considered to be very low. It should be borne in mind that following the removal of the Leman BH platform and BT upgrades, the overall infield vessel traffic and collision risk in general will be reduced as there will be fewer physical obstructions.

### 5.5.2 Hydrocarbon or chemical spills

The risk of an accidental release of hydrocarbons to sea is often one of the main environmental concerns associated with the offshore oil and gas industry. Oil spills at sea can have a number of environmental and economic impacts, the most conspicuous of which are on seabirds and coastal areas. The actual impacts of oil spills depend on many factors, including the location of the spill, volume and type of hydrocarbon spilled, the sea and weather conditions at the time of the spill, and the oil spill response.

The Leman BH platform does not have any production equipment nor has it ever been used to store hydrocarbons. As such the platform will contain only minimal quantities of hydrocarbons on the topsides. As there are no wells in the immediate area and the pipelines are gas lines rather than condensate lines, the main source of potential hydrocarbon spill would be from the fuel inventories associated with vessels and is likely to consist of marine diesel. The main causes of such a spill during the Leman BH decommissioning would be incidents such as vessel grounding, collision or explosion. Based on historical evidence, the probability of a complete loss of a fuel inventory from an offshore vessel is extremely remote. It should be noted that there are no chemicals anticipated to be used during the decommissioning operations and there is no hydrocarbon inventory on board the Leman BH platform.

The vessel selected for the proposed operations is anticipated to have a maximum diesel inventory of 450 $m^3$ which is considerably smaller than the largest diesel inventory covered under the Leman Field OPEP (2695 $m^3$). Diesel is generally lighter and less persistent in the marine environment than many other anthropogenic hydrocarbons such as crude oil although diesel has a relatively higher toxic component. However, the lighter, more toxic fractions of diesel oil are the ones which most readily evaporate and become dispersed, diluted and degraded in the water column. The non-persistent nature of diesel is reflected in the worst case spill trajectory modelling, based on an instant release of 2695 $m^3$ at the Leman field, which shows that such a spill would not reach the UK or continental shoreline or the UK/Netherlands boundary line. Seabird vulnerability to oil spills in UKCS Block 49/26 ranges from low to medium during the planned period of operations and is low overall (Table 3-4) (JNCC, 1999). Given the relatively short time that the HLV will be offshore (up to 24 days), the risk of a hydrocarbon spill during the proposed decommissioning operations is considered to be low.

### 5.5.3 Dropped objects

Overboard loss of large objects could occur if, for example, there were a failure of a crane, lifting frame, sling or pennant wire, or if a section of jacket or topside were to break up during lifting. However, given the level of detailed engineering analysis and design required for this type of project and the safeguards put in place, as well as the small number of lifts, the likelihood of such an event occurring is extremely remote.

### 5.5.4 Mitigation

Shell has a number of management, controls and mitigation measures in place to ensure that the risk of a collision or spill is avoided or minimised.

The vessels operating in the vicinity of the Leman BH platform will use appropriate lighting and a guard vessel will be equipped with radar and communication equipment so that any vessel in the area can be detected and contacted, if required. This will reduce the risk of any collision which could cause the loss of the diesel inventory. The likelihood of the complete loss of diesel inventory will be further reduced, as the stored diesel in the vessel will likely be split between several storage tanks. All vessels will also have Shipboard Oil Pollution Emergency Plans (SOPEPs).

An approved OPEP for the Leman Field system has been developed in accordance with the Merchant Shipping (Oil Pollution Preparedness, Response and Co-operation Convention) Regulations 1998. The specific decommissioning activities will be incorporated into the existing Leman Field OPEP, either as an update or an addendum, once the vessel has been selected and will be in line with the requirements of the Offshore Safety Directive (OSD) and amended OPRC regulations. The OPEP details the actions to be taken in the event of a spill as well as the resources available to deal with it, including membership of Oil Spill Response Limited (OSRL). If there is an unexpected spill or sheen observed during operations it will be reported immediately to the statutory authorities using the Petroleum Operation Notice 1 (PON1) system.

With all of the appropriate mitigation measures in place, the risk of a spill, collision or dropped object during the proposed decommissioning operations is considered to be very low.

## 5.6 WASTE MANAGEMENT

### 5.6.1 Routine vessel wastes

The discharge of food waste, bilge water and grey water (water and chemicals from washing and laundry facilities) from vessels to sea has the potential to cause short term, localised organic enrichment of the water column and an increase in biological oxygen demand (BOD). This could contribute to a minor increase in plankton and attract fish to the area. Food waste is typically macerated to increase the rate of dispersion and biodegradation at sea. Waste water will be treated appropriately before being discharged to sea, in accordance with the requirements of the MARPOL convention. Each vessel will have a Garbage Management Plan in place. Given the relatively short time vessels will be operating offshore during the proposed operations (up to 24 days), the associated impacts from these routine offshore discharges are considered to be negligible.

### 5.6.2 Onshore Dismantling Waste

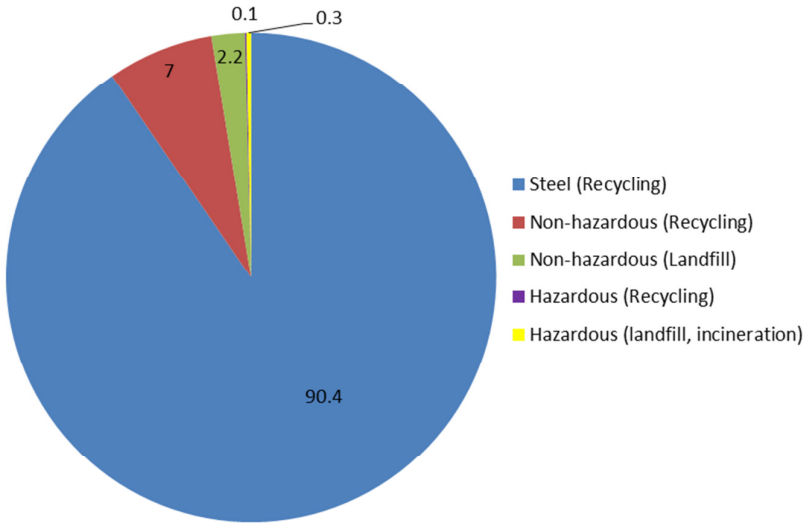
It is anticipated that up to 1605 tonnes of waste will be returned to shore and transported to the chosen onshore decommissioning yard. It should be considered that the quantity of waste is more likely to be around 1556 tonnes as approximately 49 tonnes of this total is made up of the bridge which will most likely to be removed as part of the pre-lifting operations and handled at a separate Shell designated waste management site for its operations in the southern North Sea.

This anticipated waste includes 1450 tonnes of steel as well as 70 tonnes of expected marine growth. The receiving yard will strip the installation into its components before they undergo further processing. The marine growth will be removed by high pressure cleaning and approximately 76% of this will be recycled and 24% sent to an appropriately-licensed landfill site.

An overview of the waste to be processed is provided in Figure 5-3. Over 97% of the waste generated will be recycled. There are anticipated to be potential impacts associated with the processing, transport treatment and disposal of the waste material to local communities in the vicinity of the waste yard due to increased road transport, odour and associated reduction in local air quality. These are discussed in Section 5.8.

Due to the relatively small scale of the decommissioning operations and the quantities involved, the waste generated during the proposed operations are expected to have only minor impacts.

Figure 5-3: Estimated Inventory of decommissioning waste and its fate



### 5.6.3 Mitigation

The Shell offshore representatives will ensure that good housekeeping standards are maintained on board the vessels which will all have a Garbage Management Plan in place; any waste water discharged to sea from vessels will be treated to comply with the requirements of the MARPOL Convention.

A Waste Management Plan will be developed for the Project to identify the types of waste generated and the management procedures for each waste stream. Shell will ensure the principles of the Waste Management Hierarchy (UK Government 2015c) are followed during the decommissioning activities. Transfer notes will accompany all non-hazardous waste to shore and consignment notes will be in place for any hazardous waste.

Checks will be carried out on the selected waste yard to ensure all permits and licenses are in place for the handling and disposal of the waste types identified. Shell will ensure that waste is transferred by an appropriately-licensed carrier who should have a Waste Carrier Registration, Waste Management Licence or Exemption, as appropriate for the type of waste.

## 5.7 SOCIO-ECONOMIC IMPACTS

The project activities have been assessed against the Policies and objectives of the East Offshore Marine Plan which includes consideration of the other industry activities in the project area (UK Government, 2015b). This section outlines the possible offshore and onshore socio-economic impacts of the proposed operations.

### 5.7.1 Fisheries

There is the potential for interaction with fishing vessels during the offshore lifting operations. Specifically, the deployment of HLV anchors will effectively increase the fishing exclusion zone around the Leman BH/BT complex for a limited period of time. As the footprint of the anchors will extend beyond the charted 500 m safety zone around the Leman/BT complex, the deployment of the anchors on the seabed could also potentially increase the risk of a snagging hazard to fishing gear.

As discussed in Section 3.6, the Leman BH platform lies within ICES rectangle 35F2 where fishing intensity is very low compared with other North Sea areas. The number of days spent per year in ICES rectangle 2011 and 2012 was 34 and 18 days respectively. There will be a guard vessel on site while the HLV is on site to ensure that no fishing vessels com in proximity of the anchor wires. Taking into account the very low fishing intensity in the area, the short period during which vessels will be present offshore (up to 24 days) and the fact that these vessels will be within the existing 500 m exclusion zone for most of their deployment, any potential impact on commercial fishing practices during the decommissioning operations is considered to be very low. In addition to this, a Consent to Locate (CtL) will be applied for and the relevant bodies such as the NFFO will be notified of the increased presence of vessels in the area.

Following removal of the platform there may be some debris left in place around the Leman BH jacket location. Any debris will remain well within the existing 500 m safety zone of the Leman BT platform and will be cleared when the it is surrendered, following the removal of the Leman BT platform, which is planned to take place in 2031. Therefore, the risk of snagging to bottom-trawling fishing gear is considered to be very low.

### 5.7.2 Oil and Gas activities

There are 11 installations within approximately 3.5 km to the Leman BH/BT complex. No major offshore activities are expected to occur in the Leman field during the proposed operations, other than the Leman BT refurbishment. However, there will be other operations occurring throughout the wider North Sea which have the potential to coincide with the proposed operations. The cumulative impacts of the operations in the Leman field are discussed in Section 5.8.

