Environmental Appraisal

Indefatigable 23AC & AQ, Risers and Bridges

Perenco UK

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The Power of Commitment

Abbreviations

Abbreviation	Description
Terms	
AL	Action Level
As	Arsenic
ASL	Above sea level
AtoNs	Aids to Navigation
Ba	Barium
BAC	Background assessment concentration
BAP	Biodiversity Action Plan
BC	Background concentration
BDL	Below Detection Levels
BGT	Bacton Gas Terminal
BOEPD	Barrels of oil equivalent per day
Cd	Cadmium
CEFAS	Centre for Environment, Fisheries and Aquaculture, Fisheries and Aquaculture, Science
CH_4	Methane
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
CoP	Cessation of Production
CPI	Carbon Preference Index
Cr	Chromium
CSQG	Canadian Sediment Quality Index
Cu	Copper
DDC	Drop Down Camera
DECC	Department of Energy and Climate Change
DEFRA	Department for Environment, Food & Rural Affairs
DESNZ	The Department for Energy Security and Net Zero
DP	Decommissioning Programme
DTI	Department of Trade and Industry
EA	Environmental Appraisal
EBS	Environmental Baseline Survey
EC	European Commission
EEC	Endangered Ecological Community
EIA	Environmental impact assessment
EMS	Environmental Management System
EUNIS	European Nature Information Service
ENVID	Environmental Impacts Identification

Abbreviation	Description
EPA	Environment Protection Authority
EPS	European Protected Species
ERL	Effect range low
ERM	Effect range median
EU	European Union
EUNIS	European Nature Information System
FCS	Favourable Conservation Status
Fe	Iron
gAFDW	Grams of ash-free dry weight
GHD	GHD Pty Ltd
GHG	Greenhouse Gas
GIS	Geographic Information System
HCS	Hydrocarbon Safe
Hg	Mercury
HLV	Heavy Lift Vessel
HSE	Health, Safety and Environmental
HSSE	Health, Safety, Security and Environment
IAMMWG	Inter-Agency Marine Mammal Working Group
ICES	International Council for the Exploration of the Sea
Inde 23AC	Inde 23A Compression
Inde 23AQ	Inde 23A Quarters
Inde 23AT	Inde 23A Terminal
ISO	International Organization for Standardization
IUCN	International Union for the Conservation of Nature
IWS	International Waste Shipment
JNCC	Joint Nature Conservation Committee
LAT	Lowest Astronomical Tide
LC	Least Concern
Li	Lithium
MARPOL	International Convention for the Prevention of Pollution from Ships
MBES	Multibeam echosounder
MCZ	Marine Conservation Zones
MEG	Monoethylene glycol
MMMU	Marine Mammal Management Unit
MMO	Marine Management Organisation
MMS	Minerals Management Service
MPA	Marine Protected Area
Ni	Nickel
NORM	Naturally Occurring Radioactive Material
NO_x	Nitrogen Oxides
NPD	Nitrogen-phosphorus detection

Abbreviation	Description
NSTA	North Sea Transition Authority (formerly OGA)
NT	Near Threatened
OESEA	UK Offshore Energy Strategic Environmental Assessment
OGA	Oil and Gas Authority
OPEP	Oil Pollution Emergency Plans
OPRED	Offshore Petroleum Regulator for Environment and Decommissioning
OSPAR	The Convention for the Protection of the Marine Environment of the North-East Atlantic
PAH	Polycyclic aromatic hydrocarbons
Pb	Lead
P / B	Petrogenic / Biogenic
PDEC	Petrodec
PEL	Probable Effect Level
PEXA	Practice and Exercise Areas
PL	Pipeline
POMS	PUK Operating Management System
Pr / Ph	Pristane / Phytane
PUK	Perenco UK Limited
RAT	Rope Access Technician
REF	Review of environmental factors
ROV	Remotely Operated Vehicle
RPS	Radiation Protection Supervisor
SAC	Special Areas of Conservation
SBP	Sub-bottom profiling
SCANS	Small Cetacean Abundance in the North Sea
SD	Standard deviation
SEMS	Safety and Environmental Management System
SHARP	Southern Hub Area Rationalisation Project
SIMPER	Similarity percentage analysis
Sn	Tin
SNS	Southern North Sea
SO_2	Sulphur Dioxide
SOPEP	Shipboard Oil Pollution Emergency Plan
SOSI	Seabird Oil Sensitivity Index
SPA	Special Protection Areas
SPL	Sound Pressure Level
SSS	Sidescan Sonar
SSSI	Sites of Special Scientific Interest
TEL	Threshold Effect Level
THC	Total hydrocarbon content
TOC	Total Organic Carbon
TOOPEP	Temporary Operation Oil Pollution Emergency Plan

Abbreviation	Description
UK	United Kingdom
UKBAP	United Kingdom Biodiversity Action Plan
UKCS	United Kingdom Continental Shelf
UKOOA	United Kingdom Offshore Operators Association
USA EPA	United States of American Environment Protection Agency
VOC	Volatile Organic Compounds
VU	Vulnerable
WONS	Well Operations Notification System
Zn	Zinc
Units	
"	Inch
cm	Centimetre
dB re 1 μPa at 1 m	Decibels relative to 1 micropascal at 1 meter
Hz	Hertz
kHz	Kilohertz
km	Kilometre
m	Metre
m / s	Metres per second
$mg.kg^{-1}$	Milligrams per kilogram
mm	Millimetre
ppm	Parts per million
ppb	Parts per billion
ppt	Parts per trillion
rms	Root Mean Square
te	Tonnes
°C	Degrees Celsius
μPa	Micropascal
$\mu g.kg^{-1}$	Micrograms per kilogram
μm	Micrometre

Holds

Section	Hold	Description
3	1	Provide stakeholder responses

Executive summary

In accordance with the *Petroleum Act 1998*, Perenco UK Limited (PUK) is applying to the Offshore Petroleum Regulator for Environment and Decommissioning (OPRED) to obtain approval for the decommissioning of two platforms in the Indefatigable 49/23 Alpha (Inde 23A) installation. The infrastructure proposed for decommissioning includes the Compression (AC) and Quarters (AQ) platforms, comprising:

– two steel jackets
– two topsides
– two bridges: one connecting the AQ and AC platforms and the other connecting the AC and Terminal (AT) platforms.
– two pipeline (PL) risers for PL2355 and PL2356.

The purpose of the report is to serve as the Environmental Appraisal (EA) for these decommissioning works. This EA has been prepared by GHD for Perenco UK and is subject to the limitations provided in section 1.1.

Inde 23A (Licence Number: P16) is located in the United Kingdom Continental Shelf (UKCS) in Block 49/23a, approximately 90 kilometres (km) from the nearest UK coastline.

The Inde field was discovered by Amoco in 1966 and brought into production in 1971. The development consists of Inde 23A, Indefatigable 18 Alpha (Inde 18A), Indefatigable 18 Bravo Installation (Inde 18B), Indefatigable 23 Charlie Installation (Inde 23C), Indefatigable 23 Delta Installation (Inde 23D), Bessemer 23E Installation and Davy 30A Installation.

No gas is produced from Inde 49/23A; the purpose of the installation was to provide facilities for the gathering of gas from neighbouring production platforms and for its separation prior to export to Bacton Gas Terminal (BGT) via Leman 49/27B, PL106, Leman 49/27A and PL23. There are no subsea wells associated with the Inde 23AC and 23AQ installations.

Three platforms make up the installation: Terminal (AT) (Operational), Compression (AC) (Lighthouse Mode) and Quarters (AQ) (Mothballed). AT was installed in June 1972 while AQ and AC were installed in April 1980 and November 1980, respectively. The AC platform superstructure consists of a cellar deck, a main deck and a cooler deck, which constitute an integral unit formed by horizontal steel trusses supported by vertical members mated to the jacket legs. The AQ platform superstructure comprises a cellar deck, main deck, accommodation module and helideck.

A 39.6 metre (m) long bridge connects the AT and AC platforms (AT-AC bridge). The bridge is on two levels and comprises welded steel tubulars constructed as space frames carrying a longitudinal, open walkway and provided support for piping and services. A 48.5 m bridge connects the AC and AQ platforms (AC-AQ bridge). This bridge is constructed in similar fashion to the bridge between the AT and AC platforms.

The 8” PL2355 import pipeline riser and the 3” PL2356 monoethylene glycol (MEG) export riser are located at the south-west corner of AC platform. They are routed up the south face of the jacket in a protective caisson. These risers are redundant in situ and have been flushed, cleaned, water filled, air gapped and verified as hydrocarbon safe (HCS) on the AC topside. The risers will be air-gapped subsea at the base of the AC platform approximately 2m above the seabed (-27m LAT) prior to jacket removal. There are no subsea pipelines or risers connected to the AQ platform.

It is likely that the AT-AC bridge will be decommissioned first in an earlier mobilisation so that Inde 23AC is physically disconnected from the still operational Inde 23AT for the rest of the decommissioning works. The method of decommissioning the bridges is otherwise expected to be the same. The bridges will be rigged up to the Heavy Lift Vessel (HLV) crane and lifted from the platforms.

Both the Inde23 AC and Inde 23AQ topsides will then likely be removed via a single lift removal conducted using a suitable HLV. Similarly, both the Inde 23AC and Inde 23AQ jackets will likely be removed via a single lift removal conducted using a suitable HLV. The pile cuts will be made -3 m below the seabed to ensure that any remains are unlikely to become uncovered. The PL2355 and PL2356 riser sections will be cut subsea, near the base of the AC jacket. These cuts will create an air gap between the risers and the remaining pipelines to facilitate the removal of the jacket and attached riser sections.

This EA does not include decommissioning of the Inde 23AT platform, which is operational and will be decommissioned at a later date. It also does not contain a programme for the Wenlock pipelines PL2355 and PL2356; these were covered in the Wenlock Decommissioning Programmes (DPs) prepared by Alpha Petroleum Resources Limited and approved on 23rd February 2022.

In line with legislation and regulatory guidance, this EA report has been produced to support the Inde 23A DP by assessing the potentially significant impacts associated with the preferred decommissioning option. This EA report sets out to describe, in a proportionate manner, the potential environmental impacts of the proposed activities associated with the Inde 23AC and AQ topsides, jackets, bridges, and PL2355 and PL2356 riser section decommissioning and to demonstrate the extent to which these will be mitigated and controlled to an acceptable level.

Regional datasets and site-specific surveys were used to describe the physical environment, biological communities, and socio-economic context surrounding the Inde 23A installation. A pre-decommissioning environmental baseline survey (EBS) was conducted in 2022 (Ocean Ecology Limited, 2023). The seabed habitat was characterised as circalittoral muddy sand, with macrobenthic communities more closely aligned to infralittoral biotopes such as *Fabulina fabula* and *Magelona mirabili*s assemblages. Sediments were predominantly sandy (mean 96%), with low proportions of gravel and mud. Seabed chemistry indicated low levels of total organic carbon, and hydrocarbon concentrations below North Sea background levels. Heavy metals and trace metals were generally low, although cadmium, copper and mercury exceeded reference thresholds at one station. No Annex I habitats or species of conservation interest were identified.

Annual ornithological surveys from 2023 to 2025 recorded no nesting seabirds at the platform. The area provides habitat for marine mammals including Harbour porpoise and seals. The area also supports spawning and nursery grounds for several fish species of conservation value, including cod and tope shark. Socio-economic activity in the vicinity is limited, with low levels of commercial shipping and fishing. The site lies approximately 4.96 km east of the North Norfolk Sandbanks and Saturn Reef Special Area of Conservation (SAC), and 19 km southeast of the Southern North Sea SAC. The nearest active uses include the Indefatigable West aggregate site (11.85 km east), Norfolk Boreas wind farm (25.70 km southeast), and the NORSEA COM 1 telecom cable (9.39 km). The area is also within a carbon storage licence held by Shell UK Ltd.

Potential environmental and social impacts associated with the decommissioning of Inde 23A were identified through a structured ENVID workshop and assessed using recognised environmental impact assessment methodology. The assessment considered both planned activities—such as vessel operations, cutting and lifting, pipeline removal, and seabed surveys—and unplanned events including vessel collision, pipeline breach, and hazardous material release. All planned activities—such as vessel operations, cutting and lifting, pipeline removal, and seabed surveys—were assessed as having Minor or Negligible impacts. Unplanned events—including vessel collision, pipeline breach, and hazardous material release—were assessed as having the potential for Moderate impacts, but their low likelihood reduced their overall risk rating to Minor.

Seabed disturbance is expected to affect approximately 111,833 m², but impacts are temporary and localised, with recovery supported by sediment dynamics and resilient benthic communities. Emissions to air and sea, underwater noise, and light were assessed as Minor, with mitigation measures in place to minimise effects. Waste will be managed under a structured plan prioritising recycling and safe disposal, including for hazardous materials such as NORM and asbestos. No significant impacts are expected on protected areas, and cumulative, transboundary, and in-combination effects are considered low.

Environmental impacts associated with the Inde 23A decommissioning will be managed through a combination of project-specific mitigation measures and PUK's certified ISO 14001 Environmental Management System and Safety and Environmental Management System (SEMS). Measures such as anchor plans, lift procedures, and hazardous materials protocols will be implemented to minimise risks during operations. The SEMS provides a structured framework for assigning responsibilities, ensuring staff competence, monitoring performance, and managing change, with procedures in place for incident reporting, corrective action, and continuous improvement.

The Environmental Appraisal has considered the proposed decommissioning activities in relation to the receiving environment, applicable legislation, and established industry practice. The assessment concludes that, with appropriate mitigation measures and environmental management systems in place, the works can be undertaken with limited and controlled environmental effects. Potential impacts have been identified, evaluated, and addressed through a combination of project-specific controls and procedural frameworks. The decommissioning is expected to proceed in accordance with regulatory requirements and without significant adverse impact to environmental or socio-economic receptors.

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1. Introduction

1.1 Purpose of this report

This EA report sets out to describe, in a proportionate manner, the potential environmental impacts of the proposed activities associated with decommissioning the Indefatigable (Inde) 23AC and AQ topsides, jackets, bridges, and Pipeline (PL) 2355 and PL2356 riser sections, and to demonstrate the extent to which these will be mitigated and controlled to an acceptable level.

1.2 Scope and limitations

This report: has been prepared by GHD for Perenco UK and may only be used and relied on by Perenco UK for the purpose agreed between GHD and Perenco UK as set out in section 1.1 of this report.

GHD otherwise disclaims responsibility to any person other than Perenco UK arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

1.3 EA structure

The key components and structure of this report are laid out in Table 1.1.

Table 1.1 Structure of this EA

Name	Section
-	Executive Summary
Section 1	Introduction to the decommissioning project for the 23AC and AQ topsides, jackets, bridges, and PL2355 and PL2356 riser sections, and a description of the EA report scope and structure.
Section 2	The regulatory context and guidance for undertaking a decommissioning EA.
Section 3	A summary of the stakeholder engagement process and activities carried out by PUK to date.
Section 4	An outline of the options considered for decommissioning, the decision-making process undergone by PUK to arrive at the selected decommissioning strategy and a description of the proposed decommissioning activities.
Section 5	A summary of the baseline sensitivities relevant to the activities taking place and the assessments that support this EA.
Section 6	A summary of the project Environmental Issues Identification process and findings.
Section 7	An outline of the EA method used, review of the potential impacts from the proposed decommissioning activities, and justification for scoping potential impacts in or out of assessment in this EA report.
Section 8	Assessment conclusions.
Section 9	Environmental management.
Section 10	References.
Appendix A	ENVID Worksheet
Appendix B	Air Emissions Assessment

1.4 PUK Limited

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

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

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

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

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

2. Policy and regulatory context

2.1 Overview

The decommissioning of offshore oil and gas installations and pipelines on the United Kingdom Continental Shelf (UKCS) is principally governed through the *Petroleum Act 1998* and is amended by the *Energy Act 2008*.

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

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

In the context of marine planning, the Inde 23A infrastructure to be decommissioned are located within the East Marine Plan offshore area (MMO, 2024). This area falls under the East Marine Plans which were developed to help ensure sustainable development of the UK marine area (MMO, 2022). The broad aims and policies outlined in the Marine Plan have therefore been considered in this EA report.

The primary guidance for offshore decommissioning (OPRED, 2018) details the need for an EA to be submitted in support of the DP. The guidance sets out a framework for the required environmental inputs and deliverables throughout the approval process. It describes a proportionate EA process that culminates in a streamlined EA report rather than a lengthy Environmental Statement as would be required under the Environmental Impact Assessment (EIA) Directive (Directive 2011/92/EU as amended by Directive 2014/52/EU) (European Commission, et al., 2017).

2.2 Field and infrastructure description

Inde 23A (Licence Number: P16) is located in the UKCS in Block 49/23 (see Figure 1), approximately 90 kilometres (km) northeast of Bacton Gas Terminal (BGT) off the coast of East Anglia. Its WGS84 coordinates are:

– Inde 23 Compression (AC) installation: Latitude 53° 19' 22.3364" N, Longitude 02° 34' 24.6836" E
– Inde 23 Quarters (AQ) installation: Latitude 53° 19' 24.4998" N, Longitude 02° 34' 27.8886" E.

The Inde field was discovered by Amoco in 1966 and brought into production in 1971. The development consists of Inde 23A, Indefatigable 18 Alpha (Inde 18A), Indefatigable 18 Bravo Installation (Inde 18B), Indefatigable 23 Charlie Installation (Inde 23C), Indefatigable 23 Delta Installation (Inde 23D), Bessemer 23E Installation and Davy 30A Installation. A visualisation of Inde 23A and its adjacent facilities is provided in Figure 2. Inde 23A is located approximately 4.96 km east of the North Norfolk Sandbanks and Saturn Reef Special Areas of Conservation (SAC).

Three platforms make up the installation: Terminal (AT) (Operational), Compression (AC) (Lighthouse Mode) and Quarters (AQ) (Mothballed). AT was installed in June 1972 while AQ and AC were installed in April 1980 and November 1980 respectively. The AC platform superstructure consists of a cellar deck, a main deck and a cooler deck, which constitute an integral unit formed by horizontal steel trusses supported by vertical members mated to the jacket legs. The AQ platform superstructure comprises a cellar deck, main deck, accommodation module and helideck.

No gas is produced from Inde 49/23A (Licence Number 16); the purpose of the installation was to provide facilities for the gathering of gas from neighbouring production platforms and for its separation prior to export to BGT via Leman 49/27B, PL106, Leman 49/27A and PL23. There are no subsea wells associated with the Inde 23AC and 23AQ installations.

A 39.6 metre (m) long bridge connects the AT and AC platforms (AT-AC bridge). The bridge is on two levels and comprises welded steel tubulars constructed as space frames carrying a longitudinal, open walkway and provided support for piping and services. A 48.5 m bridge connects the AC and AQ platforms (AC-AQ bridge). This bridge is constructed in similar fashion to the bridge between the AT and AC platforms.

The 8” PL2355 import pipeline riser and the 3” PL2356 monoethylene glycol (MEG) export riser are located at the south-west corner of AC platform. They are routed up the south face of the jacket in a protective caisson. These risers are redundant in situ and have been flushed, cleaned, water filled, air gapped and verified as hydrocarbon safe (HCS) on the AC topside. The risers will be air-gapped subsea at the base of the AC platform approximately 2m above the seabed (-27m Lowest Astronomical Tide (LAT)) prior to jacket removal. There are no subsea pipelines or risers connected to the AQ platform.

Inde 23AC and AQ are in Lighthouse Mode and mothball, respectively, while Inde 23AT remains Operational. AC and AQ were put in Lighthouse Mode and mothballed respectively following completion of the Southern Hub Area Rationalisation Project (SHARP) project. SHARP removed the requirement for compression on Inde 23A and moved this to Leman 27B. The process was significantly simplified such that only 23AT was required to remain operational. As such, AC and AQ have been in Lighthouse Mode and mothballed states since May 2023. AT will remain operational into the 2030s.

This EA does not include decommissioning of the Inde 23AT platform, which is operational and will be decommissioned at a later date. It also does not contain a programme for the Wenlock pipelines PL2355 and PL2356; these were covered in the Wenlock Decommissioning Programmes (DPs) prepared by Alpha Petroleum Resources Limited and approved on 23rd February 2022.

A description of the decommissioning activities covered under this DP is provided in section 4.

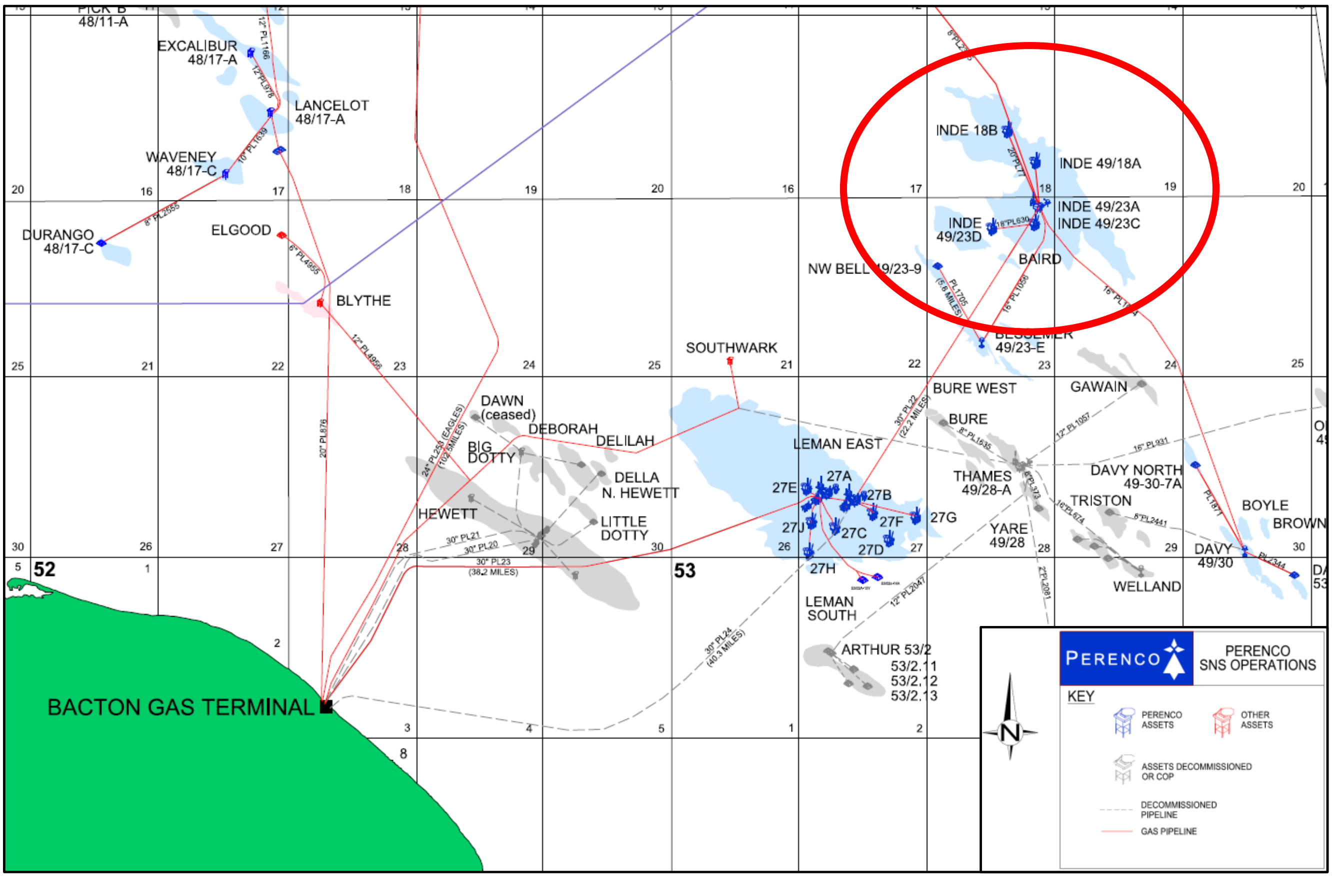


Figure 1 Overview of Inde field location

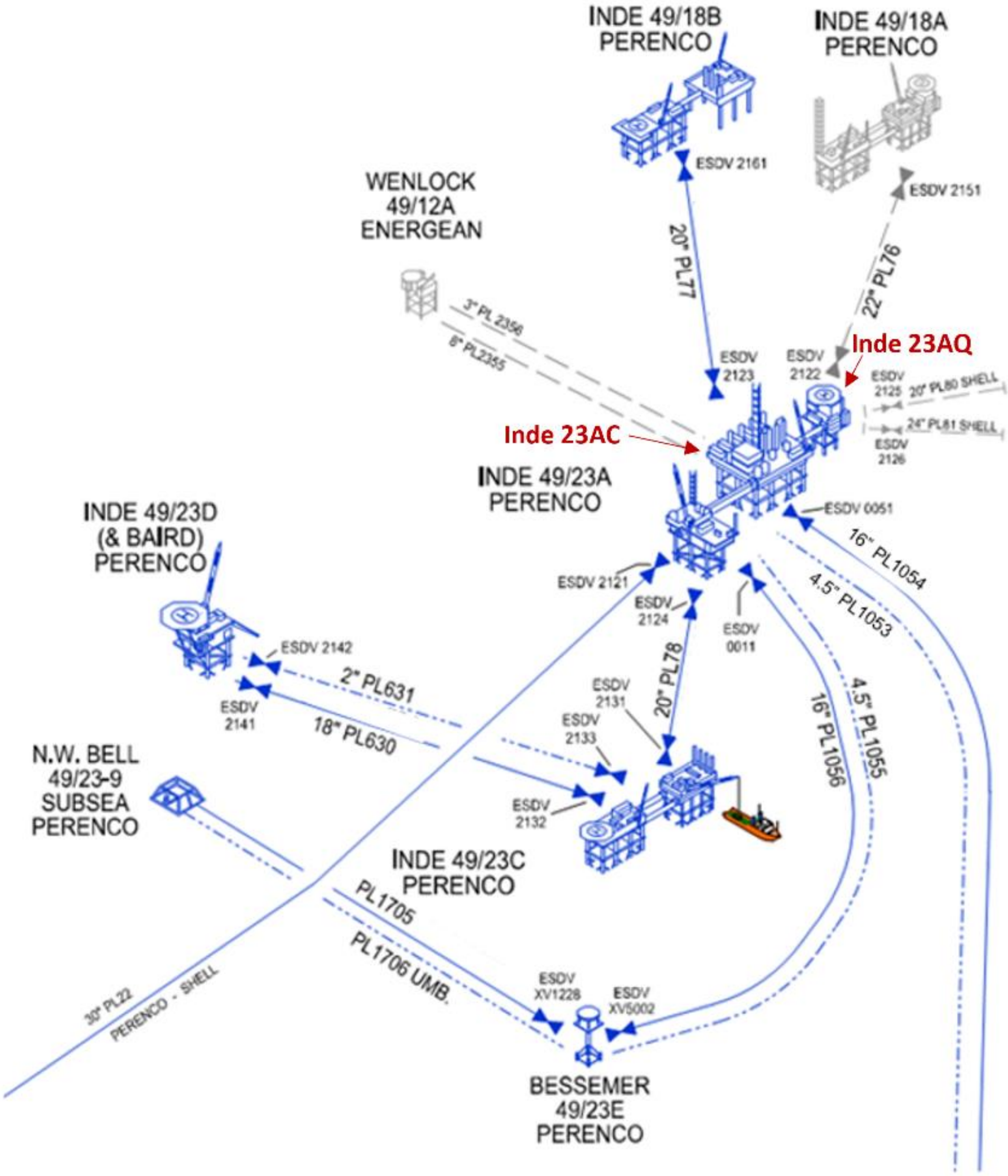


Figure 2 *Layout of Inde 23A and adjacent facilities*

3. Consultee responses

Table 3.1 provides details of stakeholder responses (HOLD 1).

Table 3.1 Consultee Responses

Who	Comment	Response
1. Stakeholder Consultation		
UK Hydrographic Office (UKHO)		
Health and Safety Executive		
Maritime and Coastguard Agency (MCA)		
Environment Agency		
Marine Management Organisation (MMO)		
Trinity House		
2. Public		
3. Statutory Context		
National Federation of Fishermen's Organisations		
Scottish Fishermen's Federation		
Northern Ireland Fish Producers Organisation		
Global Marine Group		
NSTA		Perenco has consulted with NSTA under S29(2A) of the Petroleum Act.

4. Decommissioning activities and parameters

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

4.1 Relevant infrastructure inside DP / EA scope

The infrastructure relevant to this DP / EA are the Inde 23A:

- **jackets:** Inde 23AC and Inde 23AQ fixed leg steel jackets
- **topsides:** Inde 23AC topside (compression) and Inde 23AQ topside (quarters)
- **bridges:** one bridge connecting the AQ and AC platforms and another bridge connecting the AC and AT platforms.
- **pipeline risers:** risers for 8” PL2355 and 3” PL2356.

The Inde 23AC and AQ installations and the bridges are shown in Figure 3.

Inde 23AC was primarily taken up with the LP and HP gas compression plant, 49/12A Wenlock reception facilities and the main power generation equipment. The platform has been converted to Lighthouse Mode and all equipment is now redundant; the equipment has either been removed or left in-situ.

Inde 23AQ was predominantly allocated to the living accommodation module on the main deck, utility services equipment together with additional accommodation on the cellar deck, and the helideck. The platform has been mothballed and all equipment is now redundant; the equipment has either been removed or left in-situ.

No pipeline stabilisation material will be introduced or removed from the seabed as part of the proposed decommissioning activities.

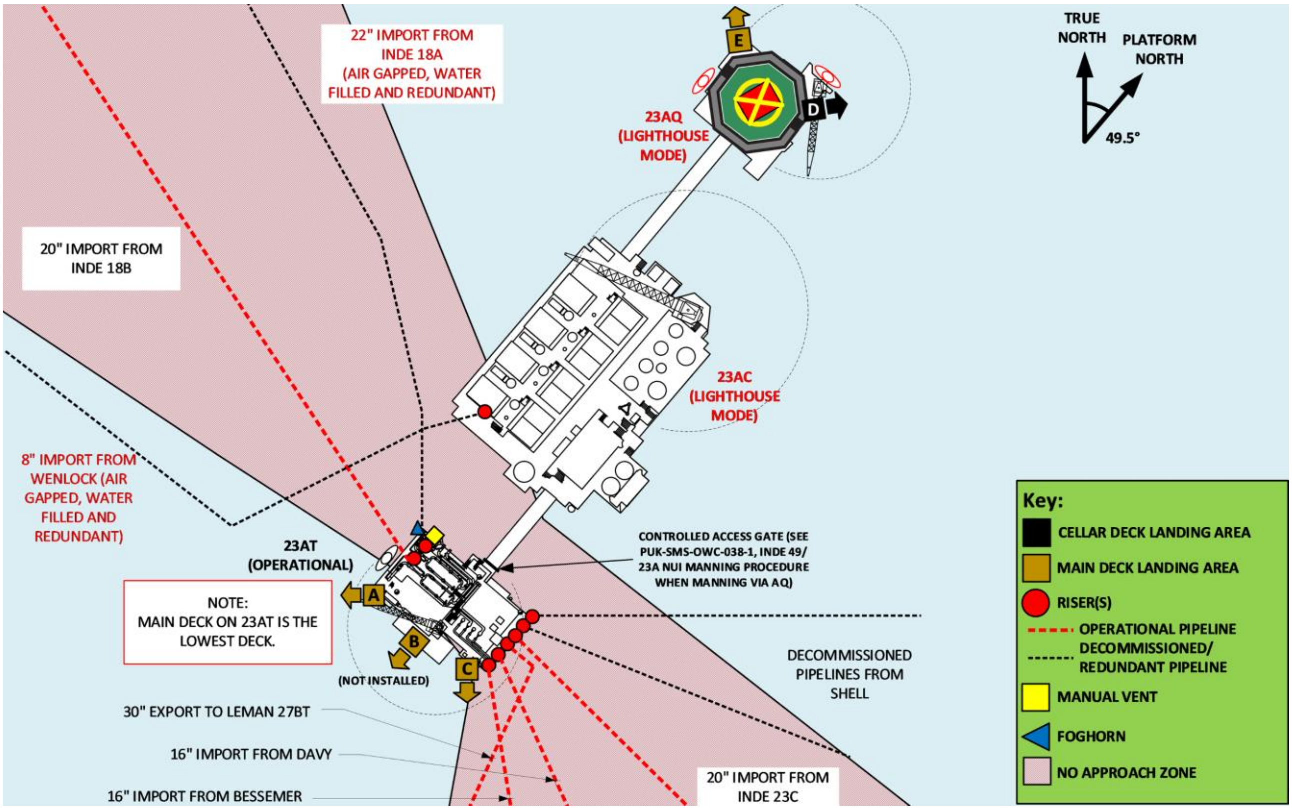


Figure 3 Configurations of Inde 23A installations. Sourced from PUK (2024).

Figure 4 *Photograph of Inde 23A with installations labelled*

Details of the above infrastructure are provided in Table 4.1, Table 4.2 and Table 4.3.

Table 4.1 Inde 23A installation (topsides and jackets) subject this DP / EA

Jacket no.	Location	Water depth (m)	Facility Type / Material	Legs no.	Piles	Weight Topside (Te)	Weight Jacket (Te)	Status
23AC	53° 19' 22.3364" N 02° 34' 24.6836" E	29.0	Fixed leg steel platform	8	8	7,652[1]	953	These installations are currently in Lighthouse Mode/mothball-ed and will remain so until the topside and jacket removal campaign.
23AQ	53° 19' 24.4998" N 02° 34' 27.8886" E	29.0	Fixed leg steel platform	4	4	1,299[2]	245	

1. Includes weight of AC topside (7,500 Te) and AT-AC connecting bridge (152 Te).
2. Includes weight of AQ topside (1,264 Te) and AQ-AC connecting bridge (35 Te).

Table 4.2 Inde 23A bridges subject this DP / EA

Bridge name	Location	Facility Type / Material	Length (m)	Weight (Te)	Status
AQ-AC Bridge	AQ to AC	Welded steel tubular frames with walkway	48.5	35	All piping and services between AT and AC have been air gapped or disconnected. There is no process pipework between AC and AQ.
AT-AC Bridge	AT to AC	Welded steel tubular frames with walkway	39.6	152	

Table 4.3 Pipeline risers subject this DP / EA

PL name	Service	Length (m)	Pipeline route	Current content	Status
8" PL2355 riser section	Gas export riser	85	From cut point 2m above seabed at riser bottom tie in flange to Inde 23AC isolation valve.	Flushed clean and filled with seawater	Out of use; exposed and attached to AC jacket and topside
3" PL2356 riser section	Chemical (MEG) injection	85	From cut point 2m above seabed at riser bottom tie in flange to Inde 23AC isolation valve.	Flushed clean and filled with seawater	

4.2 Relevant infrastructure outside the DP / EA scope

4.2.1 Inde 23AT installation

This EA does not include the AT platform which is likely to be operational into the 2030s and will be subject to a separate DP at a later date. Since the SHARP campaign in May 2023 only Inde 23AT has been operational. All pipework between AT and AC has been air gapped.

As discussed, it is likely that the AT-AC bridge will be removed in advance of the rest of the decommissioning to separate the infrastructure to be decommissioned and Inde 23A. Inde 23AT has no helipad and as such, Walk2Work is the only means of reaching the platform (refer Figure 3). Removal of AC and AQ will assist with access to AT by allowing new gates to be installed on the AC side of AT and remove the risk of personnel walking through a decommissioned asset.

4.2.2 Pipelines and stabilisation material

The pipeline scope of this EA is restricted to the PL2355 and PL2356 riser sections. The rest of PL2355 and PL2356, which connect Inde 23A with Wenlock 49/12A as shown in Figure 2, are out of scope. These were covered in the Wenlock Decommissioning Programmes prepared by Alpha Petroleum Resources Limited and approved on 23rd February 2022.

These risers are redundant in situ and have been flushed, cleaned, water filled, air gapped and verified as hydrocarbon safe (HCS) (less than 30 parts per million (ppm) oil in water). The 8” PL2355 import pipeline riser and the 3” PL2356 will be air-gapped subsea at the base of the AC platform approximately 2 m above the seabed (-27m LAT) prior to jacket removal.

Geophysical surveys of the 23A area indicated there are mattresses located along the pipelines that connect into Inde 23A. These pipelines and mattresses (beyond the PL2355 and PL2356 riser sections) are outside the scope of this EA and will be dealt with in a separate DP.

4.3 Decommissioning activities and methodology

PUK has assessed options for extending the producing life of the Inde 23AC and AQ, but a suitable relocation or reuse for the infrastructure has not yet been identified. At present, dismantling of the Inde 23A at an onshore disposal facility is considered the most likely disposal option.

Those materials deemed suitable for recycling will be recovered at an appropriate recycling facility. Disposal option selection will prioritise reuse and recycling where possible, aligned with the objectives of the Waste Management Hierarchy. PUK will consider the disposal options available, taking into account the business needs within PUK to reuse equipment and materials where appropriate.

This EA has been prepared based on the preferred decommissioning option described below. It has been assumed that three separate Heavy Lift Vessel (HLV) mobilisations may be required to decommission the infrastructure. These separate mobilisations would involve the removal and transportation of the:

1. AT-AC bridge to separate Inde 23AC and AQ from the operational Inde 23AT.
2. AC-AQ bridge, and the Inde 23AQ topside and jacket.
3. Inde 23AC topside and jacket.

The EA assumes a worst-case scenario including:

– three mobilisations of HLVs (each with two spud can placements).
– stabilisation material used for longer term HLV work (e.g. installation removals >3 months)
– excavation and an external cut on the jackets required.

4.3.1 Preparatory works

Decommissioning of Inde 23A installation and PL2355 and PL2356 riser sections are anticipated to commence from the 2026 summer. The following preparatory work has been carried out in order to enable the proposed decommissioning activities:

– The NORM storage area on AC will be emptied. There is remaining process pipework on AC that is assumed to be NORM positive and as such cannot be flushed or removal offshore. As such, this pipework will be removed in its entirety during topside removal and disposed of onshore with appropriate licensing.
– PL2355 and PL2356 have been flushed, cleaned, water filled, air gapped and verified as HCS on the AC topside. The remains of these risers are attached to Inde 23AC.
– Inde 23AC has been converted to Lighthouse Mode and all equipment is now redundant. The equipment has either been removed or left in-situ.

– Inde 23AQ is mothballed and all equipment is now redundant. The equipment has either been removed or left in-situ.

A pre-decommissioning environmental baseline survey (EBS) was completed for the Inde 23A 500 m safety zone in 2022 (Ocean Ecology Limited, 2023).

4.3.2 Heavy Lift Vessel (HLV) positioning

Removal and transportation of the installation sections will mostly occur by a Heavy Lift Vessel (HLV). HLV positioning will likely occur in the following steps:

– mobilisation of equipment and personnel to HLV
– transit of vessel to Inde field
– arrive at 500 m safety zone and complete pre-entry checks
– move into position next to the jacket in stand-off position and lower legs
– deployment of anchors and anchor chains
– raise legs, move HLV into final position, lower legs and jack-up.

There is potential that stabilisation material may be required to secure the HLV jack-up rig legs, particularly within the scour holes around the jackets (refer section 5.4). If stabilisation material is required, then it is likely that retrievable gravel or grout bags will be used. These will then be retrieved once the works are completed.

The jack-up vessel has insufficient capacity to lift and carry both Inde 23AC and AQ installations at once, and as such Inde 23AC and AQ will be lifted and transport to an onshore disposal facility separately.

4.3.3 Bridges

The Inde 23A two bridges, shown in Figure 4.1, will be individually removed.

The preference of PUK and PDEC is to remove the AT-AC bridge in a separate mobilisation prior to the decommissioning of the rest of the infrastructure. The purpose of this is to separate the AC and AQ installations from the still operational Inde 23AT installation. The AT-AC bridge removal would likely occur at during the summer of 2026 using an HLV. The AC-AQ bridge would then be removed during the next sets of works likely starting from 2027.

Each bridge will be rigged up to the HLV crane. Once rigged up, the bridge will be disconnected from the Inde 23A platforms and then lifted using the HLV crane and transferred to a predetermined position on the vessel. The process be the same for both bridges. Both bridges will be transported to an onshore disposal yard for dismantlement and processing.


Figure 5 Photographs of Inde 23A bridges. Left – AQ-AC Bridge. Right – AT-AC Bridge.

4.3.4 Topsides

Removal of topsides, shown in Figure 6, will be undertaken by breaking up offshore and transporting to shore using an HLV. Due to the size of the Inde 23A it is likely that the AQ installation will be removed and transported to shore in a separate mobilisation to the AC installation.

The topsides will likely be decommissioned using a “reverse installation” method where topside modules will be moved by reversing the steps used during its original installation. The modules will be cut and then lifted onto the HLV deck using known, re-instated (restored) padeyes to enable safe lifting.

The topsides will be transported to shore for re-use of selected equipment for break up, recycling and disposal.


Figure 6 Photographs of Inde 23A topsides. Left – Inde 23AQ. Right – Inde 23AC.

4.3.5 Jackets and risers

The jackets, shown in Figure 7 and Figure 8, will most likely be removed using HLV single lifts and then transported onshore for cleaning, dismantling and recycling. The process will be the same for both jackets (Inde 23AC, Inde 23AQ) but they will likely be removed during separate mobilisations due to the size of Inde 23A.

The PL2355 and PL2356 risers will be air-gapped subsea at the base of the AC platform approximately 2m above the seabed (-27m LAT) prior to jacket removal.

The jackets will likely be cut above the mudline with external diamond wire cutters (although oxyacetylene or high-pressure abrasive water jet could be used) and the remaining pile stubs to be cut via internal dredging and cutting to a target depth of at least 3 m below mean seabed level (msl). This ensures that any remains are unlikely to become uncovered.

PUK will investigate the opportunities to perform deeper internal cuts of the piles, subject to surveys to verify the piles are free of internal blockages. However, if this proves unfeasible it would be necessary to excavate the seabed around the piles to enable external cutting. If external cutting is required, then it is possible that some dredging work is needed around the legs of the jacket to create a subsea cut.

Once the jackets are cut, they will be removed as complete units by the HLV crane and transferred to predetermined positions on the vessel. Where required, cleaning will be carried out at the dismantling site for recycling, as appropriate.

The PL2355 and PL2356 riser sections will be removed from the seabed together with the Inde 23AC jacket structure for dismantling onshore. The riser sections will be recycled at a licenced facility. If required, then some initial break up (dismantlement) will occur offshore before the transportation to shore.

The remaining end of PL2355 and PL2356 will be re-buried under existing rock cover or, if exposed as a potential snagging hazard, will have one of the existing mats further along the pipeline in the Inde 23A 500 m SZ relocated over the end.

A high-level description of this removal option is presented below; however, it should be noted that the detailed cutting points and removal method are subject to detailed engineering and commercial tendering. It should also be noted that this process will likely be completed twice, once for AQ and once AC:

- launch a Remotely Operated Vehicle (ROV) to inspect the jacket
- connect rigging to the solar Aids to Navigation (AtoNs) grillage with help from Rope Access Technicians (RATs) (if required)
- connect rigging to main crane
- lift grillage and solar AtoNs from the jacket
- connect rigging to jacket pad-eyes with RAT and hang off rigging to the vessel deck
- remove soil plug from pile annulus and complete pile cuts
- cut riser subsea at the base of the AC jacket
- connect rigging to main crane.
- lift the jacket to the deck of the vessel and seafasten it in place
- execute as-left survey/debris removal with ROV
- complete safety checks in preparation for leaving the field and moving out of 500 m safety zone
- transport the jacket to the disposal yard for onshore disposal and recycling.

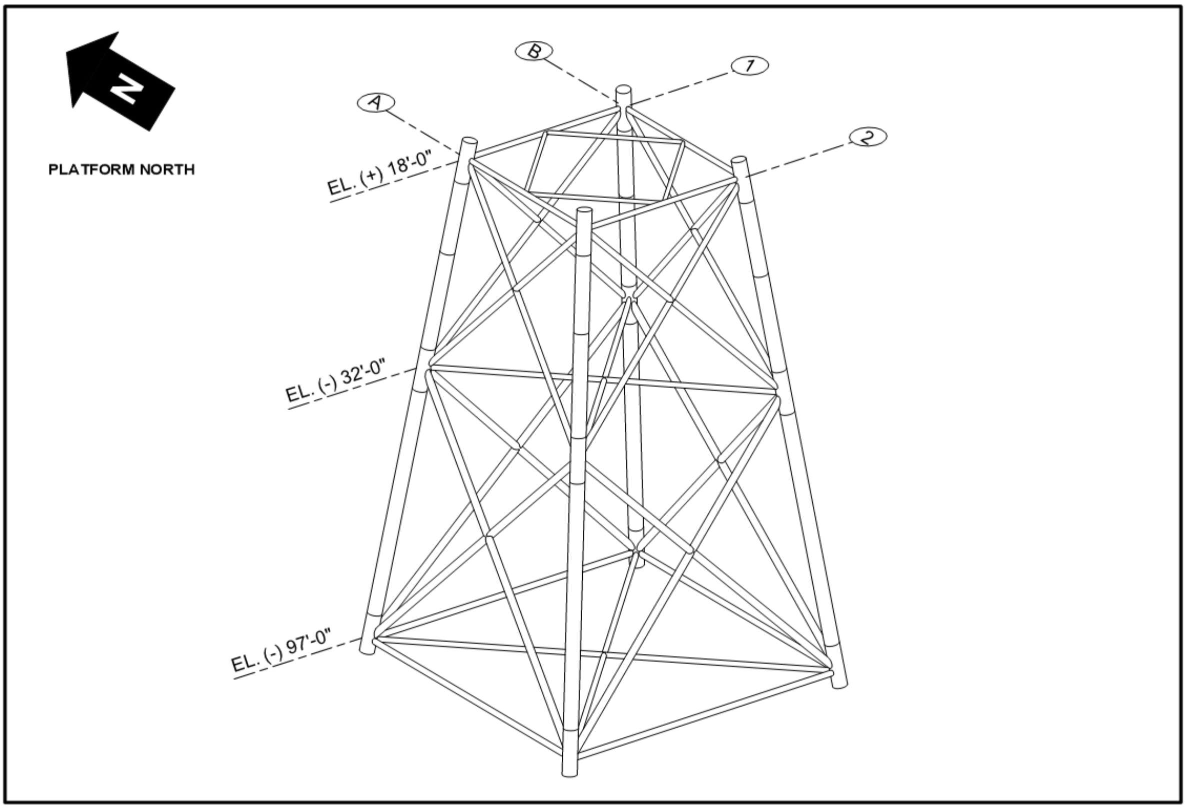


Figure 7 Drawing of Inde 23AQ jacket

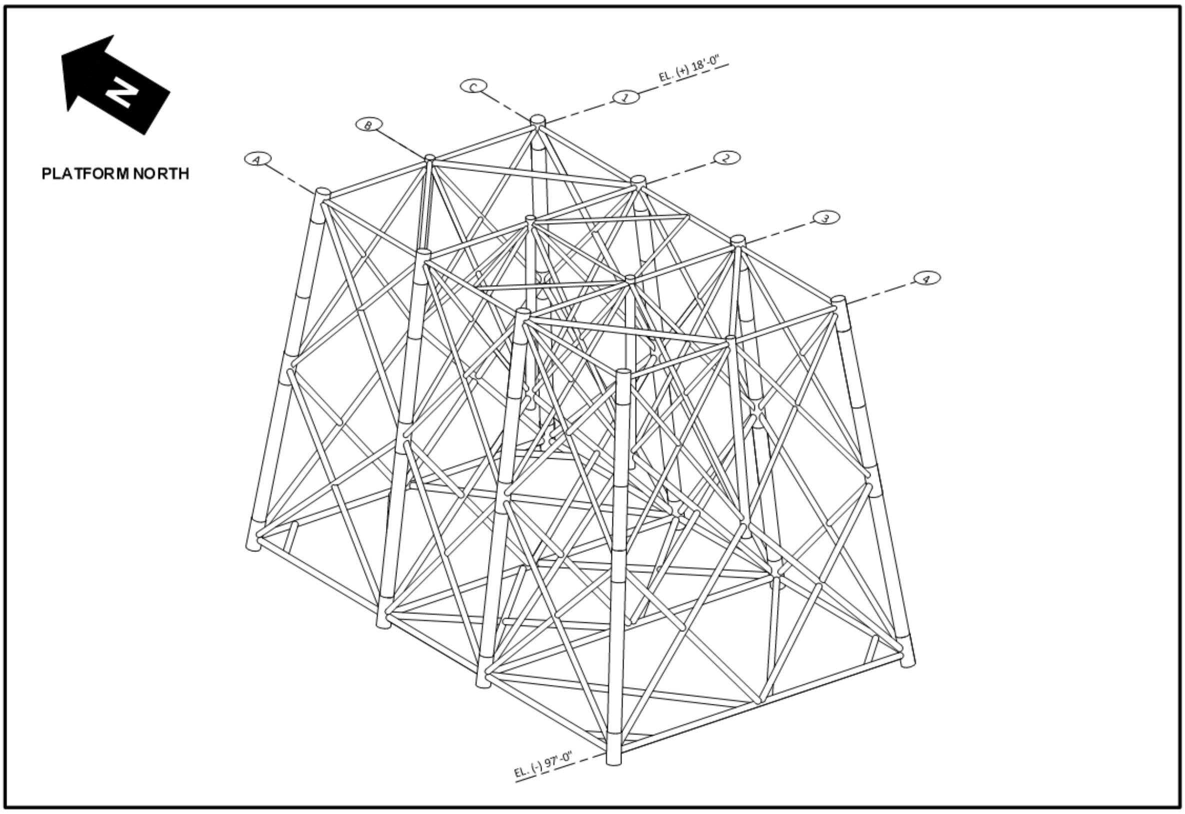


Figure 8 Drawing of Inde 23AC jacket

4.3.6 Post-removal works

Once the installations are removed, the 500m zone around each platform will be cleared initially by an ROV and handpicking.

A post-decommissioning seabed survey will be carried out in the 500m safety zone of the Inde 23A to confirm all materials have been removed. The survey will likely employ a combination of acoustic surveying devices, including sidescan sonar (SSS), multibeam echosounder (MBES) and sub-bottom profiling (SBP).

4.3.7 Programme

A schedule of the decommissioning works is provided in Figure 9.

As discussed, the AT-AC bridge would likely occur at during the summer of 2026. The HLV would then be mobilised again for two periods each about 90 days from Q2 2027. These periods would be used to remove the AQ and AC installations separately.