The decommissioning operations of the Perenco-operated Thames platform and associated field tie-backs are planned to take place between Q2 2015 and Q2 2017. The Thames platform is located approximately 24 km to the east of Leman BH. There is a potential for some interaction between projects, particularly the

availability of resources as the schedule of the planned heavy lift operations at the Thames platform overlap with the Leman BH project. The offshore interactions are expected to be very low as there is considered to be ample open water available for vessel manoeuvrability. However, there may be some indirect interaction with regard to the availability of onshore facilities, support vessels and quayside locations. Any impacts will depend on various factors such as the actual timing of operations and the location of the onshore decommissioning site.

In addition, the project area overlaps those indicated as potential Carbon Capture and Storage (CCS) areas (MMO, 2015) although the proposed project will not have any impact to impact on potential future CCS operations.

There is potential for further interaction with regards to onshore facility availability as the Shell Brent Delta topsides decommissioning is also planned to be undertaken in summer 2016. The topsides at Brent Delta will be removed using single lift and transported to the Able Seaton Port (ASP) near Middlesbrough. As the ASP facility has been identified as one of the potential onshore dismantling sites for the Leman BH platform, the Brent Delta decommissioning operations may limit its capacity and availability at the time of decommissioning. Overall, it is considered that the possible impacts to other oil and gas activities will be minor.

### 5.7.3 Shipping and Navigation

A vessel traffic study has identified a total of 13 routes used by an estimated 4,176 vessels (mainly cargo vessels) per year passing within 8.5 km (10 nm) of the Leman BH platform. This corresponds to an average of 11-12 vessels per day. However, only one of these routes passes within 5 km (2.7 nm) of the Leman BH/BT platform. The closest infield shipping lane to the Leman BH/BT platform passes approximately 2 km to the southwest and has 130 ships per year travelling from the Leman/Camelot fields to Great Yarmouth (Anatec 2013). This equates to approximately 4 vessels during the 11 days that the HLV is expected to be on location. The second nearest shipping lane passes approximately 6 km to the southeast which has only 26 infield vessels per year.

The increased vessel activity during the decommissioning operations has the potential to impact shipping and navigation in the area. However, given that the proposed operations will be of a very limited duration and that there will be ample clearance around the Leman BH/BT platform, the potential impacts to navigation are considered minor. Furthermore, following the removal of the BH platform and completion of the Leman BT refurbishment, the overall infield traffic in the immediate area is expected to decrease. Therefore the project is likely to have longer term-positive impact on navigation.

### 5.7.4 Offshore Renewables

The nearest wind farm areas to the Leman BH platform are the East Anglia Wind Farm Search Area and East Anglia Four Wind Farm, situated approximately 18km and 48km to the southeast respectively. At the time of writing the infrastructure planning for the East Anglia Four Windfarm was not expected to be applied for until Q4 2016, therefore it is very unlikely that the proposed decommissioning project will coincide with any activities at any of the East Anglia sites.

The Dudgeon Wind Farm, operated by Statoil is situated 52 km to the west of the Leman BH platform. The offshore operations are anticipated to commence in Q1 2016 and therefore may coincide with the planned operations at Leman BH. Due to the distance between the Leman BH and the Dudgeon Wind Warm, there is unlikely to be any direct interactions between operations; the Dudgeon Wind Farm area covers a relatively small area and will be easily avoided by vessels in transit to and from the Leman BH/BT location.

Overall, there are considered to be no potential impacts to offshore wind operations.

### 5.7.5 Aggregate Extraction

The nearest active licenced aggregate extraction site to the Leman BH/BT platform is Off Great Yarmouth, which is managed by Hanson UK and situated approximately 49 km to the south of Leman BH (Crown Estate, 2015). Given the distance of this site from the proposed project location and the short duration of the planned operations, there is not expected to be any impact to aggregate extraction operations.

## 5.8 ONSHORE IMPACTS

There is the potential for the onshore phase of decommissioning to have a negative impact to communities in the vicinity of the dismantling yard. Potential onshore socio-economic effects may include an increase in road traffic, increased noise in the vicinity of the onshore facility and an associated degradation of the air quality as a result of the gaseous emissions from dismantling operations. The factors associated with onshore decommissioning waste are considered separately in Section 5.6. At the time of writing the onshore location had not been selected but a generic assessment of the potential onshore impacts to communities has been made.

### 5.8.1 Noise

There will be noise associated with the onshore dismantling of the Leman BH installation. It will be necessary to cut the metal installation into suitably-sized sections to be transported to appropriate sites for recycling and disposal. The cutting itself is not thought to be particularly noisy although the noise caused by the increased industrial activity may potentially result in elevated noise levels. However, this is expected to be intermittent, last for a short time and be assessed and managed as part of the onshore decommissioning contract. It is also anticipated that the noise generated by the dismantling work will not be significantly higher that would normally occur on site. Overall, the noise impacts are considered to be minor.

### 5.8.2 Odour from Marine growth

Marine growth is identified as potentially producing an odour which may cause a problem for the nearby local communities. The main source of smell is thought to be due to the disturbance of low-oxygen layers and removal of putrefying organisms. However, given the experience of previous decommissioning operations in the southern North Sea, no notable issues were encountered with regard to odour. An odour management plan will be in place within the waste yard. Mitigation measures include rapid removal of marine growth and spraying of odour suppressants. With these measures in place, the potential impacts from marine growth will be kept to a minimum.

### 5.8.3 Employment

The main social benefits relate to the continuation of jobs in the waste yard selected for this project. These benefits will be short term but this project could help maintain employment in the local services and provide revenue into the area's economy.

### 5.8.4 Road transport

Although the waste yard to be used for initial decommissioning activities has not yet been identified, there will likely be increased traffic, particularly resulting from the transportation of the segregated waste streams to their relevant end locations. The transportation routes of the materials will be assessed when the onshore location is selected and a road transport minimisation plan will be put in place. Overall, the increased level of road transport will be temporary and of low to moderate intensity. Therefore the potential impacts to road transport are considered to be minor.

### 5.8.5 Mitigation

A Notice to Mariners will be made to notify sea users of the operations and a Consent to Locate (CtL) will be in place for the location of the HLV. In addition, a guard vessel will be on location during the lifting operations to ensure that vessels passing by keep at a safe distance. The NFFO will also be notified of the operations closer to the time. The project will take into consideration other oil and gas activities in the area when undertaking the detailed planning of the lifting and onshore dismantling phases of the project.

A Waste Management Plan will be developed for the project to identify the types of waste generated and the management procedures for each waste stream. Duty of care checks will be carried out on the selected waste yard to ensure all permits and licenses are in place for the handling and disposal of waste types identified. Any site-specific onshore socio-economic implications will also be taken into account. As the onshore impacts are expected to minor, no further mitigation has been considered.

## 5.9 TRANSBOUNDARY AND CUMULATIVE IMPACTS

### 5.9.1 Transboundary impacts

The extent of the transboundary impacts is dependent on the location of the onshore decommissioning yard. If the chosen onshore location is in the UK, then the main potential for transboundary impacts will arise from atmospheric emissions and accidental events leading to an offshore oil spill. The UK/Netherlands median line is 62 km to the east of the Leman BH location. Therefore any associated emissions resulting from the project activities are very unlikely to be measurable at the median line. Similarly, oil spill modelling shows that a diesel spill at the project location will not reach the UK/Netherlands boundary.

As is discussed in Section 2.2.4, there is a possibility that the onshore decommissioning yard will be located in the Netherlands. If so, the associated impacts relating to atmospheric emissions during the transit of the platform components to shore and the risk of diesel spills will apply to the Netherlands sector. The regulations associated with the transboundary movement of waste would also need to be adhered to and the appropriate consents will have to be in place. In addition, all of the onshore impacts considered in Section 5.7.6 would also apply to the Netherlands. Shell will ensure that the same mitigation measures proposed for the UK sector are also applied to the Netherlands to ensure that any potential environmental or socio-economic issues are addressed and any associated impacts minimised.

In summary, the transboundary impacts associated with the Leman BH decommissioning project are considered to be low.

### 5.9.2 Cumulative impacts

Seabed disturbance, atmospheric emissions, discharges to sea, underwater noise, interaction with other sea users, and accidental events may potentially contribute to cumulative impacts.

Given the relatively high levels of industrial activity within the North Norfolk Sandbanks and Saturn Reef SCI, the main potential for significant in-combination environmental impacts are those to the conservation features and objectives of the SCI as described in Section 5.2.

In isolation, the Leman BH decommissioning project has been assessed to have a low potential impact to the seabed and conservation features. However, in order to put this into context with other project activities and across the wider SCI, consideration must be taken into account of the potential in-combination impacts from other operations. The impacts associated with the proposed Leman BH Decommissioning project will be localised in nature and temporary, thus the potential for the proposed operations to directly overlap other operations is limited in both time and space. The associated in-combination effects with other offshore activities are discussed below.

#### OIL AND GAS OPERATIONS

There are several recently-completed, on-going and or/planned activities that have associated seabed disturbance, and therefore have the potential to incur cumulative and in-combination impacts to features of conservation importance. In particular, oil and gas infrastructure, has been identified as posing a moderate risk of damage to the sandbanks and *Sabellaria* reef within the North Norfolk Sandbank and Saturn Reef SCI as a result of physical loss through the presence of installations on the seabed (JNCC, 2012b).

The relevant projects are listed below.

#### Shell projects

- Leman Uptime Compression (LUC) platform installation (long term footprint), included temporary deployment of a moored HLV and Seafox 4 accommodation jack up rig. Works were completed in January 2015. The Seafox 7 accommodation rig will be required on site in summer 2015 for a maximum period of 120 days. The operations will involve the deployment of three anchors and 4 jack-up footings on the seabed.
- Planned refurbishment of Leman BT, which will be undertaken in Q3 of 2015. These works will require the use of a jack-up rig, most likely the Seafox 4 and involve the deployment of three anchors and 6 jack up footings.

- A pipeline remediation project for the production pipeline between Carrack and Clipper, located approximately 61 km north of the Leman BH platform. This project is proposed for summer 2015 and it involves rock dumping discreet sections of the pipeline route.
- Shell is not planning any drilling or well workover operations within the SCI for 2015. However, there are plans to drill the Galleon PG11 well which lies 0.46 km outside the SCI boundaries.

### Non - Shell Projects

- Perenco UK Ltd and Tullow Oil Ltd Thames area decommissioning programme across thirteen (13) UKCS Blocks (48/28-30, 49/26-30, 50/26, 52/3, 53/2-4) in the Southern North Sea (SNS). The project is ongoing, and involves well plugging and abandonment, drilling with a jack-up rig and burial of any pipelines left *in situ* (Perenco & Tullow, 2014).

Details of the seabed footprint of the projects listed above and their predicted impact on Annex I features inside the North Norfolk Sandbanks and Saturn Reef SCI are provided in Table 5-9. Where available, the total area of potential *Sabellaria* reef has been extracted from project specific documentation. These have been combined with the total area of potential *Sabellaria* reef inside the North Norfolk Sandbanks and Saturn Reef SCI in order to provide an estimate of the total area of known potential reefs inside the SCI. The Thames Complex ES did not distinguish between areas of reef identified inside and outside of the SCI, so the maps of sampling stations have been used to estimate which stations fall inside its boundaries. These were assumed to be all of the stations located inside the Bure sampling area (assumed to be Bure drop-down camera stations 35 – 39 (see Perenco UK Ltd & Tullow Oil SK Ltd, (2014)).

**Table 5-9: Potential cumulative impact of oil & gas projects within the North Norfolk Sandbanks and Saturn Reef SCI**

| Project / source | Total project footprint ($km^2$) | % of total area of SCI (3603.4 $km^2$) | Total area ($km^2$) of potential *Sabellaria* identified in project area | Total area ($km^2$) of potential *Sabellaria* impacted by project | Total area ($km^2$) of Annex I sandbanks impacted by project |
|---|---|---|---|---|---|
| Leman BH (assumed worst Case – Large HLV) | 0.405 | 0.011 | 1.74 | 0.00502 | 0.00 |
| Leman BT (Seafox 7) | 0.0047 | 0.0013 | | 0.00 | 0.00 |
| Leman A (Seafox 7) | 0.0047 | 0.0013 | | 0.000080 | 0.0013 |
| LUC (long-term and temporary installations) | 0.277 | 0.0076 | | 0.036 | 0.051 |
| Carrack-Clipper pipeline (impact inside SCI) | 0.21 | 0.0058 | 0.14 | 0.0143* | 0.0084 |
| Thames complex - Bure Area (inside SCI) | 0.00078 | 0.00002 | 0.08 | 0.00078** | 0.00078** |
| **TOTAL (inside SCI)** | **0.90** | 0.027 | **1.96** | **0.056** | **0.06** |

* Estimate based on confirmed reef - 0.0113 km and potential reef - 0.00090 $km^2$.

** due to Lack of definitive information it has been assumed that assumed the total footprint within the SCI has potential *Sabellaria* reef and Sandbanks.

### In-combination effects to sandbanks from oil and gas operations

The Leman BH project is located outside the delineated sandbanks boundaries, and has been assessed to occur out-with any potential sandbank features. Therefore the Leman BH operations will not contribute to the cumulative impacts on sandbanks.

### In-combination effects to Sabellaria reef from oil and gas operations

- Leman Field

The combined *Sabellaria* area S1/P9 is one of the largest single delineated *Sabellaria* areas within the SCI. Therefore, the in-combination effect on this feature should be considered, particularly as both the operations at Leman A and the worst case impact of Leman BH, both have the potential to impact this area. The northern section of the S1/P9 area has already been subject to disturbance of approximately 23,673 $m^2$ (2.71%) by the HLV anchors during the installation of the Leman AC platform. This particular area is at potential risk of further impacts from operations in the area. However, it should be considered that due to the high anchor wire tension, the anchor wires associated with the planned Seafox 7 accommodation rig deployed at Leman A will not overlap any *Sabellaria* reef; the only overlap with the delineated *Sabellaria* area will occur from the accommodation rig footings which amounts to approximately 80 $m^2$ of the S1/P9 area.

For the proposed leman BH platform removal, the Sheerleg anchors and anchor lines will not encroach upon the S1/P9 area and neither will the deployment of the Seafox 4 accommodation rig at the Leman BT platform. As such, the main contribution to potential in-combination impact from planned activities in the Leman field to the S1/P9 *Sabellaria* patch would occur from the potential worst case anchor footprint of the large HLV at BH which potentially overlaps 555 $m^2$ (0.06%) of *Sabellaria* patch S1/P9. As discussed in Section 5.2, this potential impact has been assessed as minor. Therefore, the cumulative impact to the S1/P9 area will be negligible.

- Impacts across wider SCI

The cumulative footprint of oil and gas activities to *Sabellaria* reefs inside the SCI is approximately 0.056 $km^2$ which represents approximately 0.44% of the total area of *Sabellaria* delineated in the SCI (Table 5-10).

Table 5-10: Summary of Cumulative Impacts to the *Sabellaria* Areas within the SCI

| Project / source | Area of potential *Sabellaria* impacted ($km^2$) | % of *Sabellaria* area impacted in SCI (12.53 $km^2$)* | % of cumulative Footprint |
|---|---|---|---|
| Leman BH Operations | 0.005 | 0.04 | 9.00 |
| Other Leman Field Operations | 0.036 | 0.287 | 64.28 |
| Carrack – Clipper pipeline | 0.0143 | 0.114 | 25.53 |
| Thames Complex | 0.00078 | 0.006 | 1.39 |
| **Cumulative footprint** | **0.056** | **0.44** | **100** |

* based on the total potential *Sabellaria* (10.57$km^2$) inside the North Norfolk and Saturn Reef SCI (Elwood, 2013) in combination with the total known *Sabellaria* within the SCI identified from project data (1.96 $km^2$).

Of this, the worst case HLV footprint at Leman BH contributes a small proportion (9%) of this total impacted area, and much less still (0.17%) for the Sheerleg HLV option. Furthermore, most of the disturbance,

including the operations at Leman BH, will be temporary in nature; the exceptions being the long-term installation of the Leman AC platform (approximately 830 $m^2$) and the Carrack - Clipper pipeline remedial work (0.0143 $km^2$). Therefore, the impacts of physical loss due to obstruction will be limited and there will remain a good potential for rapid recovery in the areas which will only be temporarily disturbed (around 75% of the total disturbed area).

As discussed in Section 5.2, the prospects for recovery of Sabellaria are good, and the cumulative footprint of 0.056 $km^2$ is very small (0.44%) in relation to the wider SCI area available for colonisation(3,603 $km^2$). On this basis, the in-combination effects from oil and gas projects to the conservation features of the SCI are considered to be of low significance.

### FISHING ACTIVITIES

As discussed previously, the fishing intensity in the vicinity of the Leman BH is relatively low. However, certain types of bottom trawling gear, such as beam trawling and otter trawls can be particularly damaging to seabed features, causing disturbance, abrasion and a flattening of the seabed topography (JNCC, 2014b; Løkkeborg, 2005). *Sabellaria* reefs can be susceptible to this type of physical disturbance. There was evidence of probable trawl scars observed during the Leman BH Habitat Assessment, crossing delineated *Sabellaria* patches S8 and S16 respectively (Figure 3-3) (Fugro EMU, 2015). However the cumulative impact of fishing gear to the wider SCI is difficult to quantify and is therefore not considered further.

### OFFSHORE RENEWABLES

There are no wind farm licensed areas within the boundaries of the North Norfolk Sandbanks and Saturn Reef SCI (Crown Estate, 2015). Therefore, offshore renewables activities are not expected to contribute to direct in-combination effects to the conservation features to the SCI. Despite this, there remains the potential for some indirect seabed impacts from windfarm areas in close proximity to the SCI such as the East Anglia and Dudgeon Wind farm areas situated 18 km and 52 km to the southeast and west of the Leman BH platform respectively. These developments have the potential to affect the sediment distribution in the area, although the extent of this is unknown.

As the Dudgeon wind farm operations potentially coincide with the Leman BH operations, the noise generated from piling may have a cumulative impact on marine mammals. Given the distance of this site from Leman BH (52 km), the relatively short duration of the proposed lifting operations and the relatively low level sound generated, the overall contribution of the decommissioning project to the in-combination effects of underwater noise is expected to be negligible.

### GAS STORAGE

The application for Deborah gas storage facilities operated by ENI was approved in 2010 with planned start up in 2015. These facilities are located 3 km outside the North Norfolk Sandbanks and Saturn Reef SCI and are not expected to contribute to direct in-combination effects.

### DREDGING AND AGGREGATE EXTRACTION

The Sole Pit, Humber 3 and 5 application areas and Humber 3 and 6 option areas lies within the North Norfolk and Saturn Reef SCI (Crown Estate, 2015). It is not known if any extraction activities are planned for these areas in the near future. Therefore the cumulative effects of these potential activities to the conservation objectives of the SCI cannot be quantified.

### SUMMARY

The above information increases the significance of seabed disturbance, particularly in light of the SCI conservation objectives and advice on operations (JNCC, 2012b) where physical loss due to obstruction, disturbance and abrasion is assessed as presenting moderate risk to the biogenic reef features.

Apart from the oil and gas operations, there is no information about the areas of potential temporary or long-term disturbance from the other activities listed above nor their interaction with the conservation features of the SCI.

The main conservation objectives of the North Norfolk Sandbanks and Saturn Reef SCI are to maintain or restore the Annex I 'Sandbanks which are slightly covered by seawater all the time' and Annex I 'Reef' habitats to favourable condition (JNCC, 2012b). The cumulative footprint of all oil and gas projects within the SCI is estimated at 0.9 $km^2$ which is only 0.027% of the total area of the SCI (Table 5-9). The total combined area of potential *Sabellaria* reef described in the Ellwood (2013) data (10.57 $km^2$) and additional areas identified inside the SCI during survey work (1.96 $km^2$) amounts to 12.53 $km^2$. The total area of *Sabellaria* reef that will be impacted by these projects is 0.056 $km^2$, representing 0.44% of the overall area of reef inside the SCI (Table 5-10).

The worst case HLV footprint at Leman BH contributes only 9% of the total area of potential *Sabellaria* reef affected by oil and gas projects inside the SCI. Furthermore, the areas of reef habitat potentially impacted by Leman BH operations are low in reef quality in comparison to other parts of the SCI. Based on the available information, the contribution of the Leman BH decommissioning project to the overall in-combination impacts to the SCI have been assessed as low.

The BH platform decommissioning will remove the obstruction, benefitting the objectives of the SCI in the long term. The operations will not significantly contribute to the in-combination effects on the conservation features in the Leman field or to the cumulative effects across the wider SCI.