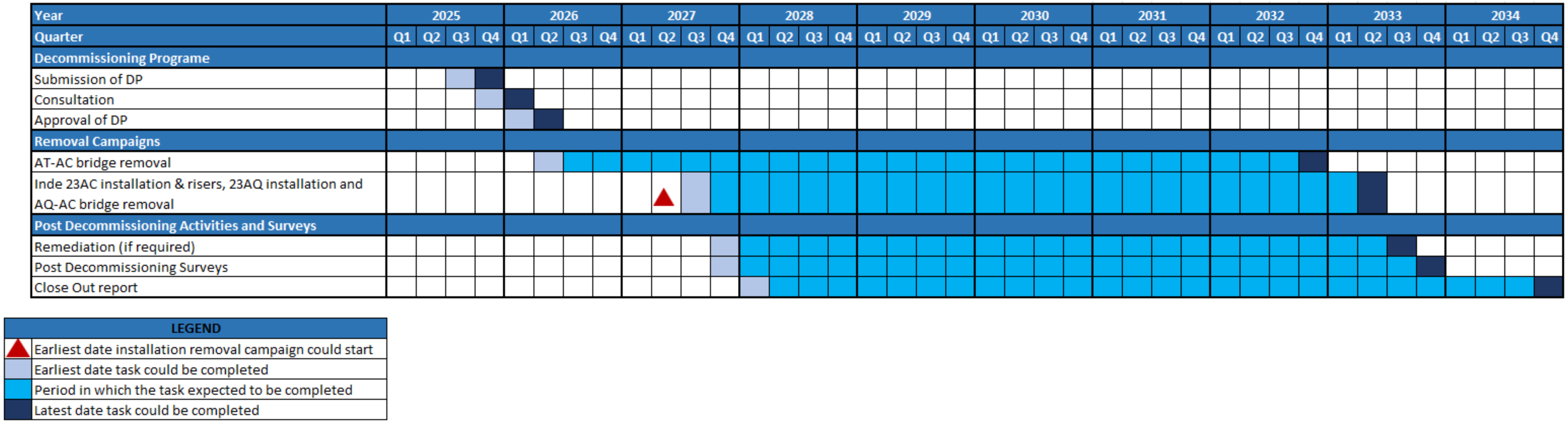


Figure 9 *Schedule of Inde 23 AC and AQ installations, bridges and riser decommissioning activities*

5. Environmental and social baseline

5.1 Introduction

This section describes the main characteristics of the physical and biological environment around Inde 23A, as well as potential environmental and social receptors.

It draws upon a number of data sources, including published papers on scientific research in the area and industry wide surveys, for example, the UK Offshore Energy Strategic Environmental Assessment 3 and 4 programmes (OESEA3 and OESEA4). Inde 23A falls within OESEA Regional Sea 2 (covers SNS area). As such, regional information from the SNS has been drawn from OESEA findings Regional Sea 2.

Site-specific investigations carried out at the Inde 23A installation have also been used for this baseline. These surveys are described in Section 5.2.

5.2 Surveys

This environmental and social baseline draws upon the information gathered during the surveys described below. The following subsections outline the methodologies and survey areas applied for these supporting surveys.

5.2.1 Inde Field Pre-Decommissioning Seabed and Environmental Baseline Survey (EBS), 2022

A pre-decommissioning Seabed and Environmental Baseline Survey, hereafter referred to as the EBS, was carried out in 2022 by Ocean Ecology Limited at the Inde 23A installation (Ocean Ecology Limited, 2023).

The key objectives of the EBS were to:

- provide baseline data for sediment physico-chemical characteristics and macrobenthic composition against which potential impacts of decommissioning activities can be measured as part of future monitoring efforts.
- identify and assess the status of species and habitats of conservation importance, including Annex I protected species and habitats (such as *Sabellaria spinulosa* biogenic reef or stony reef), and Annex V species of the Habitats Regulations, species listed under Schedule 5 of the Wildlife & Countryside Act, OSPAR species and habitats and designated features of the MPA network.

The EBS multibeam echosounder (MBES) survey site is shown in Figure 10 and included the 500 m safety zone around Inde 23A. In addition, 11 stations, shown in Figure 11, were sampled across the Inde 23A platform area to collect sediment and benthic data. A total of 10 stations arranged along a cruciform centred on the platform and one station positioned 5 km away from the platform to act as a reference station (Station I23_11).

The survey involved the collection of seabed imagery and sediment samples at the EBS sampling stations using a drop-down camera (DDC) system and a dual 0.2 m^2 Van Veen grab. A total of 84 still images were acquired at the 11 stations surveyed across the Inde 23A platform. All images were categorised using European Nature Information System (EUNIS) classification. Sediment samples were analysed to identify particle size distribution, sediment chemistry and macrobenthos.

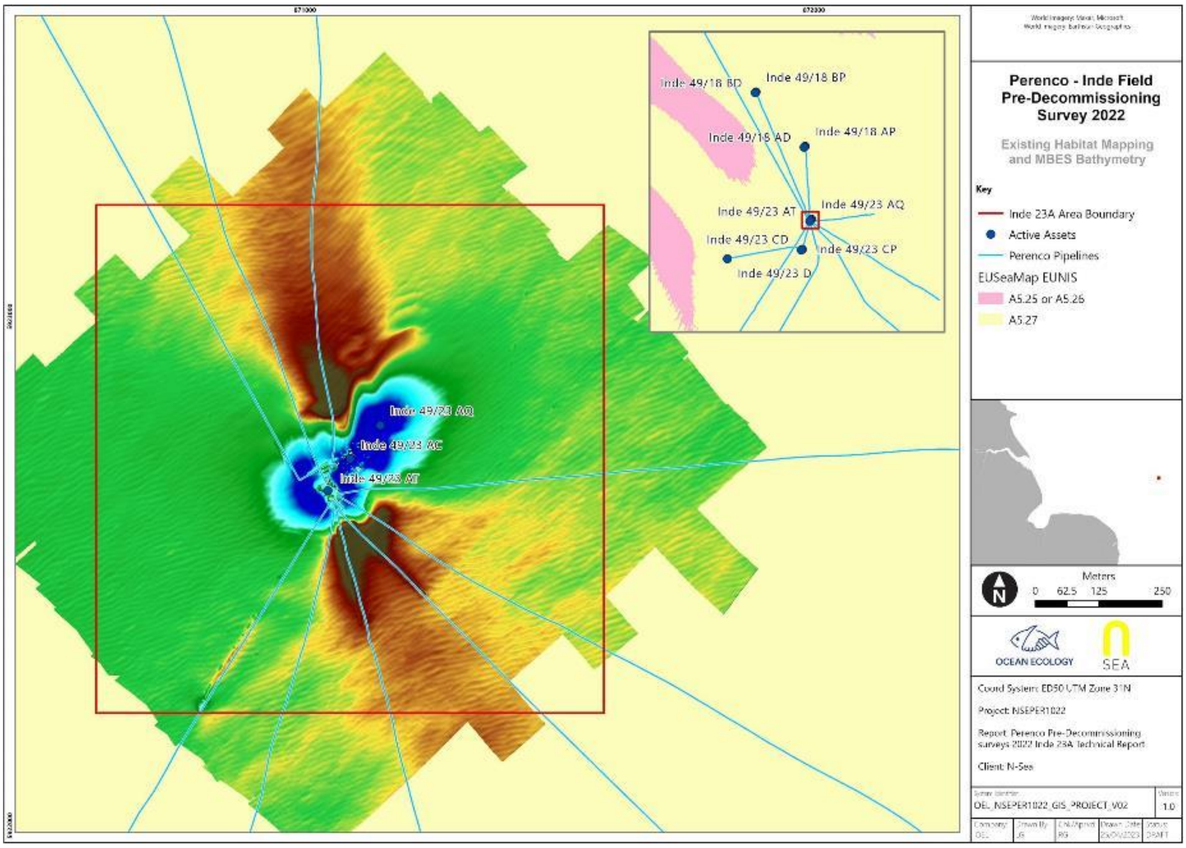


Figure 10 *2022 EBS Existing Habitat Mapping and MBES Bathymetry (Ocean Ecology Limited, 2023)*

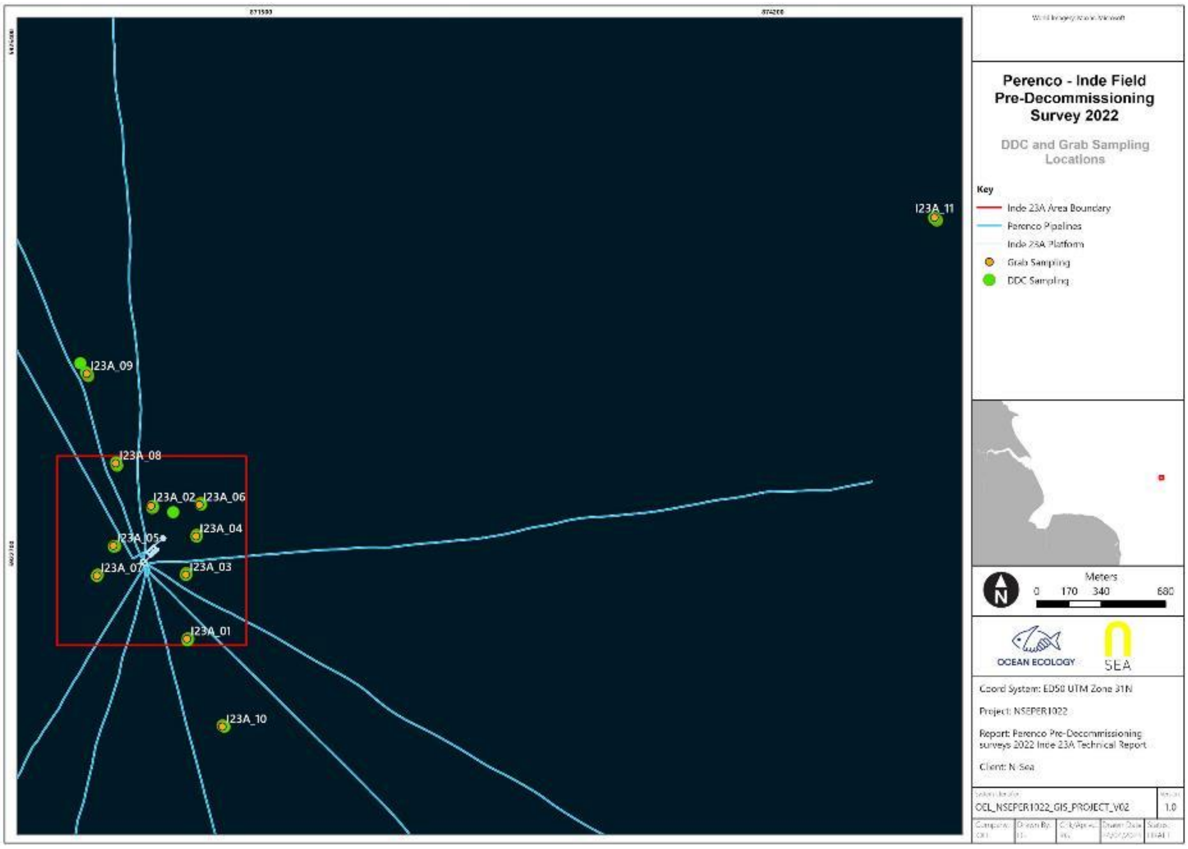


Figure 11 *EBS Sampling Stations (Ocean Ecology Limited, 2023)*

5.2.2 Annual ornithological assessments

Methodology

Annual ornithological assessments are carried out on the PUK offshore installations to confirm bird presence and nesting.

The purpose of the assessments is to confirm the locations and sizes of any nesting bird colonies on offshore platforms operated by PUK, with an emphasis on the recording of any kittiwake (*Rissa tridactyla*) colonies, to inform future mitigation measures to ensure adverse impacts on nesting birds are avoided during the decommissioning and / or alteration of the platforms.

The monitoring methodology is consistent with the following:

– OPRED advice note on the risk of kittiwake presence on offshore installations (OPRED, 2021)
– JNCC advice note on kittiwake survey methods for offshore installations (Thompson, 2021)
– Perenco Assets – Offshore Ornithological Monitoring Plan (RSK Biocensus, 2023b).

Surveys are undertaken by boat. Each asset is usually surveyed once, during which an ornithologist inspects the asset on all sides where possible. In accordance with best practice guidance, platforms are inspected from a distance of 200 m or 500 m subject to proximity agreements or unless platform service operations necessitated closer access to platforms by the boat. Inspections are aided by the use of binoculars, a scope and digital photography as necessary.

Kittiwake observations are classified in accordance with JNCC guidance, with numbers of occupied nests, trace nests, eggs, chicks within each age group, estimated fledging dates and any non-breeding birds all recorded. Any observations of behavioural responses by kittiwakes (e.g. due to the presence of boats, surveyors or on-platform activity) are also recorded. Any other species present on or in close proximity to the platforms are recorded and mapped, including any nest locations.

RSK Biocensus Ornithological Assessment Report, June 2023

An ornithological assessment of PUK offshore assets, including Inde 23A, was carried out between 13th and 19th June 2023 by RSK Biocensus (RSK Biocensus, 2023a). No occupied nests or trace nests were observed at Inde 23A during the survey (RSK Biocensus, 2023a). No evidence of breeding was observed (RSK Biocensus, 2023a).

Xodus Ornithological Assessment Report, May 2024

An ornithological survey of PUK offshore assets, including Inde 23A, was carried out in May 2024 by Xodus (Xodus Group, 2024). Inde 23A was surveyed on 29th May 2024. No nesting birds were observed during the vantage point surveys conducted at Inde 23A (Xodus Group, 2024).

Xodus Bird Survey, May 2025

A bird survey of Inde 23A was conducted on 23rd May 2025 as part of the annual bird survey of offshore assets (Xodus, 2025). No nesting bird were identified during the survey. It is noted that it was unlikely that any successful nesting activity would be initiated during the 2025 breeding season.

5.3 Meteorological and oceanographic conditions

5.3.1 Climate

Air temperatures in the SNS are generally at their lowest in January and February (mean 4°C to 6°C) and highest in July and August (around 16°C) (DECC, 2016). The highest air-temperature likely to be encountered in any 100-year period is estimated to be 27°C (PhysE, 2012). The lowest air-temperature likely to be encountered in any 100-year period is estimated to be -8°C (PhysE, 2012).

Rainfall decreases in a south-north direction in the SNS ranging from annual rainfall of 601-1,000 millimetres (mm) north the Dover Strait down to 201-400 mm north and east of north Norfolk (DECC, 2016).

Snow or sleet is recorded in the south mainly from December to April, but perhaps as early as November and can be expected for 5 to 7 days a month for January and February. Fog can affect the east coast and seas of England with visibility of less than 1 km 3-4% of the time and is associated with winds between the southeast and southwest (DECC, 2016).

Wind speeds are generally highest in winter for most of the UK (DECC, 2016). In the SNS region (Regional Sea 2), wind strengths are generally between Beaufort scale 1-6 (1-11 meters per second (m/s)) in the summer months with more frequent strong to gale force winds of force 7-12 (14-32m/s) during the winter (DECC, 2016). In January, 20% of winds can be expected to exceed force 7 (14m/s), reducing to 2-4% in July. Winds in the SNS region are generally from between south and northwest; however, in spring, the frequency of winds from the north and east increases. While infrequent, when easterly winds occur, they can bring exceptionally cold weather in winter.

In the vicinity of Inde 23A the mean annual windspeed at 100 m above sea level (ASL) is estimated to be 9.49 m/s (ABP Marine Environmental Research Ltd, 2008). Average wind speeds at 100 m ASL peak in winter (11.51 m/s), followed by autumn (10.33 m/s), spring (8.99 m/s) and summer (7.27 m/s) (ABP Marine Environmental Research Ltd, 2008). The maximum nominal wind speed likely to be encountered in any 100-year period and Inde 23A is estimated to be 46.1 m/s in a 3 second gust (PhysE, 2012).

5.3.2 Water temperature and salinity

In the region of Inde 23A, the mean annual sea surface temperature is approximately 10.2°C, ranging from 4.7°C in December to 16.8°C in August (Gormley, et al., 2014). The mean annual sea bottom temperature at Inde 23A is estimated to be 10.0°C, ranging from 4.8°C in February to 16.4°C in August (Gormley, et al., 2014). The maximum sea-surface temperature likely to be encountered in any 100-year period is estimated to be 23°C, while the minimum estimated 100-year temperature is 0°C (PhysE, 2012).

The SNS receives significant freshwater input from the rivers along its eastern boundary and is, as a consequence, less saline than the northern North Sea (DECC, 2016). Sea surface salinity remains fairly consistent throughout the year with an annual average of 34.4 parts per thousand (ppt) (Gormley, et al., 2014). Sea salinity at the sea bottom has been predicted to be fairly consistent throughout the year with an annual average of 34.5 ppt (Gormley, et al., 2014).

5.3.3 Waves

The wave climate in the SNS is strongly seasonal with maximum mean wave heights peaking around January, although extreme waves may be encountered at other times, most notably between November and March (DECC, 2016).

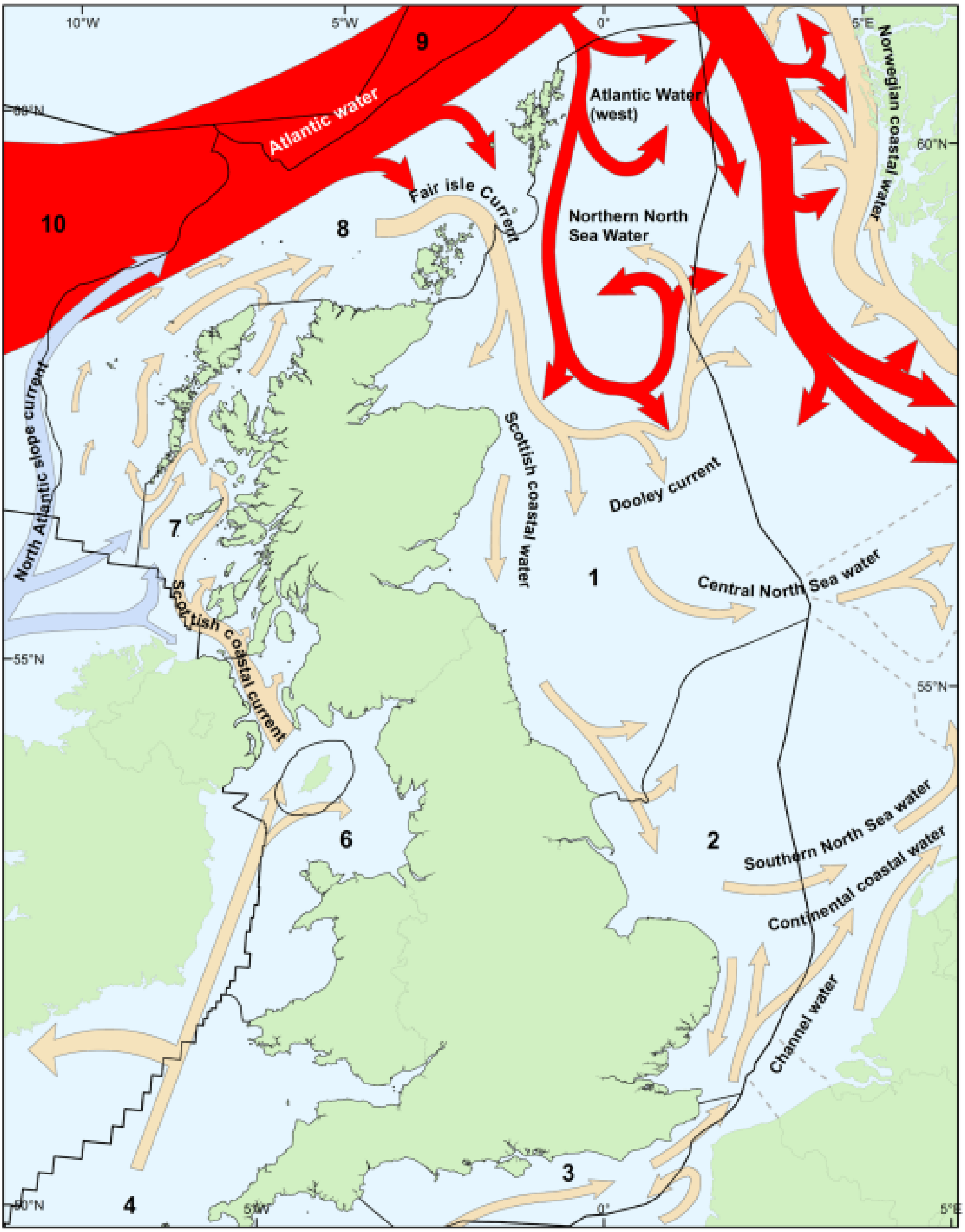
Mean annual significant wave height is estimated to be 1.55 m in the vicinity of Inde 23A, with the highest mean significant wave heights occurring in winter (1.96 m), followed by autumn (1.69 m), spring (1.46 m) and finally summer (1.13 m) (ABP Marine Environmental Research Ltd, 2008). The maximum nominal wave height and period likely to be encountered in any 100-year period are estimated to be 15.0 m and 12.0 s, respectively (PhysE, 2012).

5.3.4 Water circulation and tides

Major currents observed in the North Sea are shown in Figure 12. The general circulation of near-surface water in the North Sea is cyclonic, driven in part by the ingression of waters in waters from the Atlantic in the north, driving water southwards along the coast towards the English Channel (DECC, 2016). In addition, currents from the English Channel also move northeasterly along the UK-Dutch median line.

Significant local variations in patterns of semi-diurnal tidal and residual circulation occur in the vicinity of sandbanks (DECC, 2016). The North Norfolk Sandbanks, approximately 4.96 km west of Inde 23A, are the most extensive example of the offshore linear ridge sandbank type in UK waters (JNCC, 2025). They are subject to a range of current strengths which are strongest on the banks closest to shore and which reduce offshore. The outer banks are the best example of open sea, tidal sandbanks in a moderate current strength in UK waters.

In the vicinity of Inde 23A the mean spring peak flow tide is estimated to be 0.67 m/s with an average estimated power of 0.158 kilowatts per square meter (kW/m^2) (ABP Marine Environmental Research Ltd, 2008). The mean neap peak flow tide is estimated at 0.38 m/s with an average estimated power of 0.29 kW/m^2. The tidal range is estimated to be 1.95 m during the spring tide and 0.97 m during the neap tide. The current speed likely to be encountered in any 100-year period is estimated to be 1.57 m/s at the sea surface and 1.07 m/s at the seabed (PhysE, 2012).



Data source: UKOilandGasData, Turrell *et al* (1992), Ellett and Blindheim(1992). DECC UK Renewables Atlas. Contains public sector information licensed under the Open Government Licence v3.0	**Major residual current flows** **The width of arrows is indicative of the magnitude of volume transport. Red arrows indicate relatively pure Atlantic water.**	0 35 70 140 210 Km ED1950 HAL_OESEA3_G17_VER01

Figure 12 ***Major water masses and residual circulation in the North Sea (DECC, 2016)***

5.4 Bathymetry

The SNS Regional Sea 2 extends from the east coast of England to the median line which divides United Kingdom (UK) waters from those of The Netherlands, Belgium and France. From north to south, the SNS stretches from the Flamborough Front to the Dover Strait (DECC, 2016). This region is shallow with water depths generally 0 to 50 m.

The SNS has many extensive sandbanks features present at less than 25 m depth; these include areas which have been designated under the EU Habitats Directive (92/43/EEC) such as Dogger Bank SAC and the North Norfolk Sandbanks SAC (about 4.96 km from Inde 23A) (DECC, 2016).

Bathymetry data collected in 2021 around Inde 23A is shown in Figure 13 and bathymetry data collected in 2023 is shown in Figure 14. The seabed surrounding Inde 23A is mostly flat at approximately 29 m LAT. Scouring can be observed under the areas surrounding the installations up to a depth of about 31.6 m LAT. The shallowest water depth was associated with a ridge of sand that intersected the platform along a near north-south axis (refer Figure 10).

The safety zone shown in Figure 20, apart from the central scoured area under the platform is covered with megaripples[1]. The sand ripple crests are orientated along a southwest to northeast axis, and are steeper facing a south-easterly direction, indicating a prevailing current in this direction.

As shown in Figure 15, bathymetry data collected in 2021 also revealed spud can holes left in the seabed from an operation to the southwest of the AT installation. However, the 2023 bathymetry data revealed that the eastern most spud can holes (the only ones shown in the 2023 data) appear to mostly be refilled with sediment.

[1] Megaripples are smaller than sandwaves but larger than ripples with bedform wavelengths between 0.6 and 10 m and heights between 0.1 and 1 m (HR Wallingform, CEFAS/UEA, Posford Haskoning, & D'Olier, 2002).