# 6 ENVIRONMENTAL MANAGEMENT SYSTEM (EMS)

Shell's EMS is embedded in its Corporate Management System (CMS), a system of internal controls that demonstrates how Shell complies with laws and regulations, and which facilitates the implementation of the company's HSE policy. The EMS is independently verified to ISO 14001, which meets the requirements of OSPAR Recommendation 2003/5. Environmental protection is considered at all stages of the life cycle of Shell's oil and gas facilities. A brief description of the Shell EMS is given in the Environmental Management Section of the Shell annual environmental statement, which is available for download at:

http://s00.static-shell.com/content/dam/shell-new/local/country/gbr/downloads/pdf/uk-ourperformance-2013-environment-statement.pdf

This Section provides a summary of all elements of the EMS illustrated in Figure 6-1and describes how these will be applied to the Leman BH Decommissioning Project.

Figure 6-1: Summary of EMS elements

## 6.1 POLICY AND STRATEGIC OBJECTIVES

A copy of the Shell Policy on HSE is presented in Figure 6-2. This Policy contains a commitment to protect the environment and states that Shell has a systematic approach to HSE management designed to ensure compliance with the law and to achieve continuous performance improvement. Commitment to continuous improvement in environmental performance underpins the Shell CMS.

The EMS contains Shell's Commitment and Policy on Health, Safety, Security, Environment and Social Performance (HSSE-SP) and provides a framework for setting environmental objectives. This Policy sets the direction and objectives of environmental management, and is applicable to all activities related to the Leman BH project.

All companies contracted to Shell are required to work to similar, consistently high standards and to achieve comparable levels of performance adopted by Shell U.K. Limited. Project and Contractor employees, on their part, have a clear responsibility to exercise discipline, maintain a high level of awareness, prevent injury to themselves and others, protect the environment and comply with all statutory obligations.

## 6.2 ORGANISATION, RESPONSIBILITIES, RESOURCES AND COMPETENCY

The general responsibilities for HSE protection are specified in Shell's policy booklet. During the planning and operational phases of the proposed development, the Project Manager is responsible for ensuring that the CMS is applied to all activities.

Figure 6-2: Shell UK HSSE and SP Policy

## SHELL COMMITMENT AND POLICY ON HEALTH, SECURITY, SAFETY, THE ENVIRONMENT AND SOCIAL PERFORMANCE

### COMMITMENT

**In Shell we are all committed to:**

- Pursue the goal of no harm to people;
- Protect the environment;
- Use material and energy efficiently to provide our products and services;
- Respect our neighbours and contribute to the societies in which we operate;
- Develop energy resources, products and services consistent with these aims;
- Publicly report on our performance;
- Play a leading role in promoting best practice in our industries;
- Manage HSSE & SP matters as any other critical business activity; and
- Promote a culture in which all Shell employees share this commitment.

In this way we aim to have an HSSE & SP performance we can be proud of, to earn the confidence of customers, shareholders and society at large, to be a good neighbour and to contribute to sustainable development.

### POLICY

**Every Shell Company:**

- Has a systematic approach to HSSE & SP management designed to ensure compliance with the law and to achieve continuous performance improvement;
- Sets targets for improvement and measures, appraises and reports performance;
- Requires contractors to manage HSSE & SP in line with this policy;
- Requires joint ventures under its operational control to apply this policy, and uses its influence to promote it in its other ventures;
- Engages effectively with neighbours and impacted communities; and
- Includes HSSE & SP performance in the appraisal of staff and rewards accordingly.

**Ben van Beurden**
Chief Executive Officer

**Erik Bonino**
UK Country Chairman

Originally published in March 1997 and updated by the Executive Committee December 2009.

General Disclaimer: The companies in which Royal Dutch Shell plc directly and indirectly own investments are separate entities. In this Policy the expression "Shell" is sometimes used for convenience where reference are made to companies within the Shell group or to the group in general. Likewise, the words "we", "us" and "our" are also used to refer to Shell companies in general or those who work for them. These expressions are also used where no useful purpose is served by identifying specific companies.

Contractor companies undertake many activities, so the management of HSE protection by Contractors is an important area for Shell. All Contractors are required to fulfil defined standards in HSE management before they work with Shell, and their performance in this area is monitored and reviewed.

Shell provides training to ensure that personnel are competent to carry out their activities. Where there are specific responsibilities for environmental protection specific training is provided. Contractor companies are expected to provide an equivalent level of training and this is checked at the tender stage of projects. Contractor competency, ensuring that the correct training and relevant qualifications have been achieved, is checked during the assessment of tender documents.

Communication on environmental issues takes place primarily via line managers and supervisors. In addition, Shell has a comprehensive system of committees, meetings and publications that ensure the flow of

information between all parts of the organisation. Environmental Specialists are available to provide advice to management on environmental matters.

Communication with the authorities and interested parties is also an important part of Shell's approach to environmental management. External consultations that have taken place during the environmental assessment stage of the project are described in Appendix A.

## 6.3 IMPACT MANAGEMENT

The potential environmental impacts associated with the project have been identified by Shell, and appropriate controls will be in place to ensure that these do not lead to adverse impacts on the environment. These are detailed in Section 5.

## 6.4 PROCESSES, ASSETS AND STANDARDS

All Leman BH decommissioning activities will be managed in accordance with Shell's CMS and supporting procedures. The main Shell environmental documents are sign-posted in the CMS and its supporting documents, including the Environmental Case documents which cover the environmental aspects associated with all assets and operations.

## 6.5 PLANNING AND MONITORING

All Leman BH Decommissioning Project activities will be managed in accordance with Shell's CMS and supporting procedures. The potential environmental aspects of the activities (discussed in Section 5) have been assessed by Shell and appropriate controls are in place to ensure that these do not lead to adverse impacts on the environment.

The Shell U.K. Limited Policy on HSE contains a commitment to compliance with environmental legislation and other requirements (e.g. Oil & Gas UK guidelines). These include Shell Group requirements, which set targets and require reporting of performance for Shell Group companies.

Shell promotes compliance and continuous improvement in performance by establishing appropriate environmental objectives and targets within an annual HSE Plan. The Leman BH Decommissioning Project will be designed to comply with Shells overall environmental objectives and targets.

Monitoring is essential for the measurement of performance and implementing new measures and targets for continual improvement. Performance is measured to satisfy both regulatory requirements including compliance with environmental consents, as well to identify progress on fulfilment of project objectives and commitments. Measuring performance involves the monitoring of waste, emissions, effluents and chemical discharges.

## 6.6 IMPLEMENTATION AND OPERATION

The general responsibilities for health, safety and environmental protection are specified in Shell's policy booklet (which is issued to all staff and contractors). Because contractor companies undertake many activities, the management of HSE protection by contractors is an important area for Shell. All Contractors are required to fulfil defined standards in HSE management before they work with Shell, and their performance in this area is monitored and reviewed. Shell has a Compliance and Verification Group that carries out audits and second party checks. Shell also has HSE Interface Documents with contractors, and contractor audits are carried out to ensure that the competence and standards of contractors are checked. Specific HSE responsibilities for the Leman BH decommissioning Project will be set out in the Interface Document between Shell and the main Contractors.

Communication on environmental issues takes place primarily via line managers and supervisors. In addition, Shell has a comprehensive system of committees, meetings and publications that ensure the flow of information between all parts of the organisation.

Environmental Specialists are available to provide advice to management on environmental matters. Communication with the authorities and interested parties is also an important part of Shell's approach to environmental management. External consultations that have taken place during the environmental assessment stage of the project are described in Section 1.4 and Appendix B.

The main Shell environmental documents are sign-posted in the CMS and its supporting documents. Shell specifies certain operational controls that are to be implemented throughout the company. The main controls related to the Leman BH decommissioning project are referenced at relevant points within the Environmental Impact Assessment.

A system of emergency preparedness and response is maintained by Shell to ensure that the correct action is taken in the event of an incident or accident that could affect the environment. The arrangements covering the Leman BH Decommissioning Project activities are described in Section 5.5.

## 6.7 ASSURANCE AND MANAGEMENT REVIEW

Shell has an extensive assurance programme which includes a comprehensive programme of environmental audits. As a requirement of ISO 14001, environmental considerations are integrated into audit programmes that address all aspects of Shell's business. Project reviews, installation audits and inspections conducted by Shell, and by the regulatory authorities and verification bodies, help to ensure that standards are being maintained and that corrective action is taken where necessary. The leadership teams throughout Shell carry out regular reviews of the CMS. The reviews take into account any relevant matters including the findings of audits, non-conformances and environmental performance.

## 6.8 LEMAN BH DECOMMISSIONING HSSE-SP PLAN

A Leman BH Decommissioning Project HSSE-SP Plan will be developed which outlines how HSSE-SP issues will be managed and how Shell'

s HSSE-SP policies and CMS will be implemented effectively throughout the project. The HSSE-SP Plan will apply to all work carried out on the Leman BH project be it onshore or offshore.

## 6.9 CONTRACTOR INTERFACE

Contactors undertake a number of activities with Shell; Contactor competency is reviewed first at the tendering stage where checks are made as to whether contactors have received the level of training required and have the relevant qualifications. Shell Upstream International Europe (UIE) has a Standard for Contractor HSE management which provides a framework for:

- Defining key roles and responsibilities;
- Assessing HSE risks and contractor capability
- Managing of the contract
- Analysing and improving contractor HSE performance

Once contactors have been identified HSE interface documents are set up between Shell and their contractors to ensure that Shell UK Limited's HSE policy is effectively communicated and implemented. These interface documents are held by the relevant HSE manager, agreed by all parties and periodically reviewed. An assurance programme, including a comprehensive plan of environmental audits is in place to monitor contractor competence and standards with regards to HSE management and effective delivery of Shell's HSE policy objectives.

# 7 CONCLUSIONS

## 7.1 KEY ENVIRONMENTAL SENSITIVITIES AND POTENTIAL IMPACTS

The sensitivities and impacts identified in this assessment are considered to be typical of the UK offshore industry. Potential environmental and social impacts identified for this project include seabed disturbance and potential impact to the SCI conservation features, atmospheric emissions, discharges to sea, underwater noise, socio-economic impacts, waste management and accidental events. The main impacts of the proposed operations arise from the deployment of HLV anchors and anchor lines resulting in disturbance of the seabed and potentially seabed features of conservation importance.

The main sensitivities are associated with the Annex I habitats of the North Norfolk Sandbanks and Saturn Reef SCI. Several areas of *Sabellaria* aggregations have been identified within the project area, all of which were assessed as having 'low' to 'medium' reef quality based on size, elevation and patchiness under the biogenic reef assessment guidance (Gubbay, 2007).

### BIOGENIC REEFS

It has been assessed that although some *Sabellaria* aggregations will be disturbed during the lifting operations, the worst case scenario large HLV anchors and anchor lines will only impact a small proportion of the delineated *Sabellaria* areas (and much less for the base case Sheerleg HLV). Furthermore, the quality of the reef potentially disturbed is not expected to be of a particularly high quality based on the reefiness assessment.

As the area of disturbance is small in comparison with the available suitable habitat, the ability of the wider area to support the development and persistence of *Sabellaria* reefs will not be impacted. Therefore the project is not expected to result in any significant impact to the ecosystem services provided by these aggregations. As such the proposed operations have been assessed to have only a minor impact on the conservation objectives of the SCI, which are to restore the Annex I reef to a favourable condition.

The removal of the platform will reduce the infrastructure footprint in the area and will also reduce the need for future maintenance work in the area, thus reducing the need for further anchoring operations in the vicinity of the Leman B complex. Therefore, the proposed decommissioning operations will not undermine the conservation objectives for biogenic reefs within the North Norfolk Sandbanks and Saturn Reef SCI.

### OTHER POTENTIAL HABITATS OF CONSERVATION IMPORTANCE

The biotope 'Piddocks with a sparse associated fauna in sublittoral very soft chalk or clay' was tentatively recorded during the habitat assessment. The data was inconclusive as to whether or not this habitat was present therefore the potential impacts to this habitat could not be quantified.

### ANNEX II SPECIES

Noise generated by the proposed operations is well below the level predicted to elicit a temporary change in hearing ability (TTS) to marine mammals and is therefore not expected to pose a risk of injury. The operations at the Leman BH/BT complex have the potential to cause behavioural disturbance, both directly and in-combination. However, due to the short term duration of the proposed operations and the relatively low densities of harbour porpoise and seals expected to be present in the area, these potential impacts are considered to be minor.

## 7.2 TRANSBOUNDARY AND CUMULATIVE IMPACTS

Any associated atmospheric emissions or accidental diesel spills occurring at the project site are very unlikely to reach the UK/Netherlands median line which is 62 km from the Leman BH platform. There is a possibility that the onshore decommissioning yard will be located in the Netherlands. If so, the associated impacts relating to atmospheric emissions during the transit of the platform components to shore and the risk of diesel spills will apply to the Netherlands sector. With appropriate mitigation in place, any transboundary impacts are anticipated to be minor.

The main potential for in-combination effects from the Leman BH decommissioning project arises from the seabed disturbance that may impact the conservation features of the North Norfolk Sandbanks and Saturn Reef SCI through temporary disturbance. A number of other potential activities have been identified within the SCI that can contribute to the in-combination effects including other oil and gas activities, fishing, aggregate extraction, and windfarm developments. However, information about the presence of conservation features and the areas of potential temporary or long-term disturbance was limited to oil and gas activities. The Leman BH project will only have a very small contribution to the cumulative effects of oil and gas infrastructure within the SCI overall, even when the worst case footprint is considered. There will be no in-combination effects on the sandbanks, as the footprint of the Leman BH project is located outside the sandbanks boundaries.

The areas of *Sabellaria* reef habitat that will be affected by oil and gas projects within the SCI will be relatively small compared to the size of the SCI as a whole. The ability of the wider area to support the development and persistence of *Sabellaria* reefs will not be impacted. Therefore, the in-combination effects to the conservation objectives of the SCI from the planned projects in the area are not considered to be significant.

## 7.3 CONCLUDING REMARKS

Overall, the Leman BH decommissioning project will be short term (less than 2 weeks offshore) and have an overall small impact footprint. There will be limited direct impact to potential *Sabellaria* reef, especially in the base case which is to use the Sheerleg HLV. Following the removal of the platform, a rapid recovery of the benthic environment is expected. Furthermore, the jacket removal will have a long term positive effect in relation to the conservation objectives for the North Norfolk Sandbank and Saturn Reef SCI as the physical obstruction caused by the platform infrastructure will be removed, thus allowing the recolonizing of the area. The associated impacts from scouring around the platform will also be reduced and as such, it can be expected that suspended sediments will settle more naturally in the immediate area.

Shell will take the necessary mitigation measures to optimise the positioning of the anchors to minimise any potential impacts to Annex I habitats and the conservation features of the North Norfolk Sandbanks and Saturn reef SCI. This includes the use of mid-water buoys on the anchor lines which will reduce the overall footprint further. The other potential impacts resulting from the proposed decommissioning operations are considered to be negligible. In summary, the project will have only a minor environmental impact and will not affect the conservation objectives of the North Norfolk Sandbanks and Saturn Reef SCI.

# 8 REFERENCES


**Anatec, (2005).** Leman BT and BH High level Ship Collision Risk Assessment (Main Report). Report number A1305-SH-CRA-1.

**Anatec, (2013).** *Consent to locate - Leman AC* (Technical note). Prepared by Anatec Ltd on behalf of Shell UK Ltd. Report number: A3118-SH-CR-1

**Birtwell IK, (1999)** *The Effects of Sediment on Fish and their Habitat.* Canadian Stock Assessment Secretariate Research Document 99/139.

**Cameron TDJ, Crosby A, Balson PS, Jeffery DH, Lott, GK, Bulat J and Harrison DJ (1992),** *The Geology of the southern North Sea. UK offshore Regional Report: the geology of the southern North Sea.* (London:HMSO for the British Geological Survey.

**OGUK (2013).** *The Management of Marine Growth During Decommissioing*. Report to OGUK prepared by BMT Cordah

**CEFAS (2001).** *North Sea Fish and Fisheries. Technical report TR_003*. Produced for Strategic Environmental Assessment – SEA2

**Coull K, Johnstone R & Rogers SI (1998).** *Fisheries sensitivity maps in British Waters*. UKOOA Ltd.

**Crown Estate (2015),** *Crown Estate Website.* http://www.thecrownestate.co.uk/energy-and-infrastructure/downloads/maps-and-gis-data/. Accessed February 2015.

**DECC (2009)** Offshore Energy Strategic Environmental Assessment (OSEA). Post Public Consultation Report. June 2009

**Ellwood, H (2014).** *Creating a Composite Map of Annex I sandbanks, Version 1.1,* http://jncc.defra.gov.uk/page-3058 [Date accessed: March 2015

**Ellwood, H. (2013).** *Creating a Composite Map of Annex I Reef.* Version 2.0. http://jncc.defra.gov.uk/page-4543. Date accessed: March 2015

**DEFRA (2015). Consultation on MCZs - Department of Environment Food and Rural Affairs Website** https://consult.defra.gov.uk/marine/tranche2mczs. Accessed March 2015.

**DTI (2001).** Strategic Environmental Assessment of the Mature Areas of the Offshore North Sea – SEA 2. Consultation Document. Report to the Department of Trade and Industry, September 2001.

**Dudgeon Offshore (2014).** *Dudgeon Offshore Windfarm website:* http://dudgeonoffshorewind.co.uk/. Accessed February 2015.

**Ellis JR, Milligan S, Readdy L, Taylor N and Brown M (2012).** *Spawning and nursery grounds of selected fish species in UK waters*. Science Series Technical Report 147. CEFAS, Lowestoft.

**Ellwood, H (2014).** *Creating a Composite Map of Annex I sandbanks, Version 1.1,* http://jncc.defra.gov.uk/page-3058 (Date accessed: April 2015).

**Ellwood, H. (2013).** *Creating a Composite Map of Annex I Reef. Version 2.0.* http://jncc.defra.gov.uk/page-4543 (Date accessed: April 2015).

**Fugro EMU (2015).** *Leman BH Habitat Assessment Report.* (Report No J/3/25/2695).

**Fugro (2014).** Anchoring conditions survey and Environmental Assessment Survey UKCS BLOCKs 49/26 & 27 (Shell Report No.: ED-2014-032)

**Fugro, (2013).** Leman Alpha Complex Habitat Assessment Survey. (Report Nor J/2/25/0172)

**Gardline (2006)** Debris Detection Survey, UKCS 49/26 Leman BH/BT. (Report No.ED-2005-067)

**Gubbay S. (2007).** Defining and Managing S. spinulosa reef: An interpretation in the context of the Habitats Directive.

**Gubbay S. (2003).**Marine Aggregate Extraction and Biodiversity. Information, issues, and gaps in understanding. Report to the Joint Marine Programme of the Wildlife Trusts and WWF-UK.

**Hermannsen L, Beedholm K, Tougaard J and Madsen PT (2014).** High frequency components of ship noise in shallow water with a discussion of implications for harbour porpoises (Phocoena phocoena). Journal of the Acoustical Society of America. 136 (4), October 2014.

**Hunt (2007).** Investigating high frequency underwater vessel noise and potential masking of killer whale echolocation clicks. Beam Reach Marine Science and Sustainability School. Downloaded at: http://www.beamreach.org/071dir/props/finprop_tim.pdf. Accessed March 2015.

**IoP (2000).** Guidelines for the Calculation of Estimates of Energy use and Gaseous Emissions in the Decommissioning of Offshore Structures. The Institute of Petroleum.

**Jackson A and Hiscock, K (2008).** *Sabellaria spinulosa. Ross worm*. Marine Life Information Network: Biology and Sensitivity Key Information Sub-programme. Plymouth: Marine Biological Association of the United Kingdom. Available online at http://www.marlin.ac.uk/speciesfullreview.php?speciesID=4278

**JNCC (1999).** Seabird vulnerability in the UK waters: block specific vulnerability, 1999. Joint Nature Conservation Committee.

**JNCC (2010).** Offshore Special Area of Conservation: North Norfolk Sandbanks and Saturn Reef. SAC Selection Assessment. Version 5.0 (August 2010).

**JNCC (2012a).** North Norfolk Sandbanks and Saturn Reef. Site details. Available online: http://jncc.defra.gov.uk/protectedsites/sacselection/sac.asp?EUCode=UK0030358 (Accessed October 2014).

**JNCC (2012b).** North Norfolk Sandbanks and Saturn Reef. Conservation Objectives and advice on operations. Available online:

http://jncc.defra.gov.uk/pdf/NNSandbanksandSaturnReef_ConservationObjectives_AdviceonOperations_6.0.pdf [Accessed December 2014).

**JNCC (2014).** Joint Nature Conservation Committee website. www.jncc.gov.uk (Accessed October 2014).

**JNCC (2015).** UK BAP Priority Habitats www.jncc.gov.uk/page-5718 (Accessed: January 2015)

**Jones E, McConnell B, Sparling C and Matthiopoulos J (2013)** *Grey and Harbour Seal density Maps*. Marine Mammal Scientific Support Research Programme MMSS/001/11.