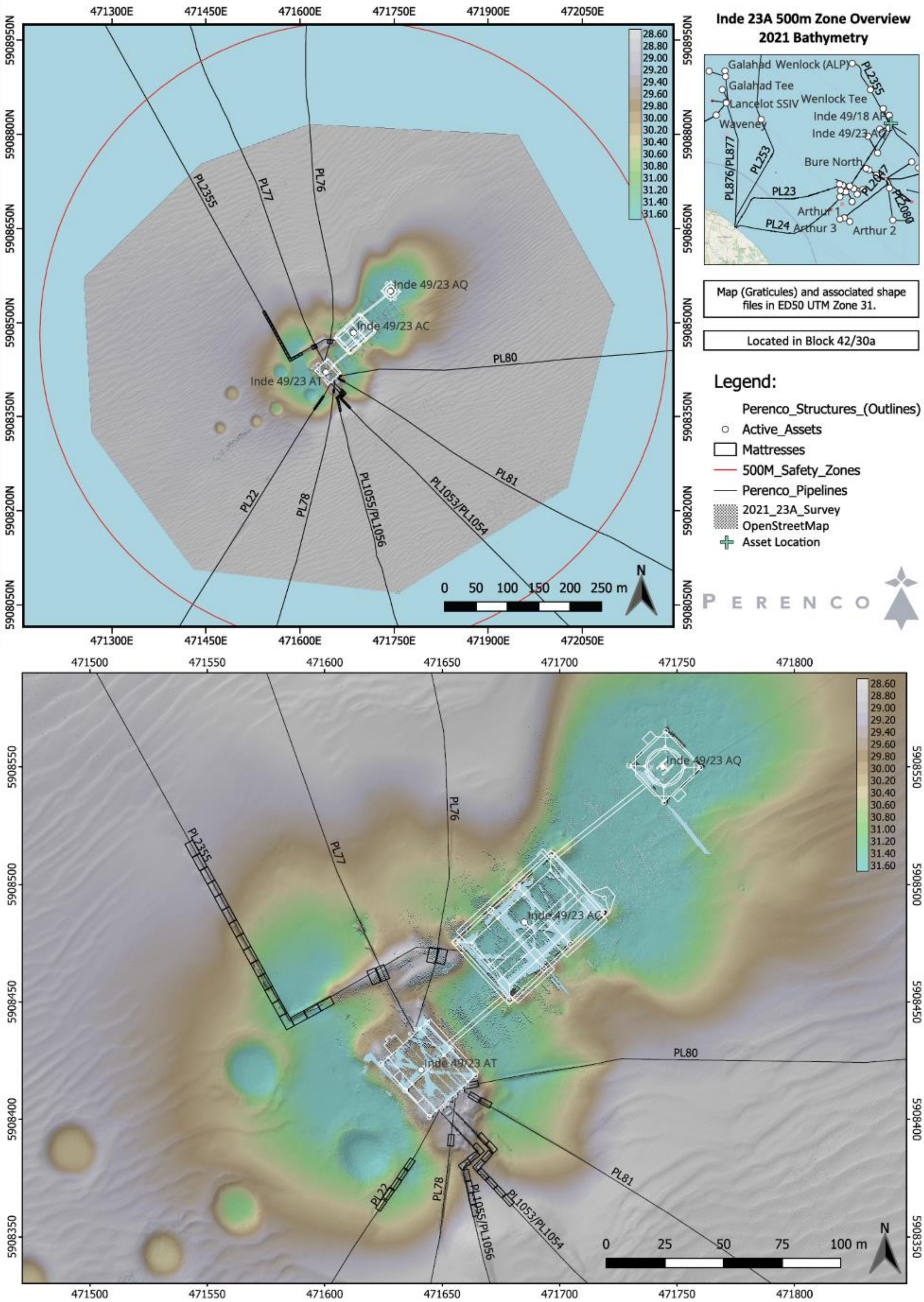
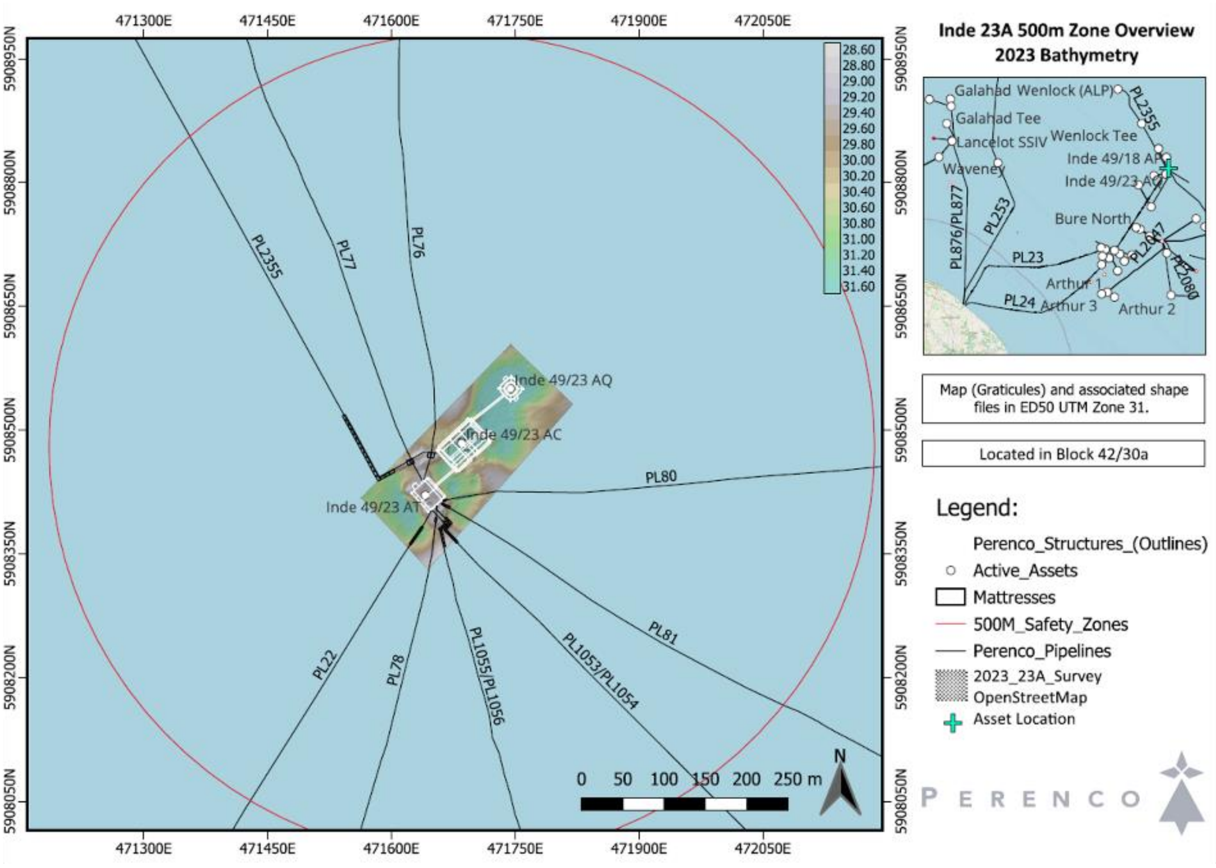


Figure 13 *2021 Bathymetry at Inde 2023A*



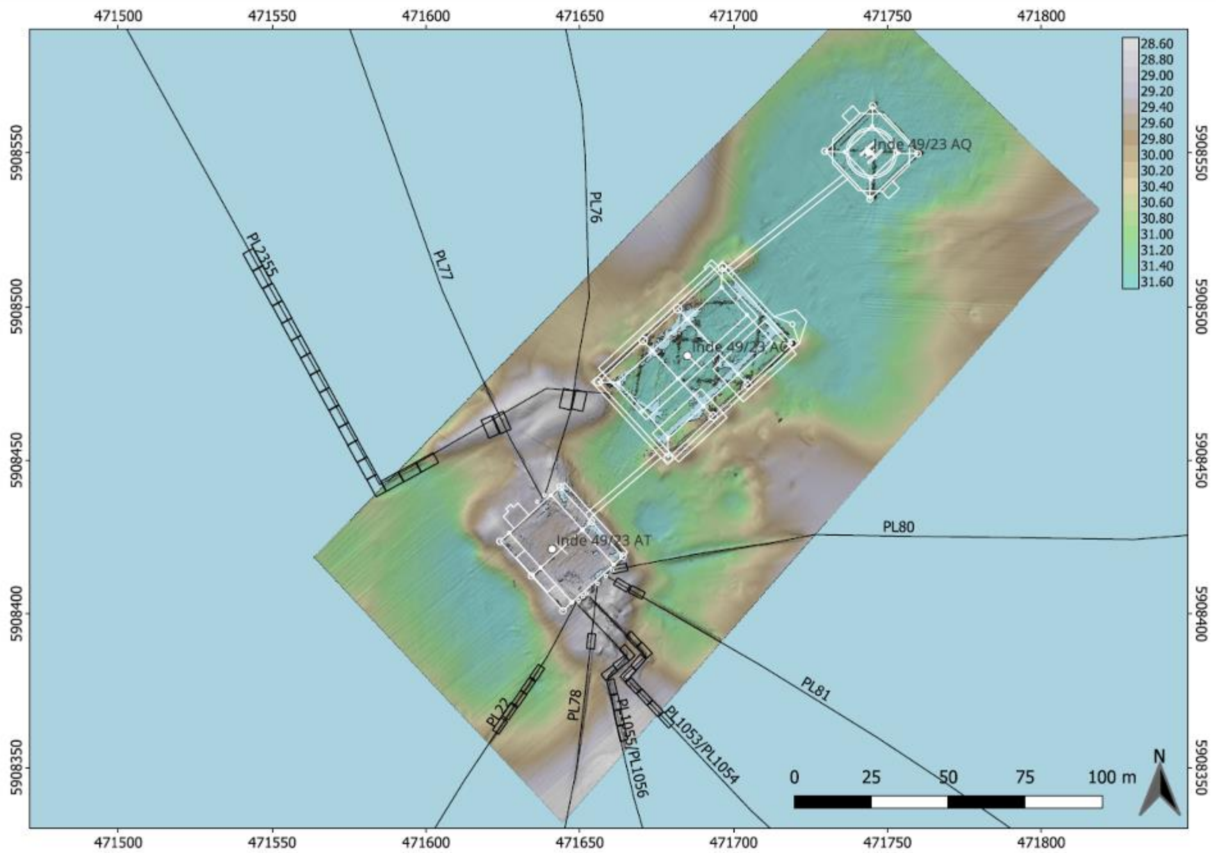


Figure 14 ***2023 Bathymetry at Inde 2023A***

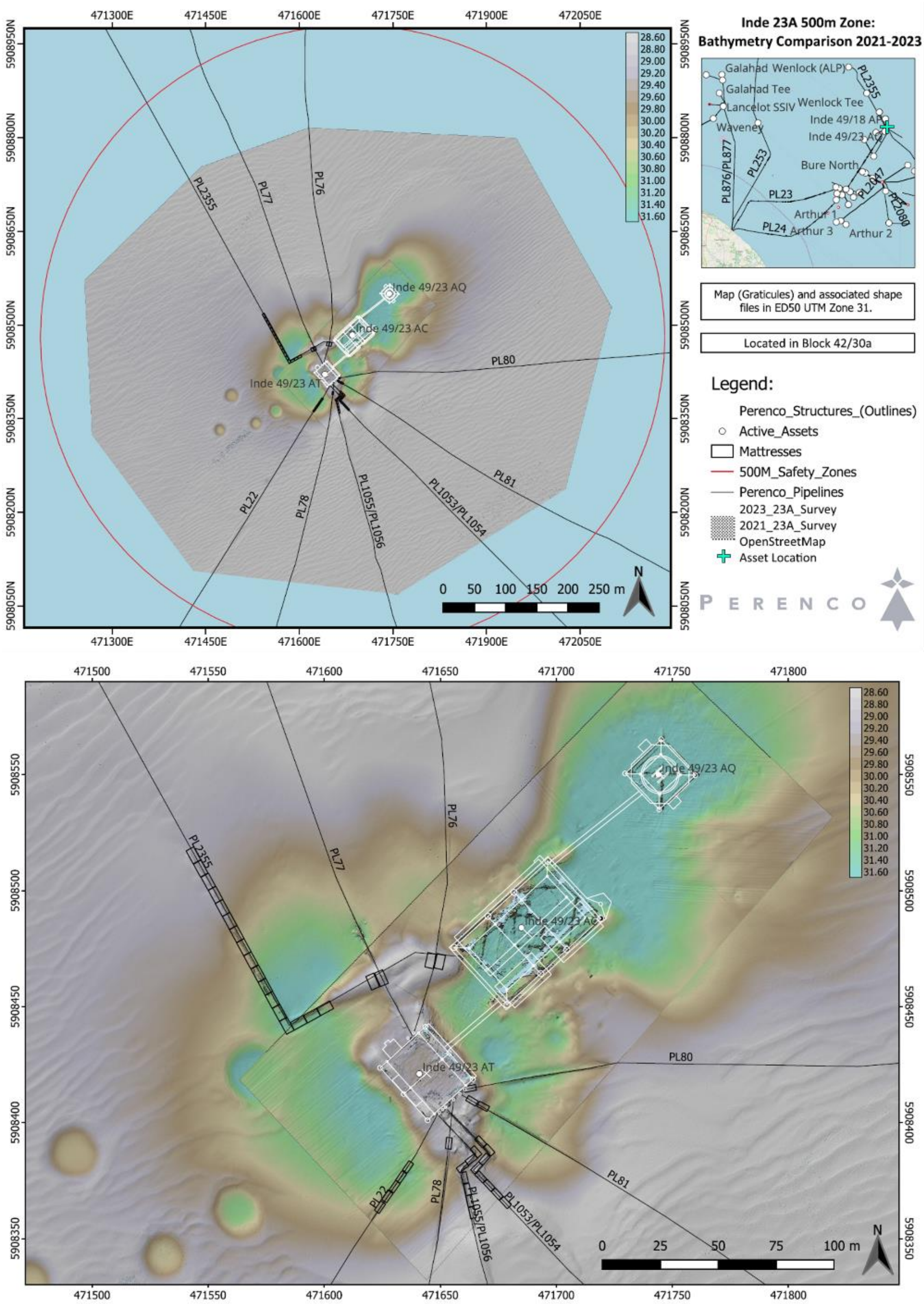


Figure 15 ***2021 Bathymetry overlain with 2023 bathymetry***

5.5 Sediment characteristics

Sediment characteristics were found to be largely consistent across the stations sampled as part of the EBS (Ocean Ecology Limited, 2023). The stations were dominated by sand with a mean proportion of sand at 96% ± 0.4 standard deviations (SD), with low proportions of gravel and mud (mean 1% ± 0.3 SD and mean 3% ± 0.2 SD, respectively). The percentage contribution of gravels (> 2 millimetres (mm)), sands (0.63mm to 2mm), and fines (< 63 micrometres (µm)) within each sample are presented in Figure 16. All but one sampling stations were classified as 'Slightly Gravelly Sand' on the Folk scale, with the remaining station (I23A_06) classified as 'Gravelly Sand'. No relationship was found between distance to the platform and mean grain size (Ocean Ecology Limited, 2023).

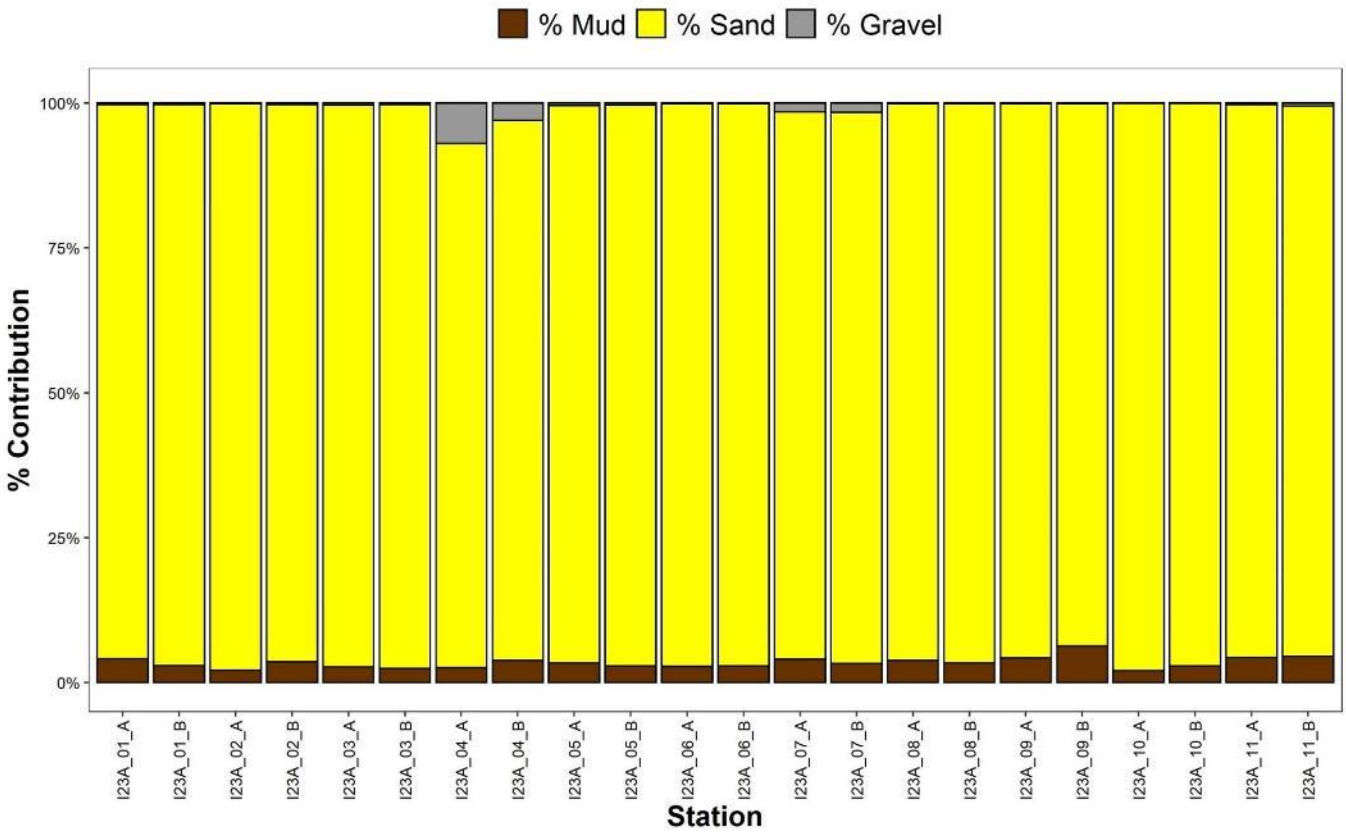


Figure 16 ***Contribution to sediment volume of gravel, sand, and fines at each sampling station across the survey area (Ocean Ecology Limited, 2023)***

5.6 Seabed chemistry

Grab samples taken for chemical analyses during the EBS were analysed for Total Organic Carbon (TOC), heavy and trace metals, Polycyclic Aromatic Hydrocarbon (PAH) and Total Hydrocarbon Content (THC). The following subsections detail the results of this analysis.

5.6.1 Total Organic Carbon (TOC)

TOC represents the proportion of biological material and organic detritus within the substrates. TOC in surface sediments is an important source of food for benthic fauna, although an overabundance may lead to reductions in species richness and abundance due to oxygen depletion.

TOC content in sediments across the Inde 23A survey area was low compared to the average content of 0.5 % for the deep ocean of 2 % for coastal seas (Seiter, Hensen, Schröter, & Zabel, 2004), ranging between 0.06 at I23A_06 and 0.16 % at I23A_01, with an average value of 0.10 ± 0.01 %.

No pattern was observed between TOC content and distance from the platform. No relationship was observed between mud content in the sediments and percentage contribution of TOC.

The TOC results are presented in Figure 17.

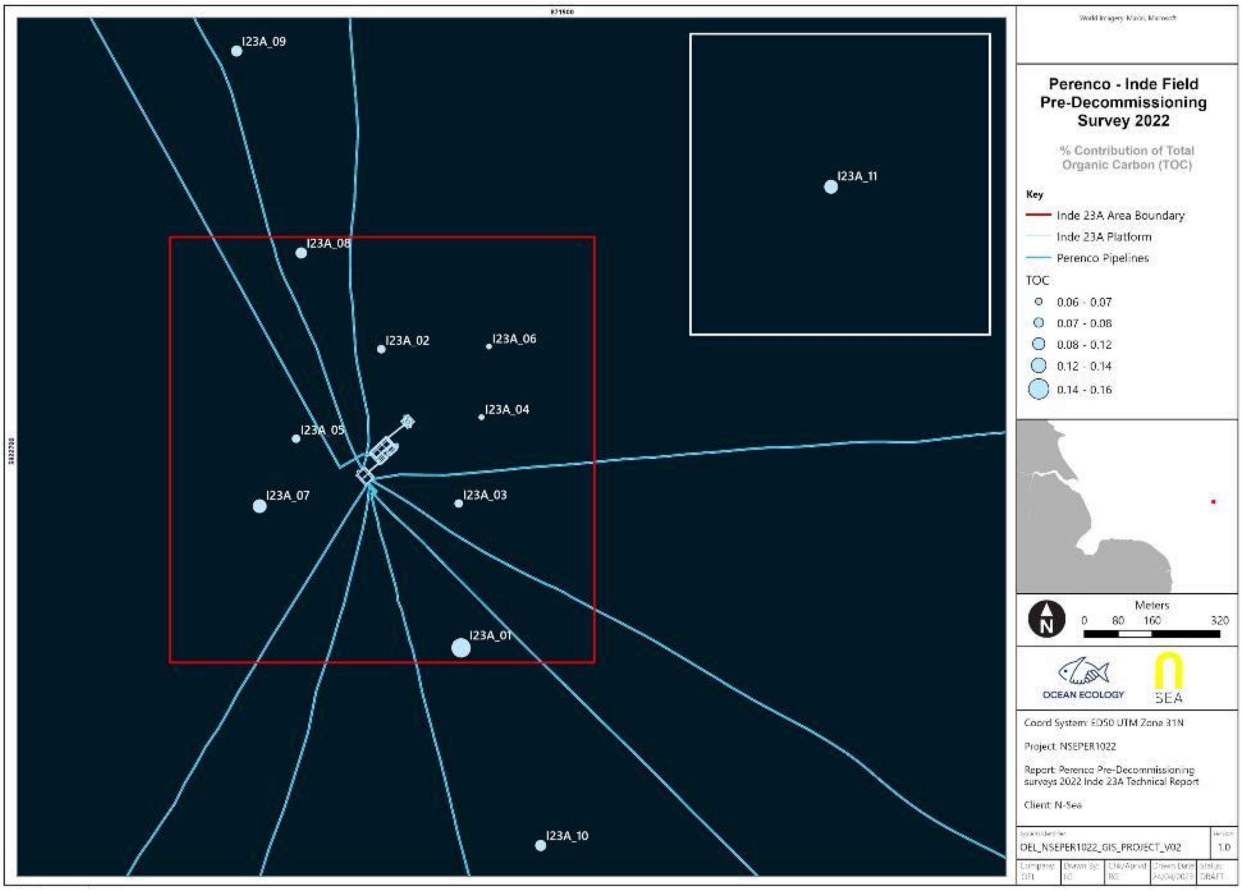


Figure 17 *TOC observed in EBS (Ocean Ecology Limited, 2023)*

5.6.2 Heavy and trace metals

Metals occur naturally in the marine environment and are widely distributed in both dissolved and sedimentary forms (Benthic Solutions Ltd, 2021a). Some are essential to marine life while others may be toxic to numerous organisms. Rivers, coastal discharges, and the atmosphere are the principal modes of entry for most metals into the marine environment, with anthropogenic inputs occurring primarily as components of industrial and municipal wastes (Benthic Solutions Ltd, 2021a).

A total of eight main heavy and trace metals were analysed from sediment samples and could be compared to national and international reference levels. These were: Arsenic (As), Cadmium (Cd), Chromium (Cr), Copper (Cu), Lead (Pb), Mercury (Hg), Nickel (Ni), and Zinc (Zn).

The metals most characteristic for offshore contamination of marine sediments from oil and gas activities are Ba, Cr, Pb and Zn, although these may vary greatly depending upon the constituents used (Benthic Solutions Ltd, 2021a).

Metal concentrations were compared to the:

- OSPAR: Background Assessment Concentration (BAC) (OSPAR et al. 2009)
- USA Environmental Protection Agency (EPA): Effect Range Low (ERL)
- Centre for Environment Fisheries and Aquaculture Science (Cefas): Action Level (AL) 1 and AL 2,
- Canadian sediment quality guideline (CSQG): Threshold Effect Level (TEL) and Probable Effect Level (PEL).

The OSPAR BAC were developed to assess the status of contaminant concentrations in sediment within the OSPAR framework with concentrations significantly below the BAC considered to be near background levels for the North-East Atlantic.

The USA EPA ERL has been adopted by OSPAR to assess the ecological significance of contaminant concentrations in sediments, where concentrations below the ERL rarely cause adverse effects in marine organisms.

Cefas ALs are used as part of a 'weight of evidence' approach to assessing dredged material and its suitability for disposal to sea. Contaminant levels in dredged material which fall below AL1 are of no concern and are unlikely to influence decision-making, while contaminant levels above AL2 are generally considered unsuitable for at-sea disposal.

At levels above the CSQG TEL, adverse effects may occasionally occur, whilst at levels above the PEL, adverse effects may occur frequently; concentrations below the ERL rarely cause adverse effects in marine organisms.

Raw data for the eight main heavy and trace metals (dry-weight concentration, mg kg-1) are shown in Table 5.1 together with available reference levels. The number of stations across the survey area exhibiting elevated heavy and trace metals levels in comparison to reference levels is present in Table 5.2. The results of the analysis are presented in Figure 18.

None of the main heavy and trace metals exceeded CEFAS AL1 except Cd which was above at I23A_01. Cd at I23A_01 was also above the OSPAR BAC, ERL and TEL. Finally, Hg was above the OSPAR BAC at I23A_01 and Cu was above the CSQG TEL and OSPAR BAC at I23A_03. I23A_01 is located within 500 m from the platform to the southwest. Cd and Hg were below detection limits at most other sampling stations.

However, the background level of Cd for the North Sea at locations within 500 m from an active platform is 0.85 mg kg-1 while it increases to 1.26 mg kg-1 at locations between 500 m and 1,000 m from an active platform (UKOOA 2001). I23A_01 is located within 500 m from the platform therefore Cd concentration here is above the relevant background level however it falls in line with the background level for locations further away from the platform. Background level of Hg for the North Sea at locations within 500 m from an active platform is 0.36 mg kg-1 (UKOOA 2001), meaning that the concentration measured at I23A_01 was below background.

Ba is known to be present in higher concentrations in sediments potentially affected by drilling fluids which can contain substantial amounts of barites (barium sulphates). Therefore, monitoring of Ba and TBa is of relevance for the oil and gas industry. Ba varied between 3.74 mg kg-1 at I23A_05 and 28.8 mg kg-1 at I23A_01, while TBa concentration was 200 mg kg-1 at stations 01, 07, 08, 09, 10 and 11 and 400 mg kg-1 at the remaining 5 stations. TBa concentrations for the North Sea range between 33,5562.12 mg kg-1 within 500 m of an active platform and 320.26 mg kg-1 at locations over 5,000 m away from active platforms (UKOOA 2001), indicating that current TBa concentrations across the survey area were below the respective background levels.