**Jones LA, Hiscock K, and Connor DW (2000).** Marine habitat reviews. *A summary of ecological requirements and sensitivity characteristics for the conservation and management of marine SACs.* Joint Nature Conservation Committee (UK Marine SACs Project report).

**Kafas, A., Jones, G., Watret, R., Davies, I., Scott, B. (2012).** Representation of the use of marine space by commercial fisheries in marine spatial planning. ICES CM I:23.

**Kingfisher (2014).** Website www-kis-orca.eu. Offshore Cable awareness map viewed November 2014.

Künitzer A, Basford D, Craeymeersch JA, Dewarumez J M, Dorjes J, Duineveld GCA, Eleftheriou A, Heip C, Herman P, Kingston P, Niermann U, Rachor E, Rumohr H, & de Wilde PAJ (1992). *The benthic infauna of the North Sea: species distribution and assemblages.* ICES Journal of Marine Sciences 49: 127-143.

**Lee, A.J. and Ramster, J.W. (1981).** Atlas of the seas around the British Isles. Lowestoft, MAFF.

**Løkkeborg, S. (2005)** Impacts of trawling and scallop dredging on benthic habitats and communities. FAO Fisheries Technical Paper. No. 472. Rome, FAO. 2005.

**MCRI, (2011).** Acoustic and visual survey for harbour porpoises of the Dogger Bank and southern North Sea, November 2011. Prepared by Marine Conservation Research International 19pp.

**MMO (2015).** *East inshore and East Offshore Marine Plan Areas.* **Website:** https://www.gov.uk/east-inshore-and-east-offshore-marine-plan-areas. **Accessed March 2015.**

**OSIRIS (2014).** Shell Leman Field Geophysical Pipeline Inspection Survey.

**OSPAR (2013).** Background document on Sabellaria spinulosa reefs. OSPAR Commission, 2013.

**OSPAR (2008).** Descriptions of the habitats on the OSPAR list of threatened and/or declining species and habitats. Reference Number: 2008-07.

**OSPAR (2000).** Quality Status Report 2000, Region II - Greater North Sea. OSPAR Commission, London, 136pp.

**Pearce B, Hill JM, Wilson C, Griffin R, Earnshaw S and Pitts J (2011a).** *Sabellaria spinulosa Reef Ecology and Ecosystem Services*. The Crown Estate. 120 pages ISBN 978-1-906410-27-8. First Published 2013.

**Pearce, B., Hill, J.M., Grubb, L. and Harper, G. (2011b).** *Impacts of marine aggregate dredging on adjacent Sabellaria spinulosa aggregations and other benthic fauna*. Prepared by Marine Ecological Surveys Limited on behalf of Marine Aggregates Levy Sustainability Fund The Crown Estate.35pp. ISBN 978-0-9506920-5-0.

**Pearce B, Taylor J and Seiderer LJ (2007).** *Recoverability of Sabellaria spinulosa following aggregate Extraction Aggregate extraction.* Aggregate Extraction Levy Fund. MAL0027. Prepared by Marine Ecological Surveys Limited.

**Perenco UK Ltd & Tullow Oil SK Ltd, (2014).** *Thames Area Decommissioning Environmental Impact Assessment.* **August 2014. Document reference: PER-SNS-DECOM-THA-005.** https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/363714/Thames_Area_EIA.pdf. Accessed March 2015.

**Planning Inspectorate (2015).** *National Infrastructure Planning Website* http://infrastructure.planningportal.gov.uk. Accessed February 2015.

**Reid JB, Evans PGH & Northridge SP (2003).** *Atlas of cetacean distribution in north-west European waters.* Joint Nature Conservation Committee, Peterborough.

**Reiss H, Degraer S, Duineveld GCA, Kröncke I, Aldridge J, Craeymeersch J, Eggleton JD, Hillewaert H, Lavaleye MSS, Moll A, Pohlmann T, Rachor E, Robertson M, Vanden Berghe E, van Hoey G and Rees HL (2010).** *Spatial patterns of infauna, epifauna and demersal fish communities in the North Sea.* ICES Journal of Marine Science, 67: 278-293.

**Rees HL, Eggleton JD, Rachor E & Vanden Berghe E (Eds) 2007.** Structure and dynamics of the North Sea benthos. ICES Cooperative Research Report No 288. 258p.

Richardson, William John, Denis H. Thomson, Charles R. Greene, Jr., & Charles I. Malme. (1995). *Marine Mammals and Noise.* Academic Press

**SCOS (2013).** Scientific advice on matters related to the management of seal populations: 2013. Report by the Special Committee on Seals.

**Scottish Government (2014).** *Scottish Government website. Scottish Sea Fisheries statistics.* www.scotland.gov.uk/Topics/Statistics/Browse/Agriculture-Fisheries/RectangleData. Accessed December 2014

**Shell (2007).** Leman BH Monthly Windroses for SNS Operational Zones 1/2 (January 1979 to December 2004).

**Shell (2015).** Rose plots for current speed and direction in the Leman BH/BT location. (October 1964 to March 1995).

**Southall BL, Bowles AE, Ellison WT, Finneran JJ, Gentry RL, Greene CR Jr, Kastak D, Ketten DK, Miller JH, Nachtigall PE, Richardson WJ, Thomas JA & Tyack PL (2007).** *Marine mammal noise exposure criteria: initial scientific recommendations. Special Issue of Aquatic Mammals,* 33(4): 412 to 522.

**Stone CJ, Webb A, Barton C, Reed TC, Tasker ML, Camphuysen CJ and Pienkowski MW (1995),** *An atlas of seabird distribution in north-west European waters*, 326pp, ISBN 1 873701 94 2

**Subsea 7 (2012)** Shell ONEgas West Annual Pipelines Inspection report ROVSV Survey data. Document Number AB-S-RP-02317.

**Subsea 7 (2013)** Shell ONEgas West Annual Pipelines Inspection report ROVSV Survey data. Document Number AB-S-RP-02336.

**The Wildlife Trusts (2015).** *The Wildlife Trusts website*. www.wildlifetrusts.org. Accessed January 2015.

**UK Government (2015a). UK Emissions statistics 1990/2013.** Available at https://www.gov.uk/government/statistics/final-uk-emissions-estimates.

**UK Government (2015b). East Inshore and East Offshore Marine Plans.** Available at https://www.gov.uk/government/publications/east-inshore-and-east-offshore-marine-plans

**UK Government (2015c). Waste Hierarchy Guidance.** Available at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69403/pb13530-waste-hierarchy-guidance.pdf

**UKDMAP (1998).** *United Kingdom Digital Marine Atlas – An atlas of the seas around the British Isles.* Software third edition compiled by British Oceanographic Data Centre, Birkenhead.

**UKHO (2014).** United Kingdom Hydrographic Office website. www.UKHO.gov.uk Accessed November 2014.

# 9 ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| mg/kg | Milligrams per kiligram |
| m/s | Meters per second |
| $\mu$ g/g | Micrograms per gram |
| °C | Degrees Celsius |
| % | Percentage |
| AHV | Anchor Handling Vessel |
| CA | Competent Authority |
| CCS | Carbon Capture and Storage |
| CO | Carbon Monoxide |
| $CO_2$ | Carbon Dioxide |
| $CH_4$ | Methane |
| CtL | Consent to Locate |
| CMS | Corporate Management System |
| DECC | Department of Energy and Climate Change |
| DP | Decommissioning Programme |
| DTI | Department of Trade and Industry |
| DyP | Dynamically positioned |
| EIA | Environmental Impact Assessment |
| EPS | European Protected Species |
| EUNIS | European University Information Systems |
| EMS | Environmental Management Systems |
| ENVID | Environmental Issues Identification |
| FOCI | Feature of Conservations Interest |
| HLV | Heavy lift Vessel |
| HSE | Health, Safety and Environment |
| HSSE-SP | Health Safety, Security, Environment and Social Performance |
| ICC | Installation Control Centre |
| ICES | International Council for the Exploration of the Sea |
| IERP | Integrated Emergency Response Plan |
| IoP | Institute of Offshore Petroleum |
| ISO | International Standards Organisation |
| ISO | International Organization for Standardisation |
| JNCC | Joint Nature Conservation Committee |
| kHz | Kilohertz |
| LUC | Leman Uptime Compression |
| MCZ | Marine Conservation Zone |

| | |
|---|---|
| MARPOL | Maritime Pollution |
| $N_20$ | Nitrous Oxide |
| NFFO | National Federation of Fishermen's Organisations |
| NOx | Mono nitrogen oxides |
| NUI | Normally unattended Installation |
| OPEP | Oil Pollution Emergency Plan |
| OGUK | Oil and Gas UK |
| OPRC | Oil Pollution Preparedness, Response and Co-operation |
| OSD | Offshore Safety Directive |
| OSPAR | Oslo Paris Convention |
| OSR | Oil Spill Response |
| PSI | Particle size analysis |
| PON | Petroleum Operation Notice |
| PEXA | Practice and Exercise area |
| RAM | Risk Assessment Matrix |
| rMCZ | recommended Marine Conservation Zone |
| ROV | Remotely operation Vehicle |
| SAST | Seabirds at Sea Team |
| SCI | Site of Community Interest |
| SCOS | Special Committee on Seals |
| SDR | Offshore Safety Directive Regulator |
| SNS | Southern North Sea |
| SOx | Sulphur oxides |
| SPA | Special Protection Area |
| SSS | Side Scan Sonar |
| SSSI | Sites of Special Scientific Interest |
| THC | Total Hydrocarbon Concentration |
| TTS | Temporary Threshold Shift |
| UK BAP | UK Biodiversity Action Plan |
| UKOOA | UK Offshore Operators Association (now "Oil and Gas UK") |
| UKCS | UK Continental Shelf |
| UOS | Unplanned Overnight Shelter |
| VOC | Volatile Organic Compounds |