Table 5.1 ***Summary of heavy and trace metal concentrations (mg kg-1) in sediments.***

Station	As	Cd	Cr	Cu	Pb	Hg	Ni	Zn
I23A_01	11.9	1.27	10.8	12.8	20.0	0.10	7.0	77.4
I23A_02	12.3	BDL	6.20	9.80	7.70	0.01	4.20	29.1
I23A_03	15.8	BDL	9.90	32.3	15.4	0.01	5.80	81.2
I23A_04	9.20	BDL	6.10	6.10	5.10	0.02	3.90	36.0
I23A_05	10.2	BDL	5.80	4.30	4.60	BDL	3.40	15.0
I23A_06	9.70	BDL	7.40	4.60	5.20	BDL	4.10	17.7
I23A_07	11.7	0.17	9.3	6.0	8.0	BDL	5.4	23.1
I23A_08	11.4	BDL	8.8	5.7	6.0	BDL	5.0	21.4
I23A_09	9.9	BDL	9.7	4.6	6.0	BDL	5.2	20.3
I23A_10	13.4	BDL	8.6	4.3	6.0	BDL	5.2	21.1
I23A_11	15.9	BDL	11.7	5.2	8.9	BDL	6.8	31.6
Min	9.2	0.17	5.8	4.3	4.6	0.01	3.4	15
Max	15.9	1.27	11.7	32.3	20	0.1	7	81.2
Mean	11.9	0.7	8.6	8.7	8.4	0.0	5.1	34.0

Station	As	Cd	Cr	Cu	Pb	Hg	Ni	Zn
Cefas AL1	20	0.4	40	40	50	0.3	20	130
CefasAL2	100	5	400	400	500	3	200	800
OSPAR BAC	25	0.31	81	27	38	0.07	36	122
OSPAR ERL	8.2*	1.2	81	34	47	0.15	21*	150
CSQG TEL	7.24*	0.7	52.3	18.7	30.2	0.13	-	124
CSQG PEL	41.6	4.2	160	108	112	0.7	-	271

Table 5.2 *Number of stations across the survey area exhibiting elevated heavy and trace metals levels in comparison to reference levels. BDL – Below Detection Level.*

Analyte	CEFAS		OSPAR		CSQG	
	AL1	AL2	BAC	ERL	TEL	PEL
As	0	0	0	11*	11*	0
Cd	1	0	1	1	1	0
Cr	0	0	0	0	0	0
Cu	0	0	1	0	1	0
Hg	0	0	1	0	0	0
Ni	0	0	0	0	-	-
Pb	0	0	0	0	0	0
Zn	0	0	0	0	0	0

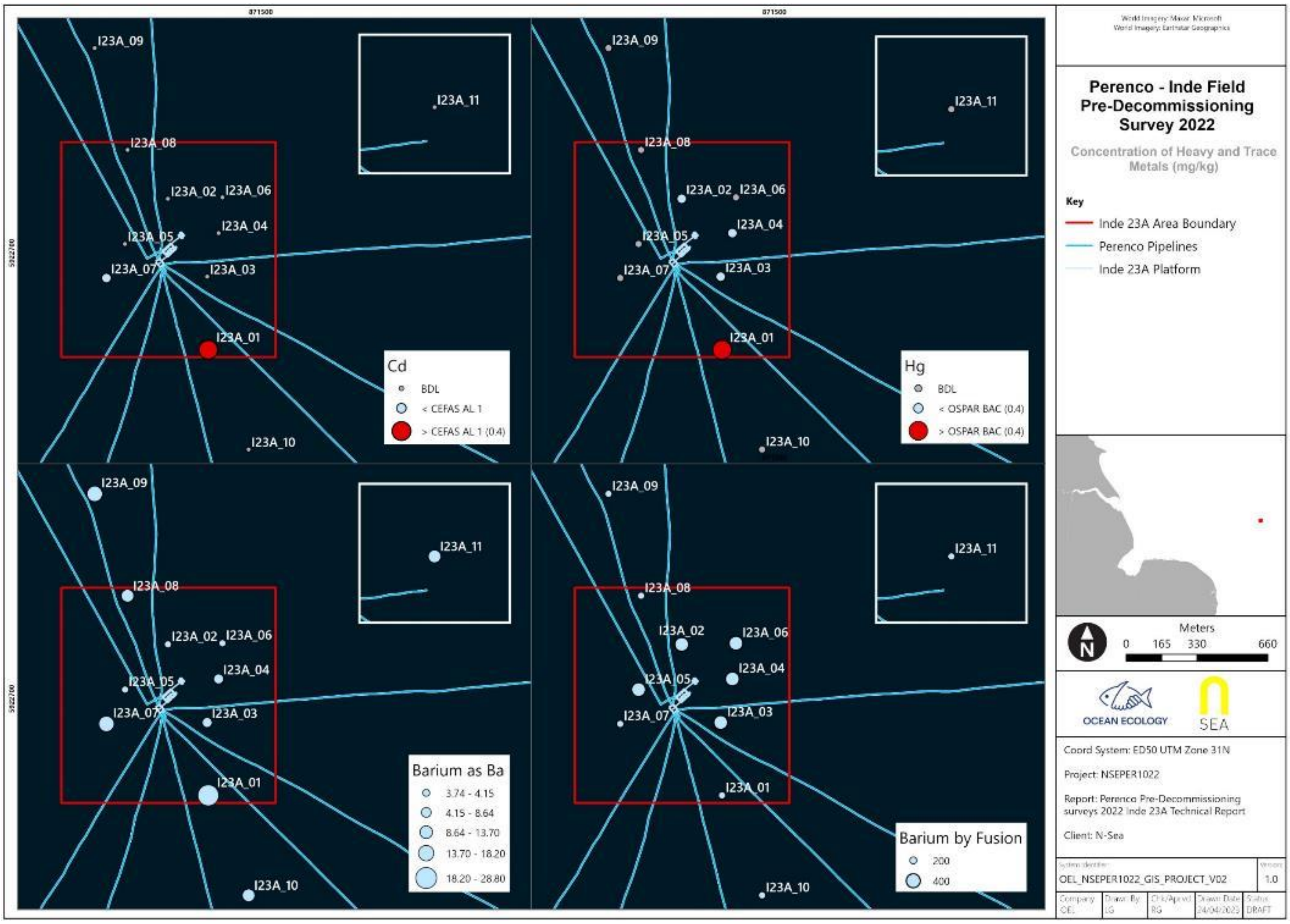


Figure 18 *Concentration of Heavy and Trace Metals (Ocean Ecology Limited, 2023)*

5.6.3 Polycyclic Aromatic Hydrocarbons (PAH)

The full ranges of EPA total polycyclic aromatic hydrocarbons (PAH) and the Department of Trade and Industry (DTI) PAHs were tested and where possible compared to:

- CEFAS AL1 (no CEFAS AL2 available for PAHs)
- OSPAR BAC and ERL
- CSQG TEL and PEL where possible.

None of the reference levels were exceeded for any of the measured PAHs across the Inde 23A platform. Total PAHs concentration across the survey area varied from < 34 µg kg-1 to up to 126 µg kg-1 at I23A_01; which is well below the background levels for the North Sea (offshore) which range between 200 µg kg-1 and 2,700 µg kg-1 (UKOOA 2001).

Generally, there are three sources of hydrocarbons depending on their origin:

- Biogenic: Produce of biological processes or early diagenesis in marine sediments (e.g., perylene).
- Petrogenic: Compounds present in oil and some oil products following low to moderate temperature diagenesis of organic matter in sediments resulting in fossil fuels. Typically include crude oil and refined crude oil products such as gasoline, heating oil, asphalt, and coal.
- Pyrogenic: Derive from various activities which ultimately involve the combustion of organic substances at high temperatures under low oxygen conditions. These may include incomplete combustion of motor fuels, or products derived from the foundry and steel industries.

When assessing the source origin of PAH compounds in sediments, the ratio between light and heavy molecular weight was found to be lower than one at four stations indicating a predominantly pyrogenic origin of PAHs. The remaining stations reported PAHs of predominantly petrogenic origin.

The highest concentration of lightweight PAHs was recorded at I23A_01 (61.3 µg kg-1) which may suggest potentially contaminated sediments at this location. This is consistent with elevated Cd and Hg concentrations at the same station. However, background level of lightweight PAHs such as Naphthalene range from 10,790 µg kg-1 within 500 m from an active platform and 30 µg kg-1 5,000 m from an active platform (UKOOA 2001) suggesting that the concentration of lightweight PAHs at I23A_01 was within background levels.

5.6.4 Total Hydrocarbons (THC)

Results for the THC analysis are present in Figure 19.

The THC in sediment samples across the survey area ranged from 2,280 µg kg-1 at I23A_10 to 6,150 µg kg-1 at I23A_08 with an average value (± SD) for the whole area of 3,905 ± 357 µg kg-1.

Background levels for THC in the North Sea range between 11,048,000 µg kg-1 within 500 m from an active platform and 6,890 µg kg-1 5,000 m from an active platform (UKOOA 2001) meaning that THC concentrations recorded across the survey area were all below background levels. No spatial pattern emerged when comparing THCs with the corresponding TOC or mud content which could have been related to transportation and deposition of hydrocarbons across the survey area.

N-alkanes (saturates) in sediments had carbon chains length ranging between C13 and C36, with the dominant chain being C25. The highest concentration of total n-alkanes of 153 µg kg-1 was recorded at station 4, while the lowest concentration of 42 µg kg-1 was found at station 2.

The Pristane / Phytane (Pr/Ph) ratio of n-alkanes was calculated where possible to determine if the source of the n-alkanes is more likely to be petrogenic (<1), biogenic with a likely planktonic influence (1-3) or terrestrial (>3) in nature. The source origin of alkanes were determined to be predominantly biogenic with six stations (01, 04, 07, 08, 09 and 11) reporting strong terrestrial influences.

The Carbon Preference Index (CPI) was also used to assess n-alkanes origin sources, and the origin of n-alkanes was considered predominantly biogenic (CPI >1) at all stations. No stations were found to represent pyrogenic or petrogenic sources of n-alkanes.

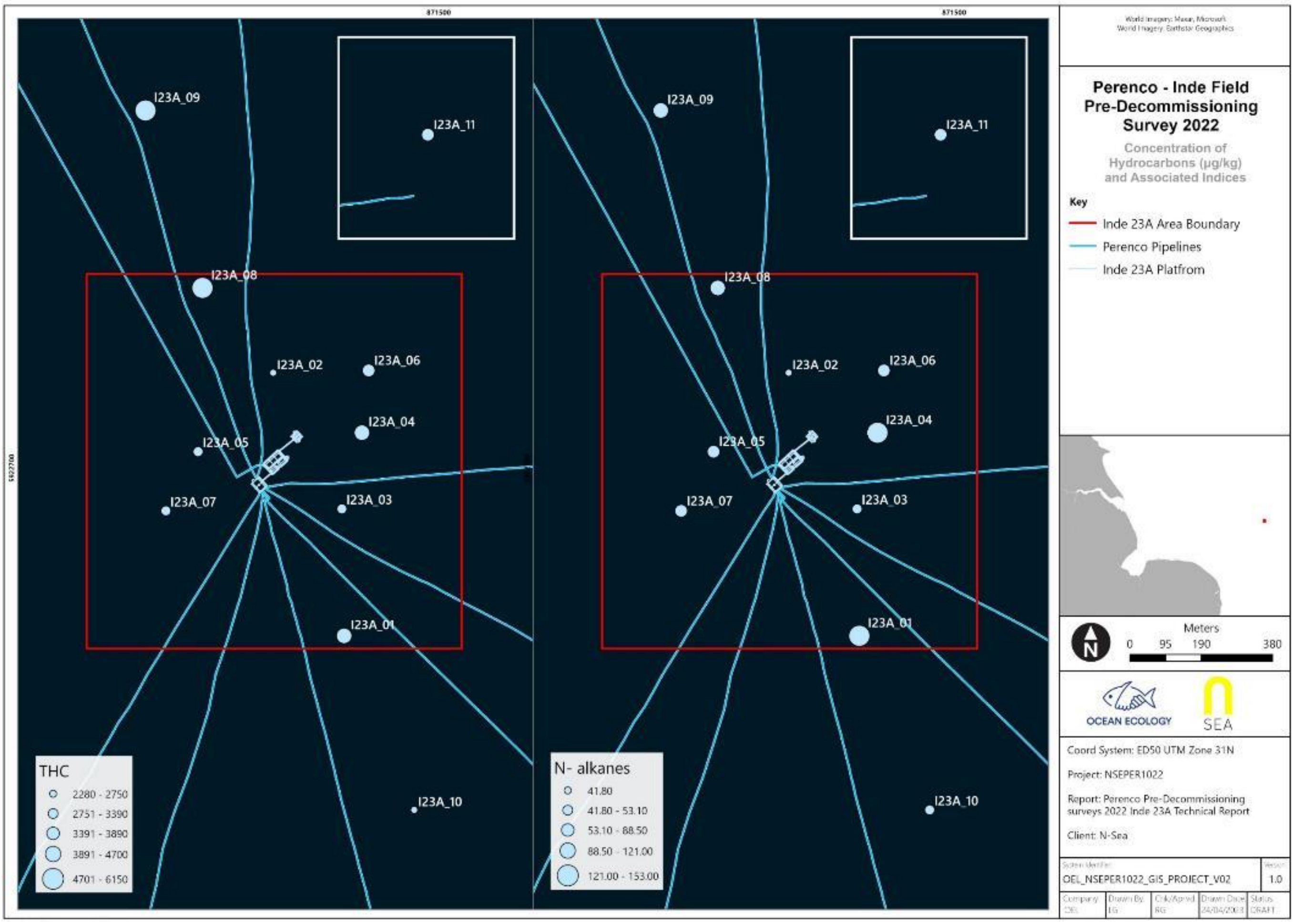


Figure 19 Concentration of Hydrocarbons and Associated indices (Ocean Ecology Limited, 2023)

5.7 Habitat classification

5.7.1 European Nature Information Service (ENUIS) Habitat Classification

Seabed data collected for the EBS was classified into marine biotypes using the JNCC (2015) classification system which was developed in collaboration with Connor et al. (2004) and Parry et al. (2015), and is analogous with the European Nature Information Service (ENUIS) Habitat Classification (EUNIS, 2019). Habitats were identified using a combination of macrobenthic assemblage, review of video footage and still images.

Existing EUSeaMap broad-scale predictive habitat mapping suggested the habitat at Inde 23A would likely be classified as A5.27 'Deep circalittoral sand' in proximity of the Inde 23A platform and in the wider region with smaller areas of A5.25 and/or A5.26. Soft sediments within the survey area aligned with the EUSeaMap with all stations classified as **A5.26 'Circalittoral muddy sand'.** Epifauna was very sparse with only a few brittle stars *(Ophiura sp.*) and hermit crabs (*Pagurus bernhardus*) observed as shown in Figure 20.

The macrobenthic community identified across the Inde 23A platform corresponded more cloesly to the characterising assemblage of EUNIS classification of **A5.242 '*Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sand'** (SS.SSa.IMuSa.FfabMag). This is a biotope typical of the infralittoral zone which is at odds with the offshore location of the Inde field. Nevertheless, all stations were located at a water depth of about 30 m which could explain why a community characteristic of the infralittoral zone was observed.

A description of these habitat types are provided below:

– **Circalittoral muddy sand (SS.SSa.CMuSa / A5.26)** (JNCC, 2022)**:** Circalittoral non-cohesive muddy sands with the silt content of the substratum typically ranging from 5% to 20%. This habitat is generally found in water depths of over 15-20m and supports animal-dominated communities characterised by a wide variety of polychaetes, bivalves such as *Abra alba* and *Nucula nitidosa*, and echinoderms such as *Amphiura spp.* and *Ophiura spp.*, and *Astropecten irregularis*. These circalittoral habitats tend to be more stable than their infralittoral counterparts and as such support a richer infaunal community.

– ***Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sand' (SS.SSa.IMuSa.FfabMag / A5.242)** (JNCC, 2022)**:** In stable, fine, compacted sands and slightly muddy sands in the infralittoral and littoral fringe, communities dominated by venerid bivalves such as *Chamelea gallina* occur. This biotope may be characterised by a prevalence of *Fabulina fabula and Magelona mirabilis* or other species of *Magelona* (e.g. *M. filiformis*). Other taxa, including the amphipod *Bathyporeia spp.* and polychaetes such as *Chaetozone setosa*, *Spiophanes bombyx* and *Nephtys spp.* are also commonly recorded. In some areas the bivalve *Spisula elliptica* may also occur in this biotope in low numbers. The community is relatively stable in its species composition, however, numbers of *Magelona* and *F. fabulina* tend to fluctuate. In deeper, offshore variants of this biotope, although still present, there is a reduction in the component species *F. fabula*, whilst *Magelona filiformis, Bathyporeia spp.*, annelid and nemertean worms, and Amphiuridae may be more common. These communities have been shown to correlate well with particular levels of current induced 'bed-stress'. Sites with this biotope may undergo transitions in community composition.

Ultimately, the habitat map for the Inde 23A platform was based on the results of the particle size analysis and seabed imagery analysis indicating that the habitat complex **A5.26**.

A map of the habitat classifications within the Inde 23A survey area is provided in Figure 21. The grab sampling stations have been overlaid on this map to show the mismatch between the presence of an infralittoral community in the circalittoral zone.

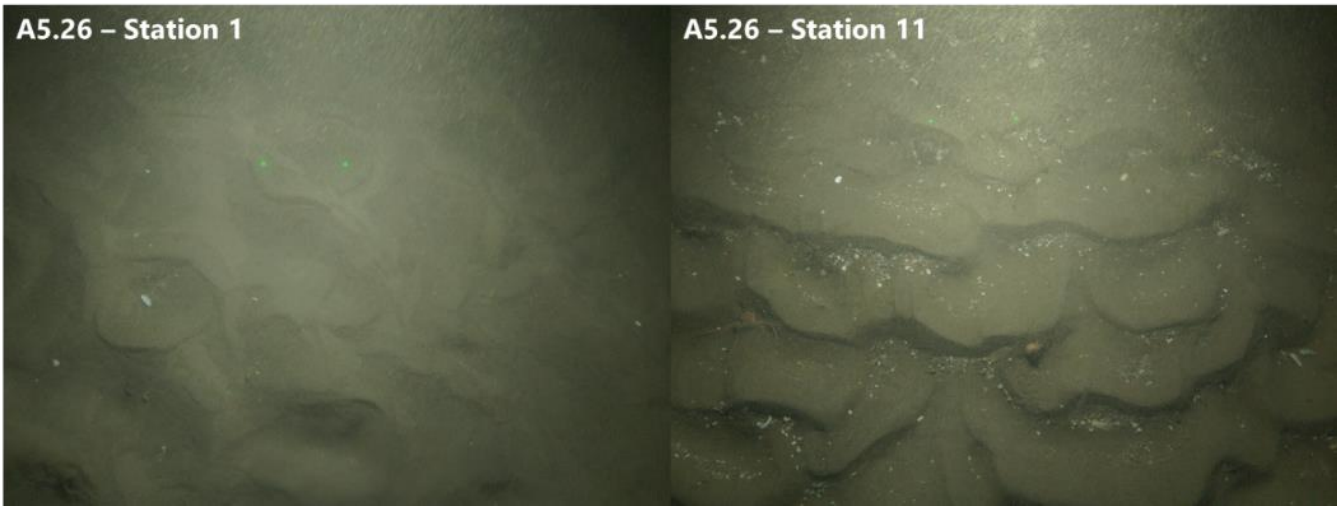


Figure 20 *Example images of EUNIS classification A5.26 observed across all sampling stations across the survey area (Ocean Ecology Limited, 2023)*

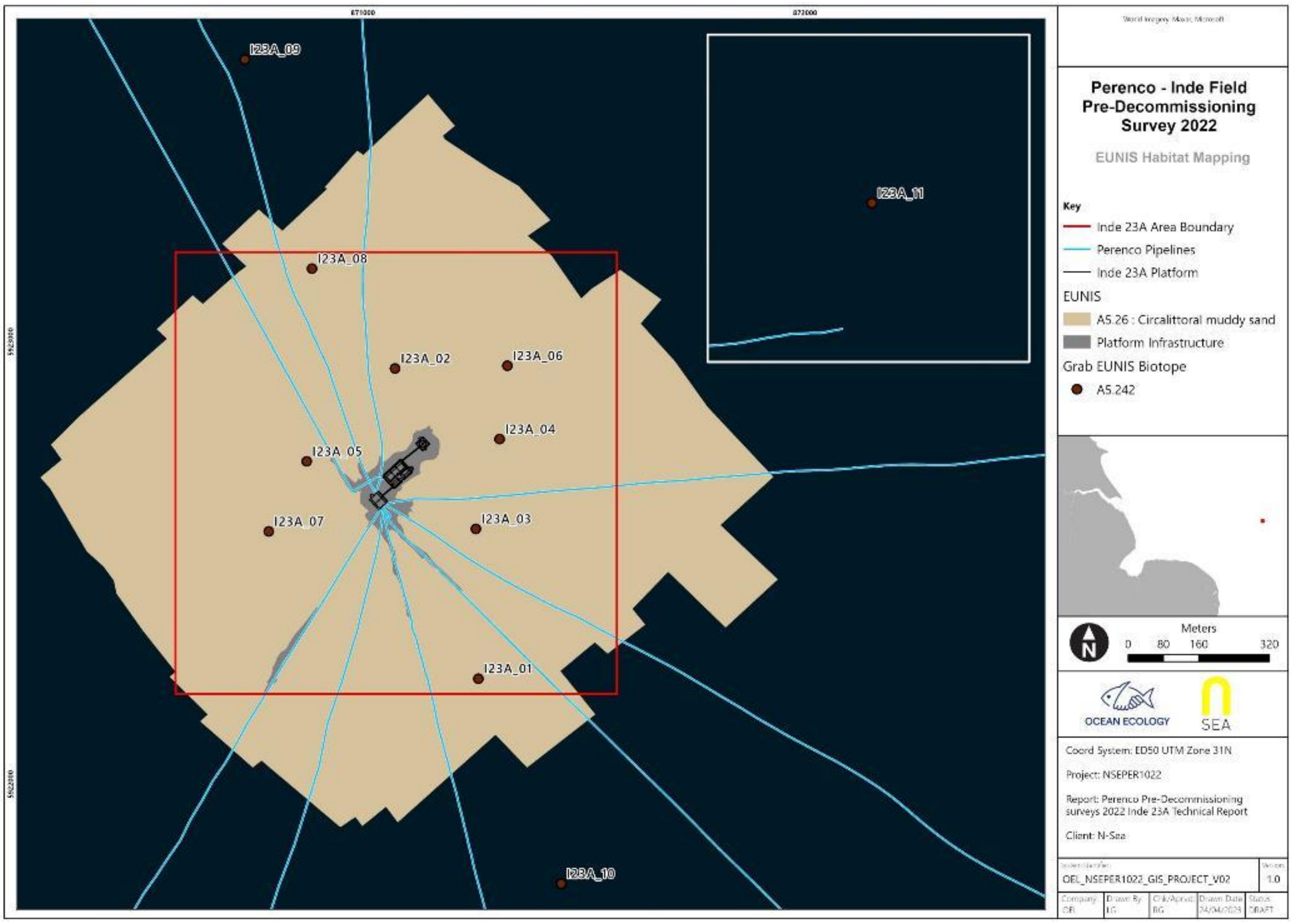


Figure 21 *Environmental Habitat Within the Inde 49/23A Survey Area (Ocean Ecology Limited, 2023)*

5.7.2 Annex I Habitat

The United Kingdom is a signatory to the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention, 1979). To meet their obligations under the convention, the habitats listed in Annex I and the species listed in Annex II in the Habitats Directive, are to be protected by means of a network of sites.

The Annex I habitat 'Sandbanks which are slightly covered by seawater all the time' are sandy sediments that are permanently covered by shallow sea water, typically occurring at depths of less than 20m below LAT. The Inde 23A survey area lies approximately 4.96 km east of the North Norfolk Sandbanks and Saturn Reef SAC which was designated to protect an area of tidal linear sandbanks. The North Norfolk Sandbanks and Saturn Reef SAC is designated for Annex I Sandbanks which are slightly covered by sea water all the time and Annex I Reefs.

The seabed imagery collected as a part of the EBS (Ocean Ecology Limited, 2023) did not reveal any Annex I reefs or other features of conversation interest. Sandbanks are generally defined as areas shallower than 20 m and the water depth across the survey area was deeper than 20 m. Overall, the EBS results aligned with reviews of existing habitat mapping derived from The European Marine Observation and Data Network (EMODnet) which did not identify any Annex I geogenic reef, including bedrock and stony reefs present at the Inde 23A survey area or the wider region.

Sandbanks and other sandy substrates may be important habitats for sandeels. As discussed in section 5.10.1, the area around Inde 23A is mapped as a spawning area for sandeels (the most common of which is the lesser sandeel, *A. marinus*). However, no sandeels were observed during the EBS. It is also noted that sandeels also have generally have a preference for seabed habitats containing a high proportion of medium and coarse sand (particle size 0.25 to 2 mm) (Holland, Greenstreet, Gibb, Fraser, & Robertson, 2005) and the substrate in the survey area was classified as circalittoral muddy sand which features fine to very fine sand with a fine silt fraction (JNCC, 2022).

No evidence of *Modiolus*, sponge communities or *Arctica islandica* (ocean quahog) were recorded in the EBS. The area is not mapped as a herring spawning area (refer section 5.10.1) and the sediments are not considered to be suitable for herring (Franco, Smyth, & Thomson, 2022).

5.8 Benthic biodiversity

As discussed in section 5.7.1, the seabed habitat at Inde 23A was classified as 'Circalittoral muddy sand' (SS.SSa.CMuSa / A5.26) but with macrobenthic communities more aligned with '*Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sand' (SS.SSa.IMuSa.FfabMag / A5.242).

'Circalittoral muddy sand' is typically associated with a wide variety of polychaetes, bivalves such as *Abra alba* and *Nucula nitidosa*, and echinoderms such as *Amphiura spp* and *Ophiura spp.*, and *Astropecten irregularis* (JNCC, 2022). *Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sand' is typically dominated by venerid bivalves such as *Chamelea gallina* (JNCC, 2022)**.**

During the EBS, an impoverished macrobenthic assemblage was identified across the survey area, with a total of 681 individuals and 63 taxa recorded. The mean (± SE) number of taxa was 13 ± 1 per station. Mean (± SE) abundance per station was 31 ± 3 with a mean (± SE) biomass per station of 0.2828 ± 0.1243 gAFDW (grams of ash-free dry weight).

As shown in Figure 22, juvenile brittle stars (*Ophiuridae*) were the most abundant taxon sampled accounting for 18% of all individuals recorded. It accounted also for the highest occurrence and greatest average density per sample. Other key taxa included the sea potato *Echinocardium cordatum* and the pea urchin *Echinocyamus pusillus* which accounted for the first and second maximum abundance in a single sample and the polychaete *Sthenelais limicola* which was the second most frequent taxon sampled across the survey.

Figure 23 illustrates the relative contributions to abundance, diversity, and biomass of the major taxonomic groups in the macrobenthic community sampled. On average, Echinodermata taxa contributed most to abundance and biomass as they accounted for about 45% of all individuals recorded and 87% of all biomass recorded. Annelida taxa instead contributed the most to diversity accounting for 33% of all taxa recorded.

Figure 24 shows variations in macrobenthic mean abundance, diversity and biomass per station across the survey area. The highest mean abundance was found at station 8 (I23A_08) while the highest diversity and biomass were recorded at station 10 (I23A_10) with the latter due to the presence of large Echinodermata individuals. Biomass was generally low across the survey area except for stations 1, 8 and 10 where large Echinodermata individuals were found.

No species of conservation or economical interest were identified across the survey area.

The SIMPER (similarity percentage analysis) routine was used to identify the key taxa contributing to the within group similarity. Characterising taxa of this group were the polychaetes *S. limicola* and *Magelona johnstoni*, the bean like tellin *Fabulina fabula*, the amphipod *Bathyporeia elegans*, the bivalve *Nucula nitidosa* and the pea urchin *E. pusillus* and all together contributing to about 51 % of the group average similarity of 50.23.

As discussed, the biotope A5.242 '*Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sand' was deemed to be that best aligned with the community observed in this group and therefore across all stations sampled.

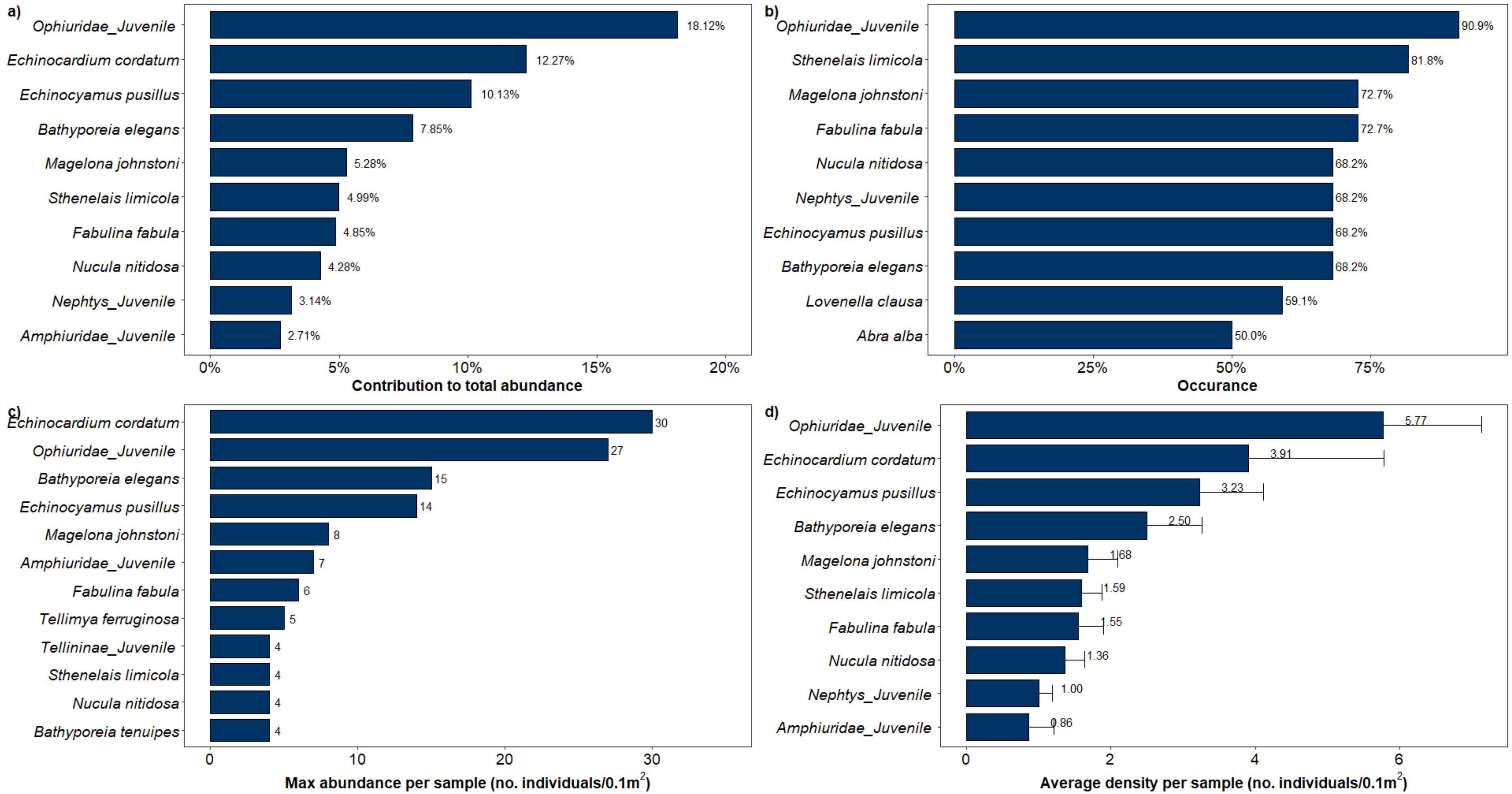


Figure 22 ***Percentage contributions of the top 10 taxa to total abundance (a) and occurrence (b) from samples collected across the Inde 23A platform. Also shown are the maximum densities of the top 10 taxa per sample (c) and average densities of the top 10 taxa per sample (d). (Ocean Ecology Limited, 2023).***

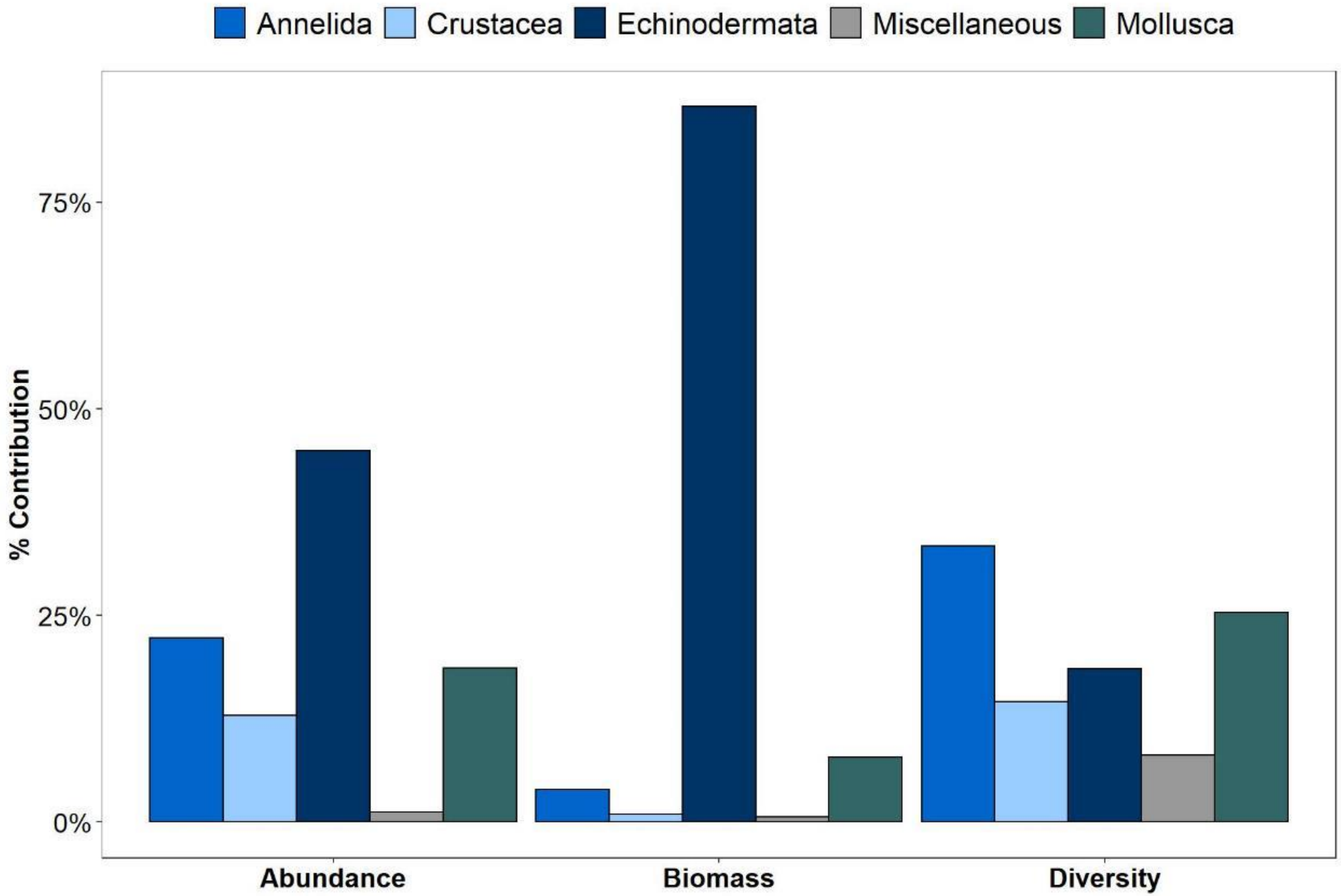


Figure 23 *Relative contribution of the major taxonomic groups to the total abundance, diversity and biomass of the macrobenthic community sampled across the Inde 23A platform. (Ocean Ecology Limited, 2023).*

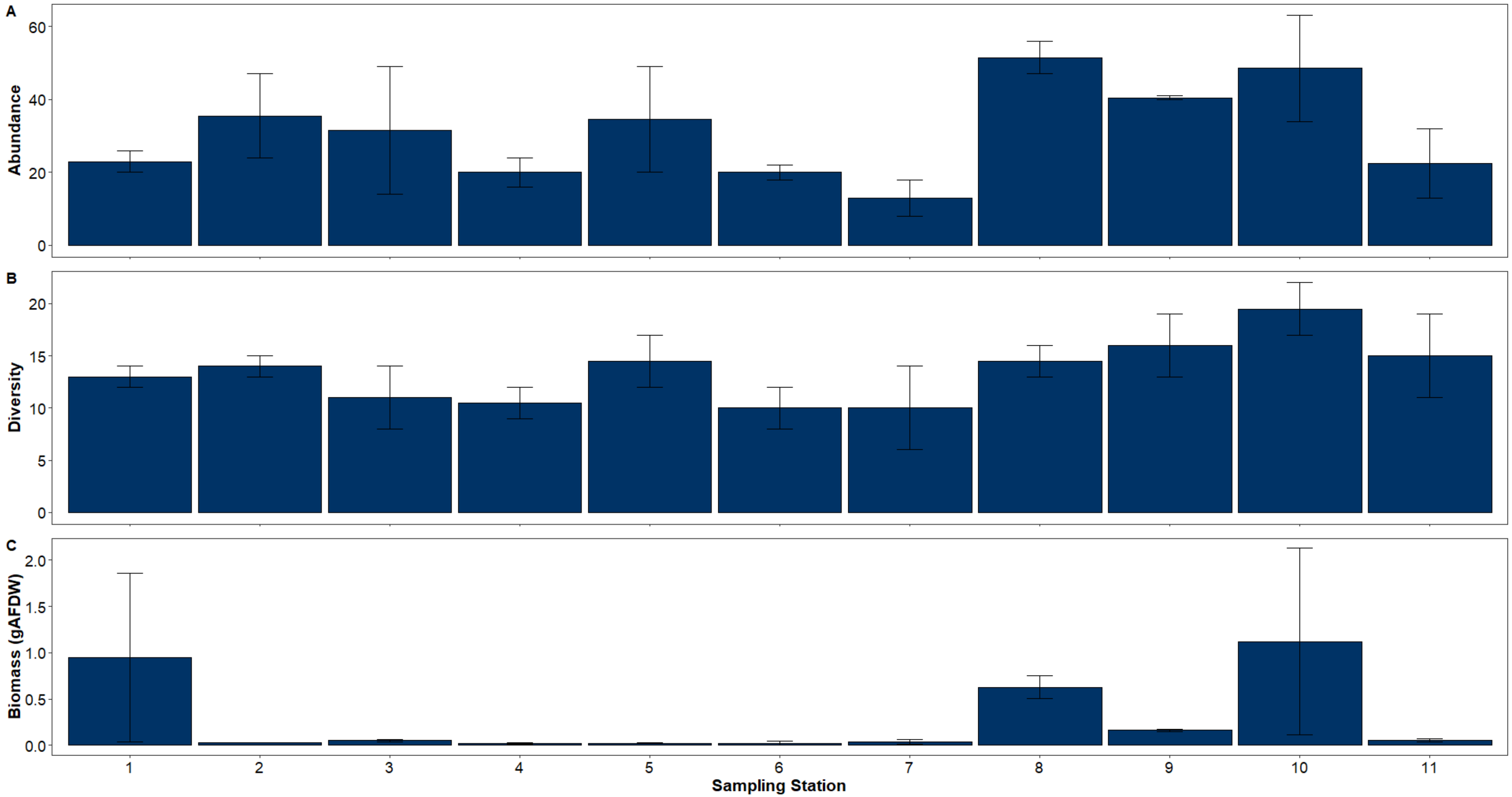


Figure 24 *Mean abundance, mean diversity and mean biomass per station across the Inde 23A platform. Error bars indicate the standard error between replicate samples. (Ocean Ecology Limited, 2023).*

5.9 Plankton

The collective term plankton describes the plants (phytoplankton) and animals (zooplankton) that live freely in the water column and drift passively with the water currents. Typically, in the SNS Regional Sea 2 a phytoplankton bloom occurs every spring, generally followed by a smaller peak in the autumn (DECC, 2016).

The phytoplankton community in the SNS area is dominated by the dinoflagellate genus *Tripos* (*T. fusus, T. furca, T. lineatus*), along with higher numbers of the diatom, *Chaetoceros* (subgenera *Hyalochaete* and *Phaeoceros*) than are typically found in the northern North Sea. From November to May when mixing is at its greatest, diatoms comprise a greater proportion of the phytoplankton community than dinoflagellates (DECC, 2016).

The zooplankton community is dominated by copepods including *Calanus helgolandicus and C. finmarchicus* as well as *Paracalanus* spp, *Pseudocalanus* spp, *Acartia* spp, *Temora* spp and cladocerans such as *Evadne* spp (DECC, 2016). There has been a marked decrease in copepod abundance in the SNS, which has been linked to changes in global weather phenomena (DECC, 2016).

5.10 Fish and shellfish

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

It is noted that some fish species congregate around platforms and along pipelines. Spawning individuals and juveniles can however be sensitive to seismic activities, seabed disturbance activities, discharges to sea and, in some cases, accidental spills.

5.10.1 Fish spawning and nurseries

A number of species, which have benthic eggs, have a dependency on specific substrata for spawning. For example, sandeels lay their eggs on sandy sediments and therefore may spawn on discrete sandy sediments within the blocks of interest. Such sediments would therefore be considered important for this species (DECC, 2016). A number of other species, including some demersal species, have pelagic eggs and / or larvae (including cod, haddock, Norway pout and saithe) and are therefore less reliant on specific sediment types for spawning (DECC, 2016).

Juvenile fish are vulnerable to predators and harsh conditions in the open water. Therefore, it is typical for juvenile fish to stay in sheltered nursery grounds, which also provide an abundance of food (DECC, 2016).

The North-East Atlantic and North Sea are split into statistical grids called International Council for the Exploration of the Sea (ICES) Rectangles in order to map statistical information about the area. Inde 23A is located within UKCS Blocks 49/23, corresponding to ICES Rectangle 35F2 (refer Figure 25). CEFAS / Marine Scotland has published data on critical spawning and nursery grounds for selected fish species around the UK (CEFAS, 2012; Coull et al., 1998; Ellis et al., 2012).

Species that spawn and / or nurse within the vicinity of Inde 23A, based on CEFAS (2012) data, are shown in Figure 25, and include:

- sandeel (*Ammodytes marinus*)
- cod (*Gadus morhua*)
- herring (*Clupea harengus*)
- mackerel (*Scomber scombrus*)
- plaice (*Pleuronectes platessa*)
- nephrops (*Nephrops norvegicus*)
- sprat (*Sprattus sprattus*)
- whiting (*Merlangius merlangus*)
- tope shark (*Galeorhinus galeus*).

Table 5.3 provides the spawning and nursery seasons for these species, where relevant, based on research published by Ellis et al. (2012) and Coull et al. (1998).

All of the species listed in Table 5.3, with the exception of nephrops and sprat are listed as UK BAP priority marine species (JNCC, 2007). Cod is also on the OSPAR List of Threatened and/or Declining Species and Habitats (OSPAR Commission, 2025). Tope Shark is listed as 'Critically Endangered' globally and 'Vulnerable' in Europe on the International Union for the Conservation of Nature (IUCN) Red List of Threatened Species. Similarly, cod is listed as 'Vulnerable' globally on the International Union for the Conservation of Nature (IUCN) Red List of Threatened Species. All other species from Table 5.3 are listed as Least Concern IUCN (IUCN, 2025).

Table 5.3 Fish species present at Inde 23A (within ICES 35F2) (destinations, spawning season, and nursery presence)

Species	Designations			Spawning and nursery seasons											
	1	2	3	J	F	M	A	M	J	J	A	S	O	N	D
Sandeel			LC	S	S									S	S
Cod			VU	SN	SN	SN	SN	N	N	N	N	N	N	N	N
Herring			LC	N	N	N	N	N	N	N	N	N	N	N	N
Mackerel			LC	N	N	N	N	N	N	N	N	N	N	N	N
Plaice			LC	S	S	S									S
Nephrops			LC	SN	SN	SN	SN	SN	SN	SN	SN	SN	SN	SN	SN
Sprat			LC					S	S	S	S				
Whiting			LC	N	SN	SN	SN	SN	SN	SN	N	N	N	N	N
Tope Shark			CR	N	N	N	N	N	N	N	N	N	N	N	N

Designations: 1. UK BAP (JNCC, 2007); 2. OSPAR List (OSPAR Commission, 2025); 3. IUCN Red List (IUCN, 2025).

LC – Least Concern; NT – Near Threatened; VU – Vulnerable; EN – Endangered; CR – Critically Endangered

Key: S = Spawning; N = Nursery; Peak spawning= Darker blue colour.
Spawning seasons sought from Ellis et al. (2012) and Coull et al. (1998).
Spawning and nursery areas sought from CEFAS (2012).

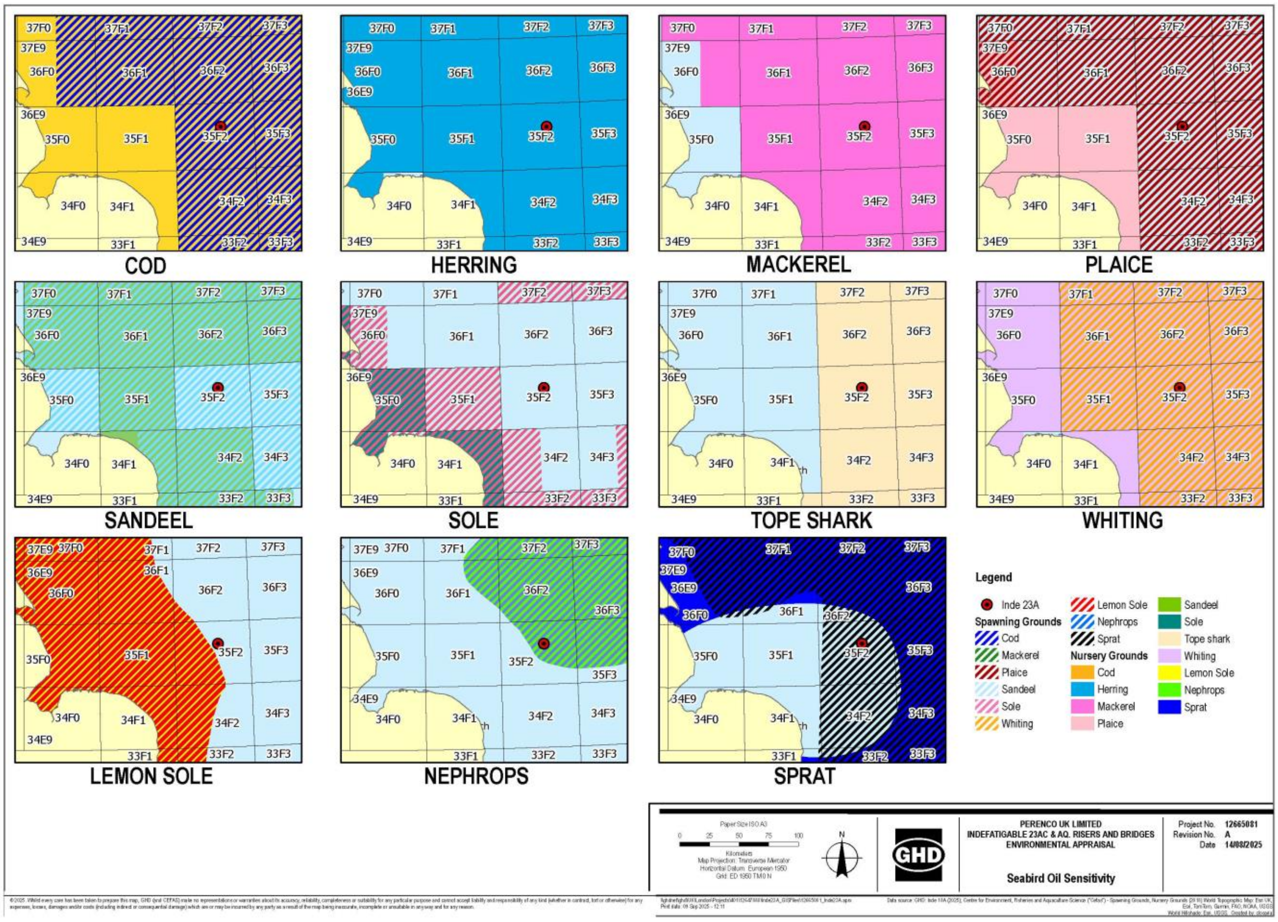


Figure 25 ***Fish presence***

5.10.2 Elasmobranch species

Elasmobranch species (sharks, skates, and rays) are also an important component of the North Sea ecosystem. Elasmobranchs have a low fecundity and slow growth rate, leaving them vulnerable to overfishing pressures and pollution events, and subsequent recovery of populations in response to disturbance events is low.

In a survey of the distribution of elasmobranchs in UK waters undertaken by Ellis et al. in 2012, a total of 26 elasmobranch species were recorded throughout the North Sea and surrounding waters. Species which have been recorded in the SNS at various times throughout the year and may therefore be present in the vicinity of the block of interest, are listed in Table 5.4. As discussed in section 5.10.1, tope shark (*Galeorhinus galeus*) (IUCN Critically Endangered) is mapped as nursing in ICES 35F2.

Of these species, blonde skate, common smoothhound, spiny dogfish, starry smoothhound, thornback skate, tope shark and undulate skate are of most concern due to their unfavourable IUCN conservation status (IUCN, 2025). In addition, spotted skate, thornback skate, and spiny dogfish are listed on the OSPAR list (OSPAR Commission, 2025).