# 10 APPENDIX A: STAKEHOLDER ENGAGEMENT COMMENTS

| | Issue raised | Shell response | DP/EIA section |
|---|---|---|---|
| 1 | Meeting with DECC Decommissioning and Environmental Management Teams, 10/12/2014 | | |
| 1.1 | Potential for re-use of the accommodation block | The accommodation block has been considered for re-use at Clipper complex as a new accommodation module. However, due to its age (installed in 1981) and deteriorated condition, this was not deemed feasible. | DP (1.5)<br>EIA (2.2.3) |
| 1.2 | Impacts to the current operations and planned modifications to Leman BT. | No impact to operations of other facilities is expected. All of the functions of Leman BH would be transferred to Leman BT platform. Details of Leman BT refurbishment project are provided within this EIA and the DP for information only, as this work is out with the scope of the Leman BH decommissioning project. | DP (1.5, 1.7)<br>EIA (2.3) |
| 1.3 | Cut power cable to be left *in situ*. The proposal for the power cable should be clearly outlined within the Decommissioning Programme. | The cut end of the cable is located within the 500m safety zone of Leman BT platform, this safety zone will be retained until the final decommissioning. | DP: (1.5)<br>EIA (2.3) |
| 1.4 | Clarifications to be provided within the EIA as to whether the HLV will move position during the lifts and the type anchoring (chains, wires, etc.) used. | Details of HLV anchoring operations and the type of anchoring will depend on the vessel selected through a commercial tendering process. The EIA discusses and assesses impacts from both types of HLV (traditionally moored HLV and a smaller Sheerleg HLV) | EIA (2.2, 2.3, 5) |
| 1.5 | Clarification as to whether the Leman BH platform is located on a sandbank. | Shell confirmed that there was a small sand ridge at the platform location, however the ridge was submerged deeper than 20 m and did not form part of the larger sandbank nearby. | EIA (3.2, 3.5.1) |
| 1.6 | DECC emphasized that the survey results and the project should be discussed with JNCC. | A follow up consultation with JNCC was held on 04/03/15. Summary of issues raised is provided in this table below. | EIA (Appx. A) |
| 2 | Meeting with SFF/NFFO/Marine Scotland; February 2015 | | |
| 2.1 | MS asked for clarification regarding the fate of debris on the seabed following the platform removal. | Leman BH is located 40 m away from Leman BT platform, to which it is currently bridge-linked, and the platforms share one 500m safety zone. Only Leman BH platform will be removed as part of the decommissioning project. Leman BT platform will remain in place and will retain the 500 m safety zone. Any debris within this 500 m zone will remain on the seabed until the time of Leman BT decommissioning. The centre of the safety zones between Leman BH and Leman BT is 66 m, therefore there will be a small portion of the current Leman BH safety zone which will lie out with the Leman BT safety zone. However, no debris is anticipated to be in this area. | DP (6.2)<br>EIA (2.3.6) |
| 2.2 | NFFO offered a possibly to use a NFFO vessel to carry out trawl sweeps once the structure is removed to support a clean bed certificate | As above, as the 500 m zone will not be surrendered until the final Leman BT decommissioning, no verification trawl sweeps are envisaged as part of Leman BH DP. | DP (6.2)<br>EIA n/a |

| | Issue raised | Shell response | DP/EIA section |
|---|---|---|---|
| 3 | Meeting with JNCC; 04/03/2015 | | |
| 3.1 | Some Leman A and Leman B *Sabellaria* aggregations appear to connect and overlap. This indicates that the largest identified aggregation appears to be a relatively stable structure. Shell needs to ensure its connectivity as a single patch are discussed in the habitats assessment report and the relevant EIAs | This has been addressed both in this EIA and the supporting Leman BH Habitat assessment report (Fugro EMU, 2015). | EIA (3.2, 3.5, 5.2) |
| 3.2 | Ensure in-combination effects are considered from the overlap with Leman AC on-going project, Leman BH and other Shell and other companies' activities | Addressed in this EIA | EIA (5.8) |
| 3.3 | Address in the EIA whether any stabilization materials present /planned for removal | Stabilization materials are likely to be present in the immediate vicinity of the platform. There is no plan to remove or relocate these during the Leman BH platform removal, and no plan to install further stabilisation material. Therefore the stabilization material is only mentioned in the baseline section. | EIA (3.3.3) |
| 3.4 | JNCC supports the proposed approach to assessing the potential impact of both HLV and Sheerleg anchoring. Impacts to the delineated *Sabellaria* aggregations to be assumed as worst case scenario recognizing that there appears sufficient area to re-position the anchors. | Addressed in this EIA | EIA (5.2) |
| 3.5 | Clarification sought regarding the number of anchoring operations required for Sheerleg. | Sheerleg would require 2 anchoring operations. | EIA (2.3, 5.2) |
| 3.6 | Ensure EIA addresses proximity to sandbanks | Discussed in the baseline description and impact assessment sections | EIA (3.2, 3.5 and 5.2) |

# 11 APPENDIX B: SABELLARIA ASSESSMENTS AT DELINEATED PATCHES AND ROV TRANSECTS

**Figure B1:** Detail of reef elevation and patchiness at *Sabellaria* patch S1

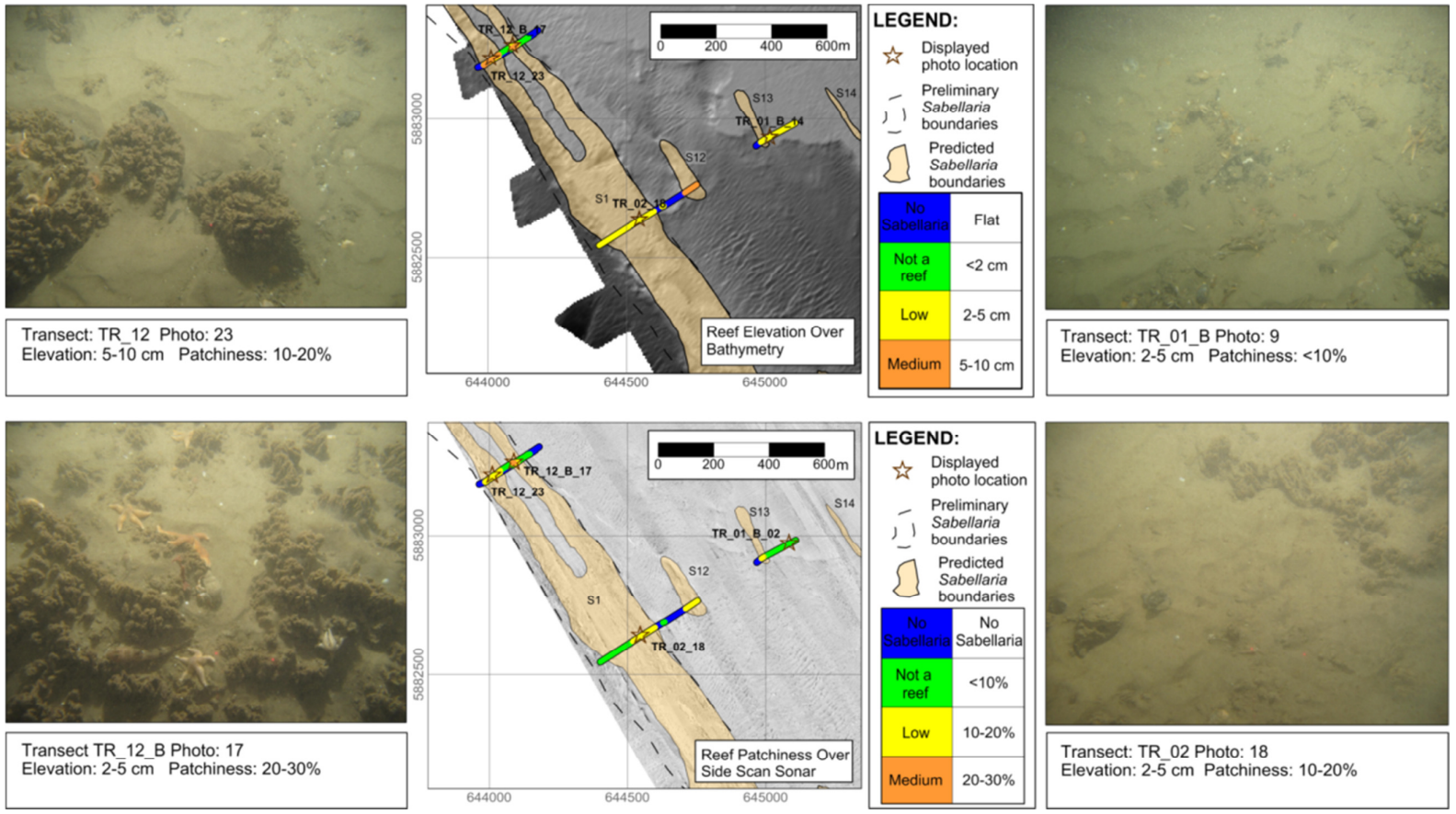
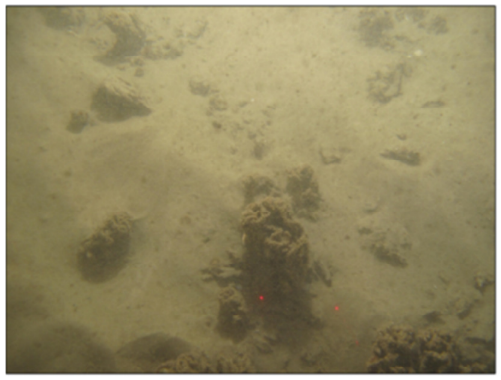
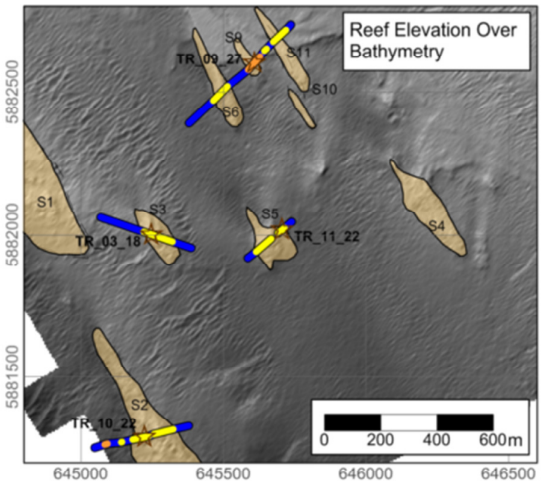
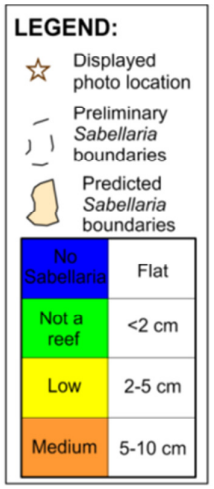