Table 5.4 ***Elasmobranch species found in the SNS***

Common name	Latin name	Depth Range (m)	Designations	
			IUCN Red List	OSPAR List
Blonde skate	*Raja brachyura*	10-900	NT	
Common smoothhound	*Mustelus mustelus*	5-350	EN	
Cuckoo skate	*Leucoraja naevus*	12-290	LC	
Small spotted catshark	*Scyliorhinus canicula*	<400	LC	

Common name	Latin name	Depth Range (m)	Designations	
			IUCN Red List	OSPAR List
Spiny dogfish	*Squalus acanthias*	15-528	VU	
Spotted skate	*Raja montagui*	<530	LC	
Starry smoothhound	*Mustelus asterias*	0-100	NT	
Thornback skate	*Raja clavata*	10-300	NT	
Tope shark	*Galeorhinus galeus*	0-2000	CR	
Undulate skate	*Raja undulata*	50-200	NT	

Species list sourced from Ellis et al. (2012).
Designations sourced from IUCN (2025) and OSPAR Commission (2025), and up to date as of June 2025.
LC – Least Concern; NT – Near Threatened; VU – Vulnerable; EN – Endangered; CR – Critically Endangered

5.11 Seabirds

Inde 23A is within defined population areas within the Seabird Mapping & Sensitivity Tool (SeaMaST) for 22 bird species including Red-throated Diver (*Gavia stellata*), Atlantic Puffin (*Fratercula arctica*), Razorbill (*Alca torda*), Guillemot (*Uria aalge*), Little Tern (*Sternula albifrons*), Arctic Tern (*Sterna paradisaea*), Common Tern (*Sterna hirundo*), Roseate Tern (*Sterna dougallii*), Sandwich Tern (*Thalasseus sandvicensis*), Kittiwake (*Rissa tridactyla*), Great Black-backed Gull (*Larus marinus*), Herring Gull (*Larus argentatus*), Lesser Black-backed Gull (*Larus fuscus*), Great Skua (*Stercorarius skua*), Arctic Skua (*Stercorarius parasiticus*), Shag (*Gulosus aristotelis*), Gannet (*Morus bassanus*), Manx Shearwater (*Puffinus puffinus*), Fulmar (*Fulmarus glacialis*), Great Cormorant (*Phalacrocorax carbo*), Great Northern Diver (*Gavia immer*) and Red-throated Diver (*Gavia stellata*) (Natural England, 2025).

Offshore structures, such as oil platforms in the SNS, create a manmade archipelago of islands that provide several opportunities to birds (Xodus Group, 2024). Birds can be attracted to offshore installations for their foraging opportunity and as a refuge or roosting site. They may also get attracted to platforms by the illumination of either lighting or the flare.

Certain species have recently been recorded nesting on SNS assets, as these structures present ideal nesting ledges akin to cliff ledges. The most commonly recording nesting birds on offshore platforms are kittawakes. Nests are typically around 30 cm diameter and typically constructed above the splash zone, with a vertical surface at the back of the ledge, and ideally with a surface above the nest to shield from weather and predation. It is unusual to see single nests scattered around an onshore colony as kittiwakes are colonial and social breeders.

Other species recorded nesting on offshore assets include Razorbill (*Alca torda*), Guillemot (*Uria aalge*), Lesser Black-backed Gull (*Larus fuscus*), Herring Gull (*Larus argentatus*), Carrion Crow (*Corvus corone*), Common Guillemot (*Uria aalge*), and Razorbill (*Alca torda*) (Xodus Group, 2024). Birds that reside in the SNS, such as Jackdaws (*Coloeus sp*.), as are known to fly between platforms when foraging, often exploiting infield vessel movements (Xodus Group, 2024).

RSK Biocensus (2023b) identified suitable nesting ledges on Inde 23A shown in Figure 26. However, as discussed in section 5.2, no bird species have been recorded nesting at the Inde 23A platforms in annual surveys conducted from 2023 to 2025. In 2025, one fulmar, two guillemots, one kittiwake, one gannet and lesser black-backed gull were recorded at the platform.

It should be noted that seabird presence is unpredictable and as such having no history of nesting birds does not guarantee that lack of presence will continue in the future, particularly given the other anthropogenic pressures on bird populations.

Figure 26 Suitable nesting ledges on Inde 23A (RSK Biocensus, 2023a)

Seabird populations are particularly vulnerable to surface pollution. The vulnerability of bird species to oil pollution varies considerably throughout the year and is dependent on a variety of factors, including time spent on the water, total biogeographical population, reliance on the marine environment and potential rate of population recovery.

The Seabird Oil Sensitivity Index (SOSI) has been developed to identify areas where seabirds are likely to be most sensitive to oil pollution (Webb, Elgie, Irwin, Pollock, & Barton, 2016). The SOSI score for each UKCS Block can be ranked into sensitivity categories, from 1 (extremely high sensitivity) to 5 (low sensitivity).

An assessment of the median SOSI scores indicates that the sensitivity of seabirds to oil pollution in UKCS block 49/23 ranges from low to high (refer Table 5.5). SOSI scores for the region around Inde 23A are shown in Figure 27.

Table 5.5 SOSI scores for UKCS block 49/23

UKCS Block	J	F	M	A	M	J	J	A	S	O	N	D
49/17	N	N	N	N	N	N	2	5	5	N	N	N
49/18	N	N	N	N	N	5	2	5	5	N	N	5
49/19	N	N	N	N	N	5	5	5	5	N	N	5
49/22	N	N	3	N	N	N	N	5	3	N	N	1
49/23	**3***	**4***	**4**	**4***	**5***	**5**	**5***	**5**	**5**	**5***	**3***	**3**
49/24	N	N	5	N	N	5	5	5	5	N	N	5
49/27	N	N	4	N	N	N	N	5	N	N	N	1
49/28	N	N	4	N	N	N	N	5	N	N	N	1
49/29	N	N	4	N	N	5	N	5	N	N	N	3

SOSI Level	Portal Code	GIS Data Levels
Extremely High	1	> 40.545
Very High	2	16.588 - 40.545
High	3	7.620 - 16.588
Medium	4	3.895 - 7.620
Low	5	0 - 3.895
No Coverage	N	N

Notes:

One asterisk (*) - indicates a proxy score gathered from the same block in an adjacent month.
Two asterisks (**) - indicates a proxy score gathered from an adjacent block in the same month.

Bold UKCS block – location of Inde 23A

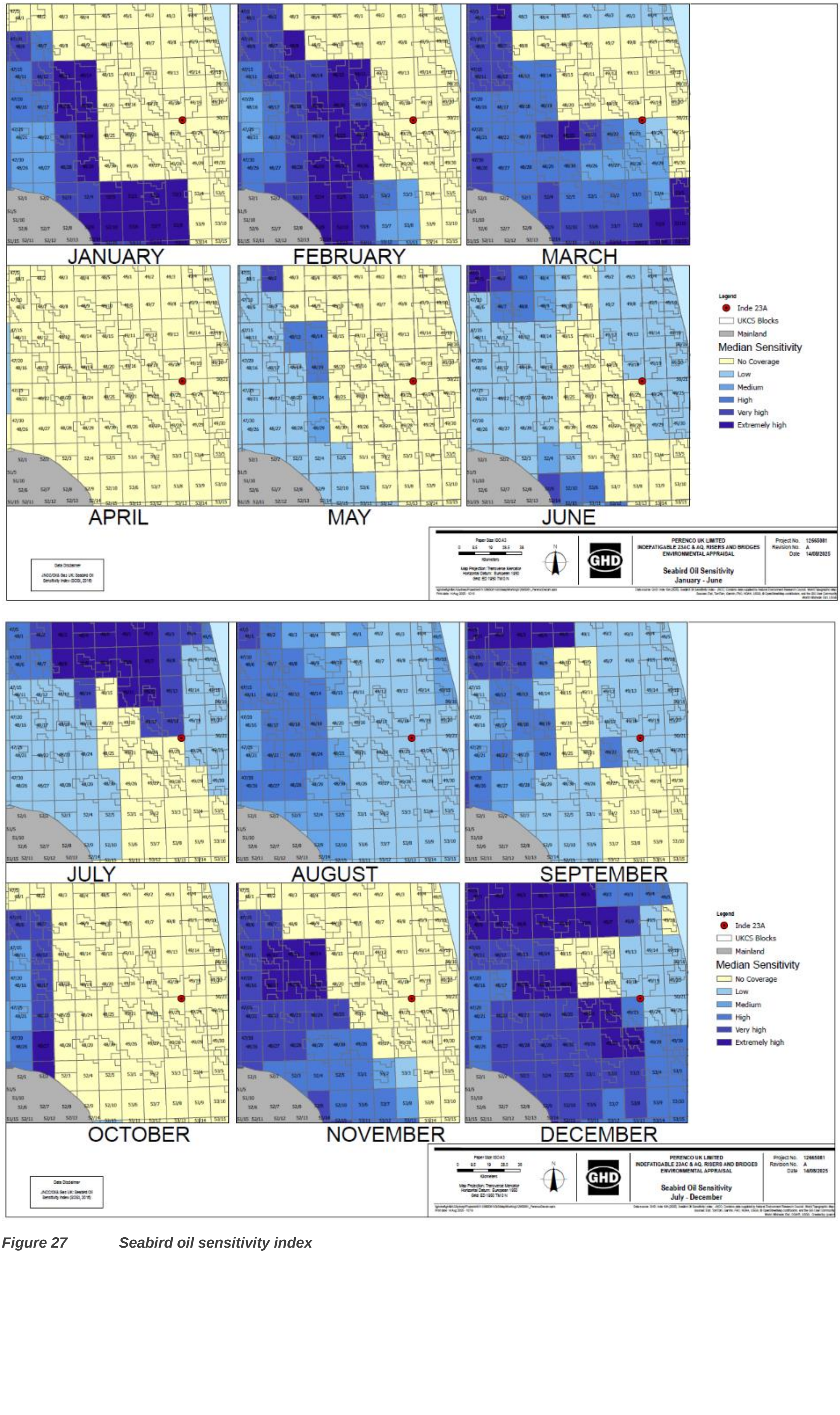


Figure 27 Seabird oil sensitivity index

5.12 Marine mammals

5.12.1 Cetaceans

Cetaceans (whales, dolphins, and porpoises) are protected under Annex IV of the Council Directive 92/43/EEC (also known as the Habitats Directive).

The relative abundance and density of cetaceans in the vicinity of Inde 23A can be derived from data obtained during the Small Cetacean Abundance of the North Sea (SCANS-IV) aerial and ship-based surveys. The Inde 23A field is situated within the SCANS-IV Block 'NS-C'. Cetacean numbers estimated to be within NS-C based on SCANS-IV data are provided in Table 5.6. Estimates have been provided both from the summer survey that occurred in 2022 and a winter survey that occurred in 2024. The summer density numbers have been sourced from the modelled density shapefiles from the SCANS-IV (2023) report which provide densities on a more granular level than SCANS-IV Blocks.

The ocean around Inde 23A has a relatively high estimated density of Harbour porpoise (*Phocoena phocoena*) suggesting that the area represents an important habitat area. Summer presence of Harbour porpoise was higher than winter, although it is noted that fewer surveys have occurred during winter than summer in the SNS (Ramirez-Martinez, et al., 2025).

Other modelled densities of cetacean species around Inde 23A were all under the average densities for all SCANS-IV survey areas (Gilles, et al., 2023). Figure 28 provides the modelled distribution maps for species recorded in NS-C during the SCANS-IV 2022 summer survey.

Table 5.6 Cetacean abundance and density recorded in SCANS-IV survey

Species	SCANS-IV Data			
	Estimated summer abundance within NS-C (Individuals)[1]	Modelled summer density at Inde 23A (Individuals / km^2)[2]	Estimated winter abundance within NS-C (Individuals)	Estimated winter density within NS-C (Individuals / km^2)[3]
Harbour porpoise	38,557	0.814125	22,758	0.3780
Bottlenose dolphin	2,520	0.000812	Not sighted	Not sighted
White-beaked dolphin	894	0.001555	3,546	0.0589
Common dolphin	192	0.004651	Not sighted	Not sighted
Minke whale	412	0.007516	Sightings too low to determine abundance	Sightings too low to determine abundance

Notes:

1. Abundance estimates were sourced from SCANS-IV survey data collected in the summer of 2022 (Gilles, et al., 2023). Only species where abundance estimates were recorded within NS-C have been provided.
2. Density estimates for species have been source in close vicinity of the Inde 23A installation using the modelled distribution map data from the SCANS-IV survey report (SCANS-IV, 2022).
3. Abundance and density estimates from the first winter SCANS-IV survey campaign (2024) have been provided for NS-C (Ramirez-Martinez, et al., 2025).

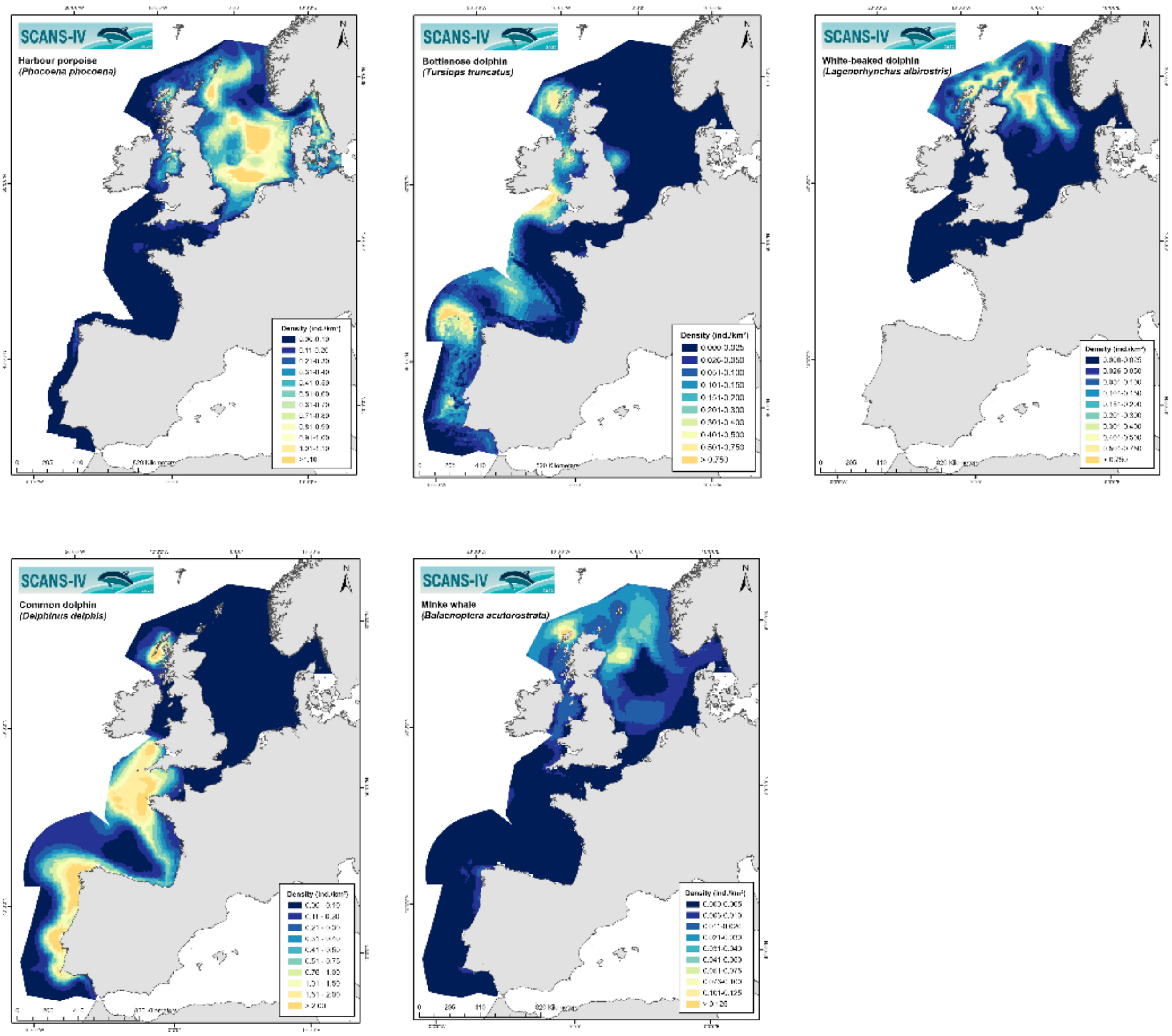


Figure 28 ***Modelled distribution maps for species recorded in NS-C during the SCANS-IV 2022 summer survey (SCANS-IV, 2022)***

For the management of marine mammals, the UK Statutory Nature Conservation Bodies have identified Marine Mammal Management Units (MMMUs) to provide information on the geographical range and abundance of marine mammals and therefore understand the potential effects of anthropogenic activities on populations. The abundance of cetacean species within their respective MMMU is shown in Table 5.7. As shown in Table 5.7, Harbour porpoise has the highest recorded density with the MMMU followed by Common dolphin (*Delphinus delphis*).

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

Table 5.7 Estimates of cetacean abundance in the relevant MMMUs

Species	Management unit[1]	Management unit area (km^2)[1]	Abundance of animals	95% Confidence interval[1]	Density[2]
Harbour porpoise	North Sea	678,206	346,604	289,498 – 419,967	0.511
Bottlenose dolphin	Greater North Sea	639,886	2,022	548 – 7,453	0.003
White-beaked dolphin	Celtic and Greater North Seas	1,560,875	43,951	28,439 – 67,924	0.028
Common dolphin			102,656	58,932 – 178,822	0.066
Minke whale			20,118	14,061 – 28,786	0.013

Notes:

1. Management units, species abundance and confidence interval estimates sourced from IAMMWG (2023).
2. Density (individuals per km) was calculated using the total area of the Management Unit and the abundance of animals within that MMMU.

5.12.2 Pinnipeds

Two species of seals are found in the SNS: Grey seal (*Halichoerus grypus*) and the Harbour (or Common) seal (*Phoca vitulina*). Both species are listed under Annex II of the Habitats Directive and protected under the *Conservation of Seals Act 1970* (from 0 to 12 nautical miles from the coast) as well as being listed as UK BAP priority marine species.

Grey and harbour seals will feed in both inshore and offshore waters depending on the distribution of their prey, which changes both seasonally and yearly. Both species tend to be concentrated close to shore, particularly during the pupping season (October and November for grey seals and June and July for common seals). This is also true during moulting season (generally January to April for grey seals and August and September for the common seal) seasons.

The UK seal populations are found mostly in Scottish waters. However, on the east coast of England, Harbour seals tend to concentrate around The Wash, with Grey seals more regularly found around the Humber Estuary and foraging offshore.

Estimated seal densities in the vicinity of Inde 23A are shown in Figure 29 and provided in Table 5.8. Inde 23A has relatively low densities of seal, with grey seals being more prevalent than harbour seals (Carter & Russell, 2021).

Table 5.8 Estimated seal densities at Inde 23A (2020) (Carter & Russell, 2021)

Species	Estimated density (individuals per 5 km x 5 km cell)		
	Mean	Low	Upper
Grey seal	0.00247008	0.00118138	0.00416474
Harbour seal	0.000264111	0.000101765	0.00057499

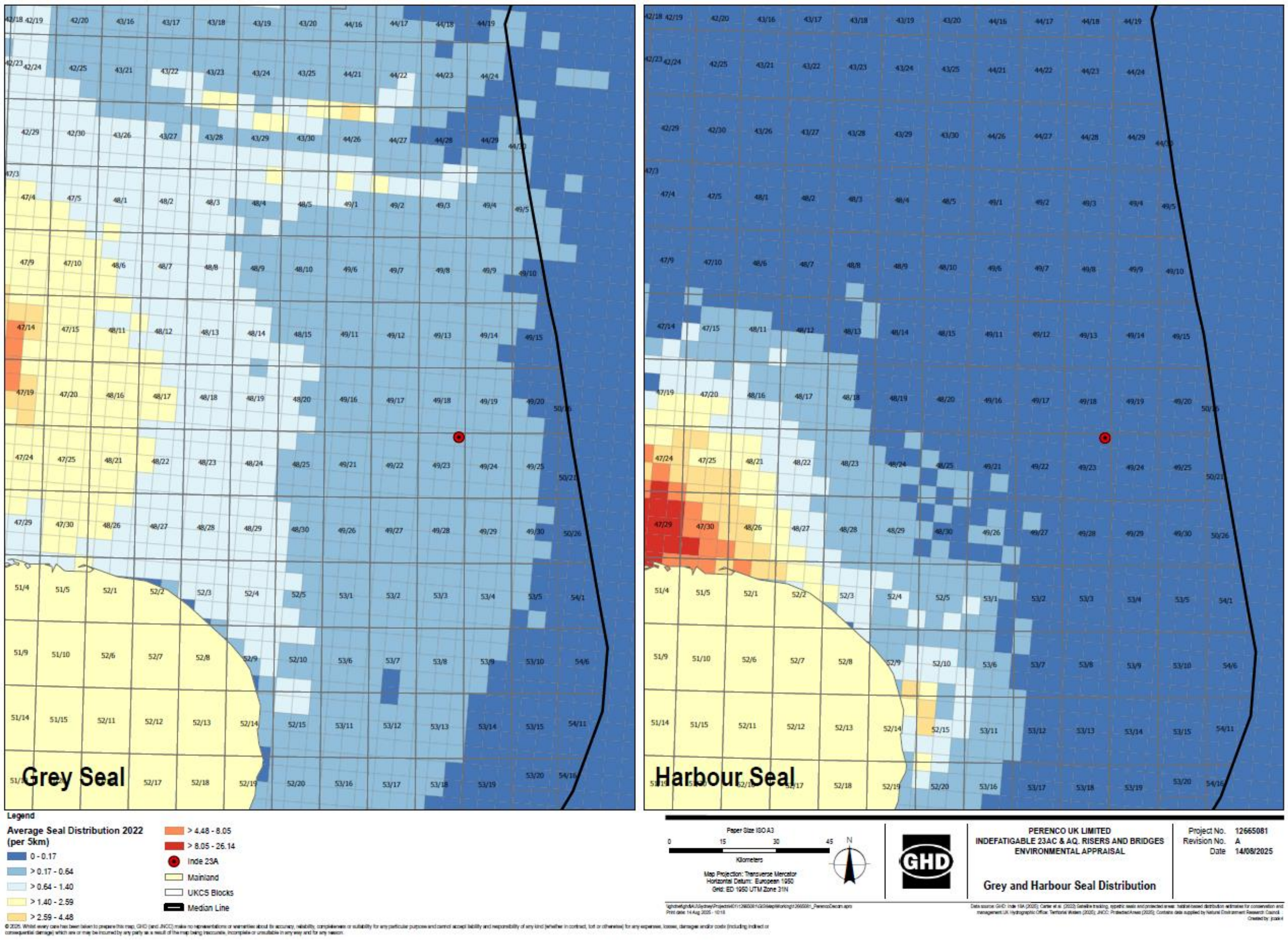


Figure 29 ***Grey and harbour seal distribution***

5.13 Socio-economic

5.13.1 Commercial shipping

The waters surrounding the Inde 23A installation are described as having 'Very Low' shipping activity (NSTA, 2016). DEFRA shipping vessel data shows that an average of 7.374 vessels passed through the region around Inde 23A per week and an average of 383.448 vessels passed through annually (MMO, 2019).

The closest shipping lane is approximately 11.07 km to the southeast of Inde 23A (UK Hydrographic Office, 2024) (refer Figure 30). This shipping lane is the deep-water route from North Hinder to Indefatigable Bank and runs northeast through UKCS quadrant 49 (UK Hydrographic Office, 2024). The Inde 23A installations are within 500 m automatic safety zones meaning vessels cannot enter without authorisation.

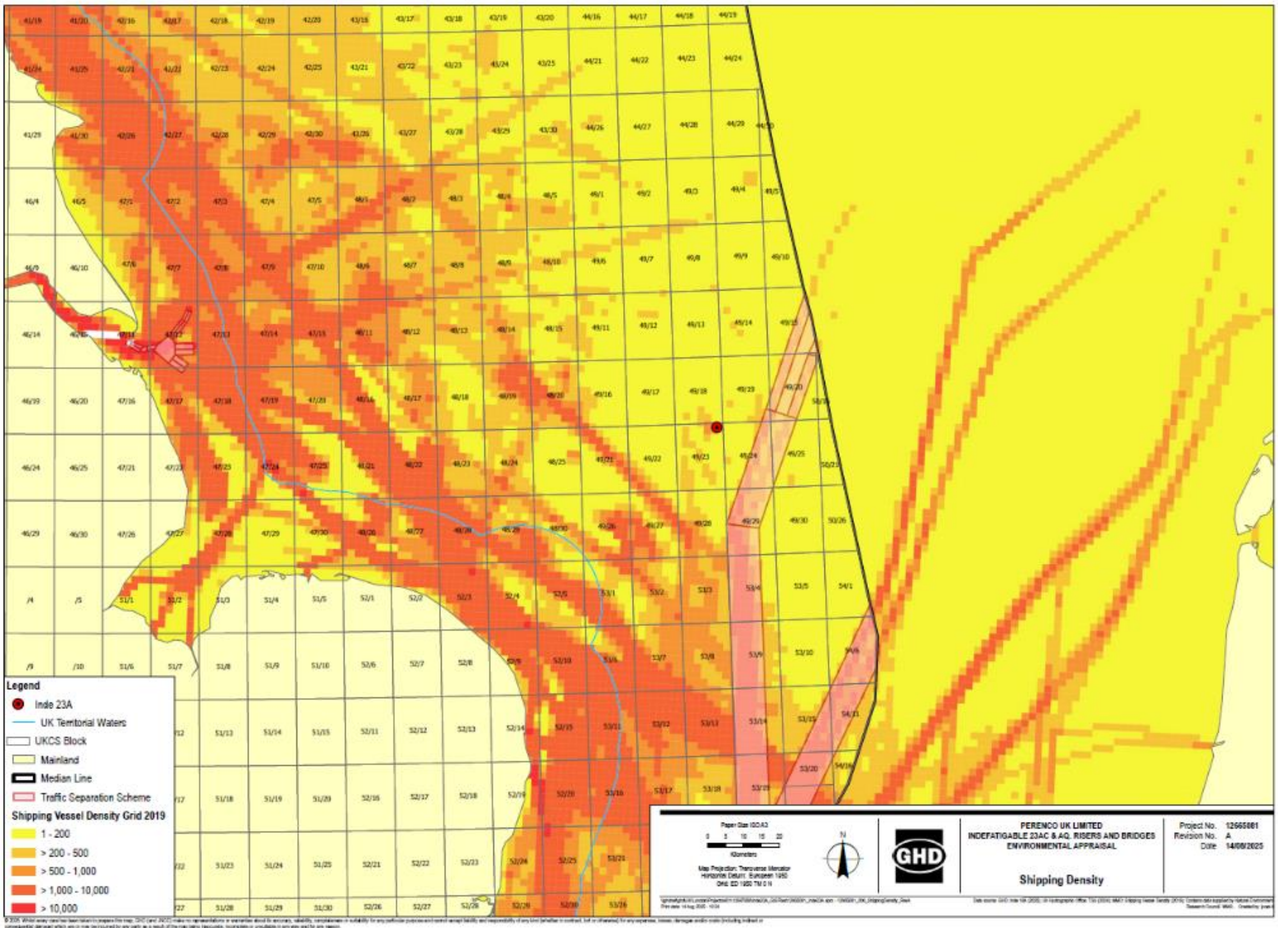


Figure 30 *Shipping density*

5.13.2 Commercial fisheries

The North Sea is one of the world's most important fishing grounds, and major UK and international fishing fleets operate in the SNS, targeting a mix of demersal, shellfish and pelagic fish stocks. However, the area around Inde 23A contributes a relatively small amount to the SNS fishing effort and value (refer Figure 31).