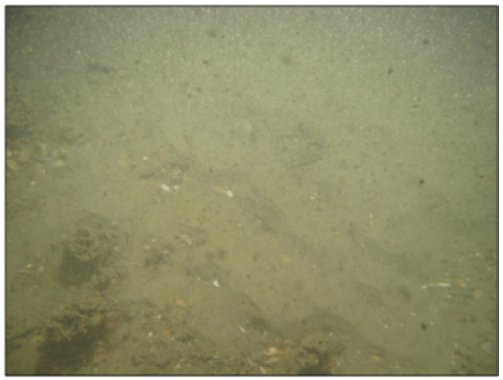
**Figure B2:** Detail of reef elevation and patchiness at *Sabellaria* patches S3, S4, S5, S6, S9 and S11



Transect: TR_09 Photo: 27
Elevation: 5-10 cm Patchiness: 10-20%

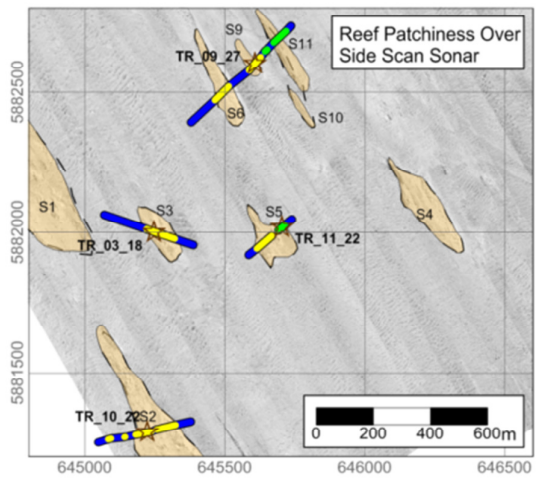


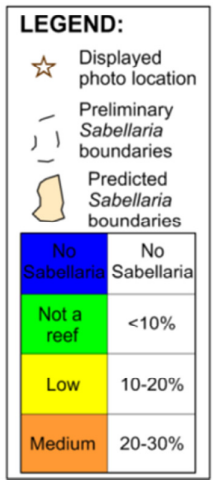



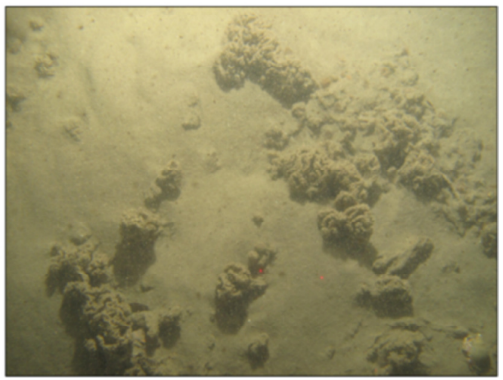



Transect: TR_11 Photo: 22
Elevation: 2-5 cm Patchiness: <10%

Transect TR_03 Photo: 18
Elevation: 2-5 cm Patchiness: 10-20%



Transect: TR_10 Photo: 22
Elevation: 2-5 cm Patchiness: 10-20%

**Figure B3:** Detail of reef elevation and patchiness at Sabellaria patches S7, S8 and S16.

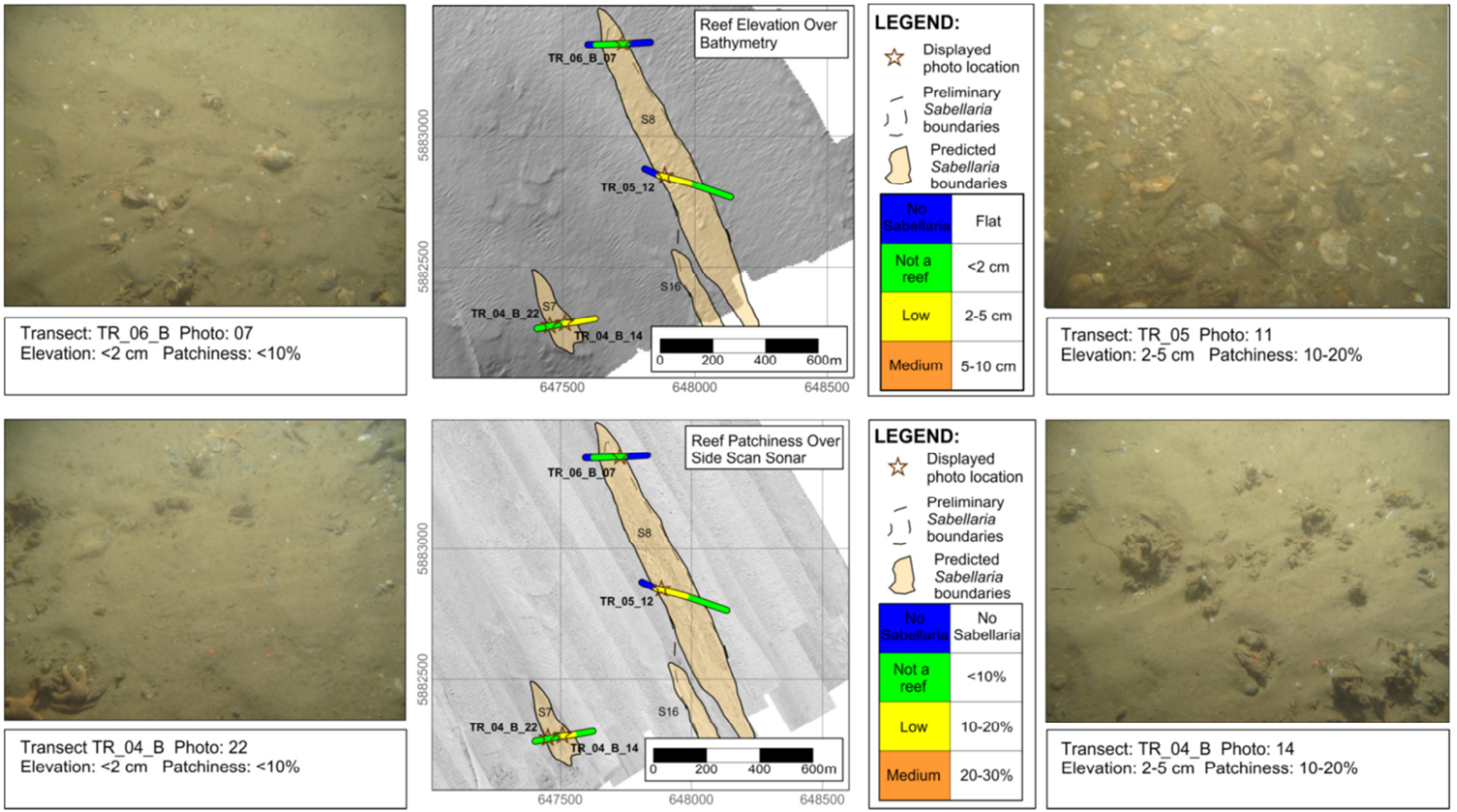
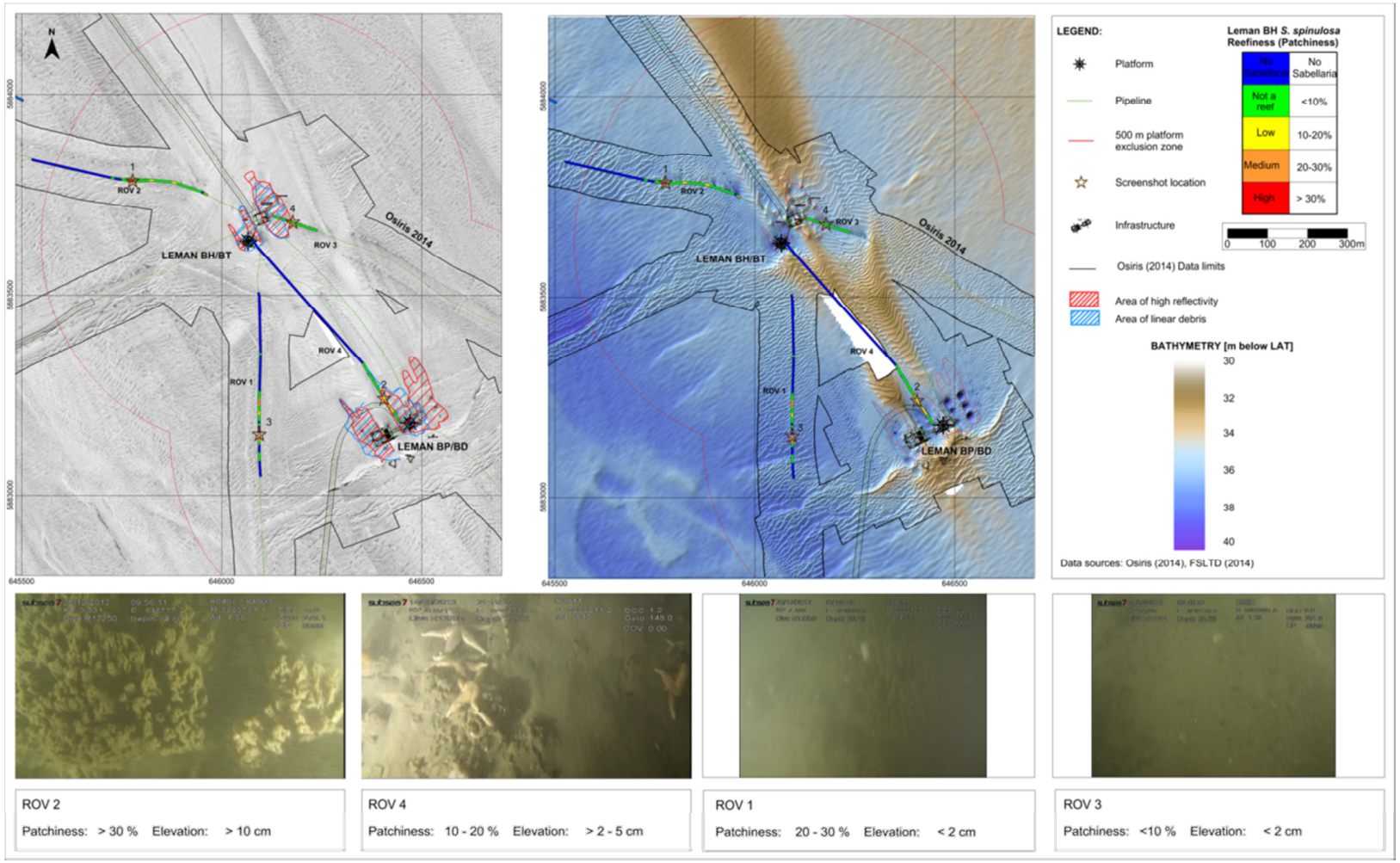



**Figure B4:** Detail of reef patchiness from ROV Pipeline inspection survey data