The MMO estimates that the cumulative fishing effort (vessels over 12 m) between 2016 and 2021 in the vicinity of Inde 23A equated to 7,126.79 hours, or 0.57% of the UK's total (MMO, 2025). This effort equated £2,580,955.61 in value or 0.14% of the UK's total value (MMO, 2025).

Inde 23A is within the International Council for the Exploration of the Sea (ICES) rectangle 35F2 (ICES, 2025). There is currently no data published on fishing effort in this area. Activity within the adjacent ICES rectangle 36F2 included 235 days of fishing effort during 2023, 200 days of effort in 2022 and 196 days of effort in 2021 (Marine Directorate, 2024). The types of gear used were primarily seine nets, traps, trawls and dredges (Marine Directorate, 2024). A total of 340 tonnes (te) was landed in 36F2 in 2023, 336 te in 2022 and 289 te in 2021 (Marine Directorate, 2024) . Landed species are made up predominantly of Edible crab (*Cancer pagurus*) and Great Atlantic scallop (*Pecten maximus*) (Marine Directorate, 2024).

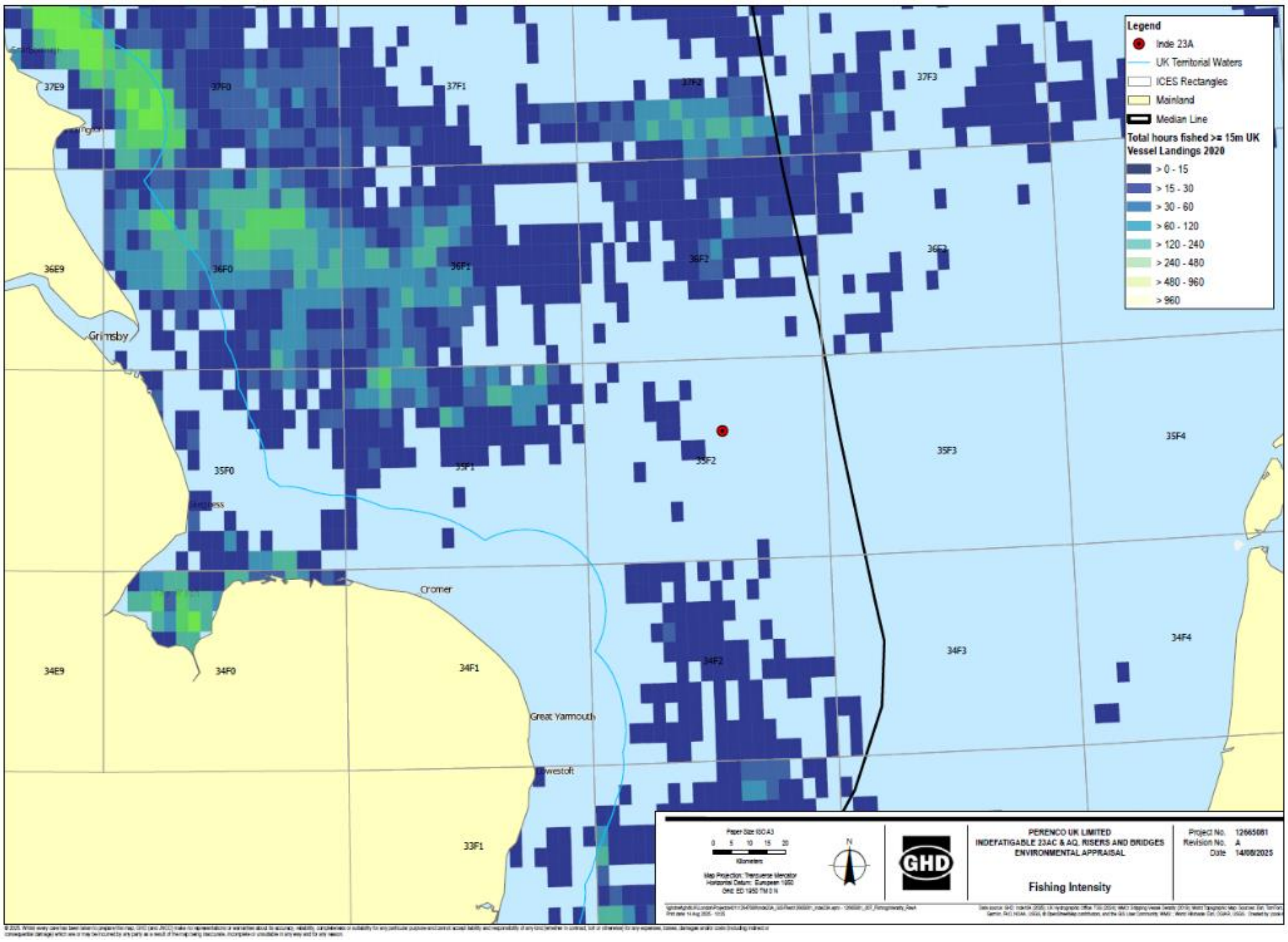


Figure 31 *Fishing intensity*

5.13.3 Oil and gas activities

Oil and gas activity within the SNS is generally high and targets a number of existing gas fields. The Inde field has three installations within UKCS block 49/23: Inde 23C, Inde 23D and the Bessemer 23E Installation (refer Figure 32). Due to the high oil and gas activity in the area, there are also a number of pipelines, flowlines and umbilical's that pass through UKCS block 49/23. These include PL2355 / PL2355 (Wenlock Gas pipeline), PL77, PL76, PL80, PL81, PL1053, PL1054, PL1055, PL1056, PL78 and PL22 which pass through Inde 23A (refer Figure 2) (NSTA, 2024a).

There are also 39 wells inside block 49/23 (NSTA, 2024a). The majority of these are in some phase of abandonment (11 in AB3, 9 in AB2 and 5 in AB1). The remaining are recorded to be in Completed (Operating) (11) or Completed (shut-in) (3) status.

The surrounding area is also heavily licenced for oil and gas fields with various other installations to the north (Inde 49/18A, Inde 49/18B) (NSTA, 2024a).

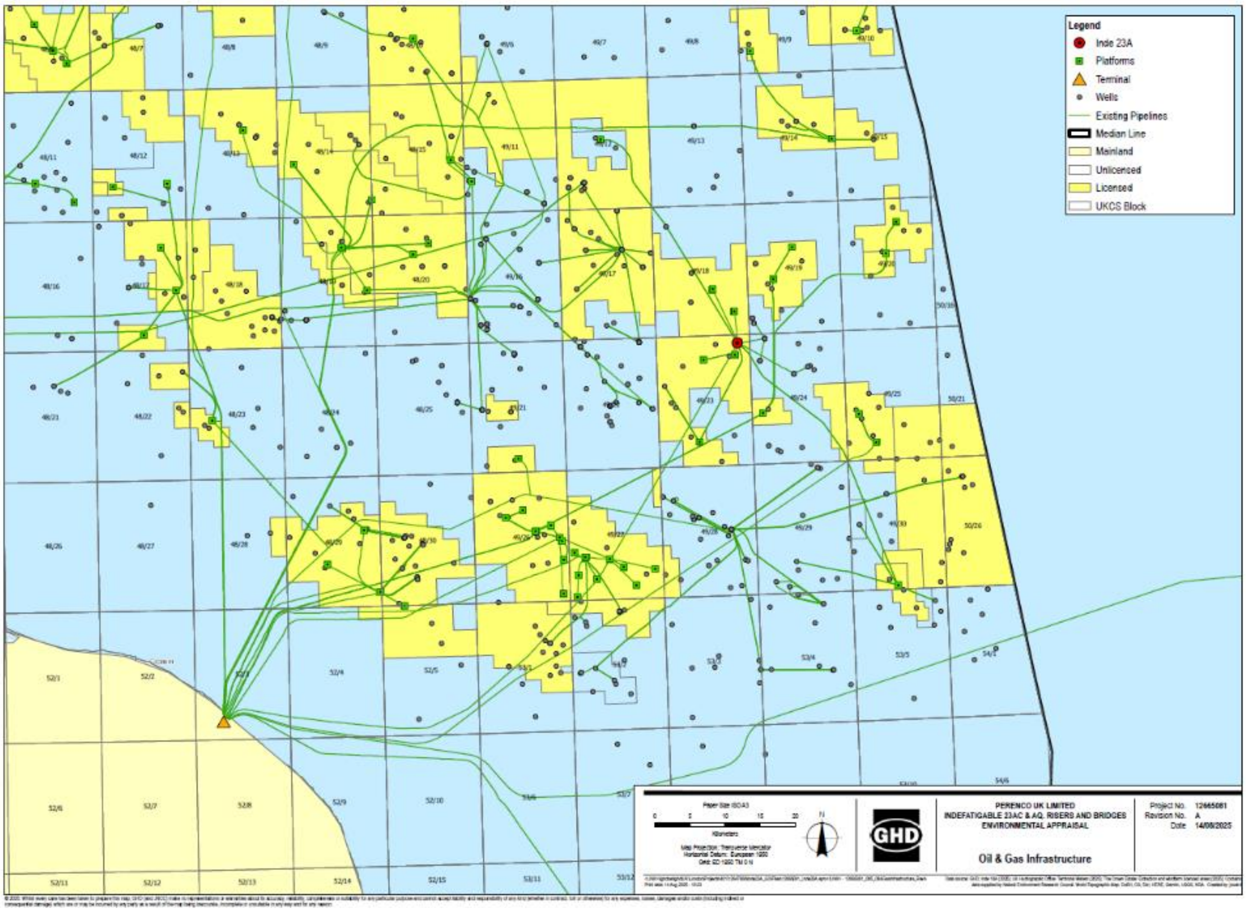


Figure 32 *Oil and gas infrastructure*

5.13.4 Marine aggregates

The closest marine aggregate location is Indefatigable West, operated by Deme Building Materials Ltd, approximately 11.85 km to the east of Inde 23A (The Crown Estate, 2024) (refer Figure 33). Beyond Indefatigable West, there is also Indefatigable East, operated by the same company, approximately 23.91 km southeast. Both Indefatigable West and Indefatigable East are marine aggregate exploration and options areas with licence end dates of 30th June 2030.

DEME Building Materials Ltd also operates two marine production areas, one approximately 36.26 km to the north-northeast (Humber 5) and the other approximately 41.04 km to the northeast (Humber 3) (The Crown Estate, 2024).

5.13.5 Offshore wind

The nearest offshore wind farm to Inde 23A is approximately 25.70 km to the southeast (Norfolk Boreas) (Kingfisher, 2024) (refer Figure 33). There are also offshore windfarms 31.09 km to the south (Norfolk Vanguard West) and 43.33 km to the northeast (Hornsea Project Three (HOW03) (Kingfisher, 2024).

5.13.6 Carbon capture and storage

Inde 23A is within a Carbon Storage Appraisal and Storage Licence area (licence reference CS027) held by Shell U.K. Limited (NSTA, 2024b) (refer Figure 33). This area is currently under investigation for the feasibility of geological storage of captured carbon dioxide.

5.13.7 Wrecks

There are no protected wrecks within 10 km of the Inde 23A installation (Historic England, 2025). The closest obstruction recorded within the UK Hydrographic Office dataset is a foul ground approximately 5.55 km to the northeast on Inde 23A where a sailing vessel is suspected to be buried (UK Hydrographic Office, 2025). There is also a dangerous wreck recorded about 4.59 km northeast of Inde 23A (UK Hydrographic Office, 2025).

5.13.8 Telecommunications and cables

The Inde 23A platforms are approximately 9.39 km from the nearest subsea cable (NORSEA COM 1 LOW-MUR TELECOM CABLE) (Kingfisher, 2024). This telecommunication cable runs north-south along the border of UKCS block 49/27 and is currently operated by Tempnet (Kingfisher, 2024). There are also decommissioned cables previously operated by Inmarsat and BT, approximately 19.97 km to the north, and 29.00 km to the southeast, respectively (Kingfisher, 2024).

5.13.9 Military activity

The Inde 23A installation does not fall within a known Military Practice and Exercise Area (PEXA) (OceanWise, 2024) (refer Figure 33). The closest PEXA is approximately 15 km north of the installation and is registered to HQ Air.

5.13.10 Tourism

Due to the distance between the Inde 23A installation and the nearest landfall (90 km northeast of BGT) recreational activities in the region are highly unlikely. MMO vessel data has 0 recorded recreational vessels passing through the region around Inde 23A in 2019 (MMO, 2019).

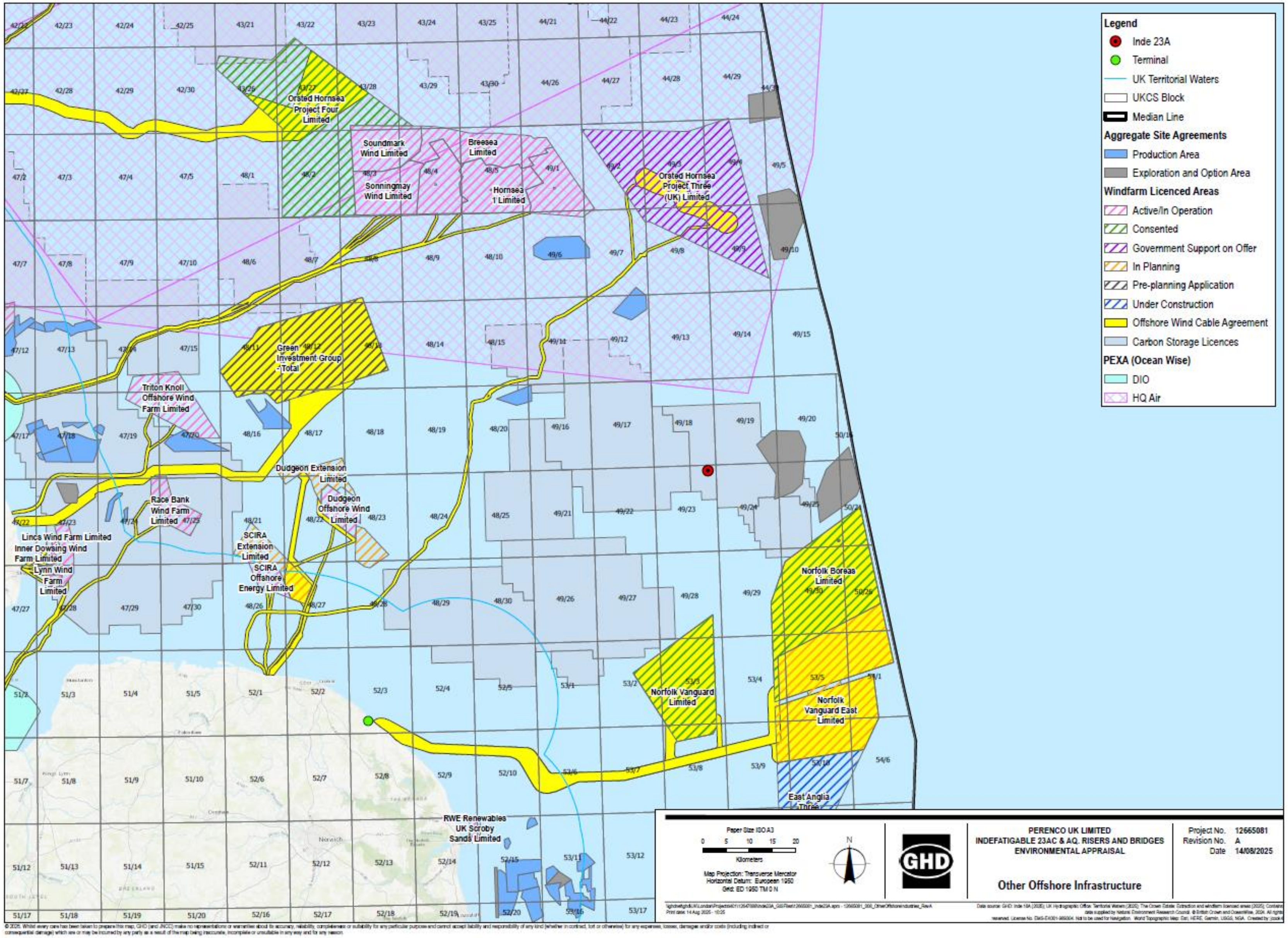


Figure 33 *Other offshore infrastructure and interests*

5.14 Management

5.14.1 Protected areas

The UK is party to a number of international agreements to establish an ecologically important network of Marine Protected Areas (MPA's) within UK waters. These MPAs include:

– **SACs:** qualifying features include three marine habitat types (shallow sandbanks, reefs, and submarine structures made by leaking gases) and four marine species habitats (grey seal, harbour seal, bottlenose dolphin, and harbour porpoise).
– **Special Protection Areas (SPAs):** designated to protect birds under the EU Wild Birds Directive. The Directive requires conservation efforts to be made across the sea and land area.
– **Marine Conservation Zones (MCZs):** which are designated under the *Marine and Coastal Access Act (2009)* to protect nationally important marine wildlife, habitats, geology, and geomorphology.

Other relevant international designations include Ramsar Wetlands of International Importance (Ramsar sites), and national designations such as Sites of Special Scientific Interest (SSSI).

As shown in Figure 34, there are two MPAs within 40 km of the Inde 23A installation. Details on these MPAs are provided in Table 5.9.

Table 5.9 MPAs within 40 km of Inde 23A

Site Name	Distance and direction	Qualifying features and site description	Conservation Objectives
North Norfolk Sandbanks and Saturn Reef SAC[1]	4.96 km west	Features: Annex I habitat: Reefs (1170); Sandbanks which are slightly covered by sea water all of the time (1110) Description: The North Norfolk Sandbanks are the most extensive example of the offshore linear ridge sandbank type in UK waters. The banks support communities of invertebrates which are typical of sandy sediments in the southern North Sea such as polychaete worms, isopods, crabs and starfish. Areas of *Sabellaria spinulosa* biogenic reef are present within the site, consisting of thousands of fragile sand-tubes made by ross worms (polychaetes) which have consolidated together to create solid structures rising above the seabed.	For the features to be in favourable condition thus ensuring site integrity in the long term and contribution to Favourable Conservation Status of Annex I Sandbanks which are slightly covered by sea water all of the time and Annex I Reefs. This contribution would be achieved by maintaining or restoring, subject to natural change: – The extent and distribution of the qualifying habitats in the site; – The structure and function of the qualifying habitats in the site; and The supporting processes on which the qualifying habitats rely.
Southern North Sea SAC[2]	19.00 km southeast	Features: Harbour porpoise (*Phocoena phocoena*) Description: The Southern North Sea SAC is an area of importance for harbour porpoise, supporting an estimated 17.5% of the UK North Sea Management Unit population. Approximately two-thirds of the site, the northern part, is recognised as important for porpoises during the summer season, whilst the southern part supports persistently higher densities during the winter. Inde 23A is in the vicinity of summer habitat[3].	To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining Favourable Conservation Status (FCS) for Harbour Porpoise in UK waters. In the context of natural change, this will be achieved by ensuring that: 1. Harbour porpoise is a viable component of the site; 2. There is no significant disturbance of the species; and The condition of supporting habitats and processes, and the availability of prey is maintained.
Citations for features and descriptions: 1. (JNCC, 2024); 2. (JNCC, 2023b); 3. (JNCC, 2019a). Citations for conservation objectives: 1. (JNCC, 2017b); 2. (JNCC, 2019b).			

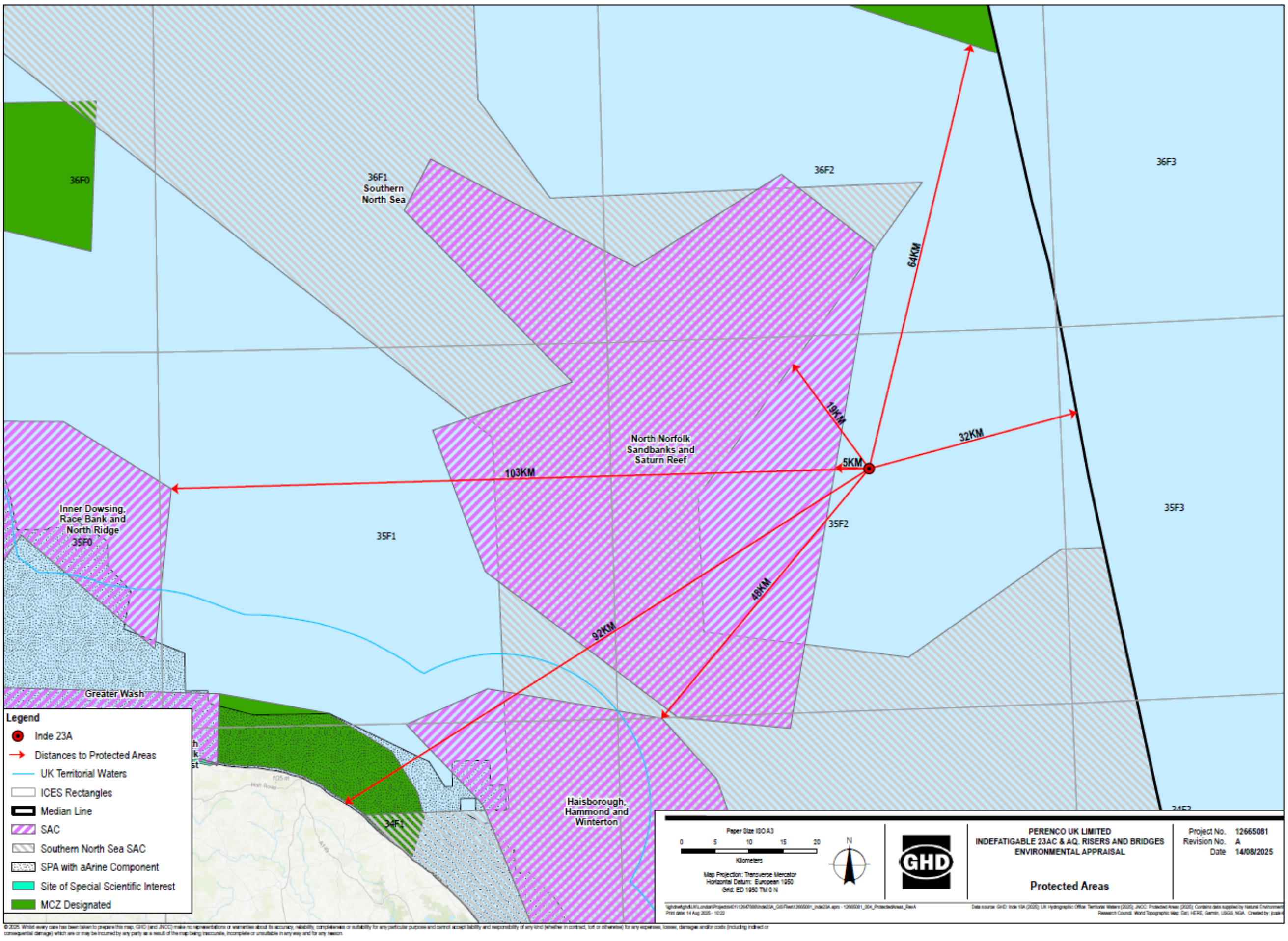


Figure 34 *Protected areas*

5.14.2 National Marine Plan

In the context of marine planning, the Inde 23A infrastructure to be decommissioned is located within the East Marine Plan offshore area (MMO, 2024). This area is managed under the East Inshore and East Offshore Marine Plans, which were developed to help ensure sustainable development of the UK marine area (DEFRA, 2014).

Table 5.10 provides associated policies and objectives contained within relevant marine plans and highlights how these have been addressed by the proposed operations.

Table 5.10 *Marine planning associated objectives and policies relevant to the proposed decommissioning strategy*

Relevant objectives	Associated policies	Addressed by the project
Objective 1: To promote the sustainable development of economically productive activities, taking account of spatial requirements of other activities of importance to the East marine plan areas.	Policy EC1: Proposals that provide economic productivity benefits which are additional to Gross Value Added currently generated by existing activities should be supported.	The proposed decommissioning strategy is in line with minimising taxpayer costs for decommissioning oil and gas infrastructure in the SNS.
Objective 2: To support activities that create employment at all skill levels, taking account of the spatial and other requirements of activities in the East marine plan areas.	Policy EC2: Proposals that provide additional employment benefits should be supported, particularly where these benefits have the potential to meet employment needs in localities close to the marine plan areas.	The proposed operations will utilise local contractors in the area and a support base close to the proposed operations.

Relevant objectives	Associated policies	Addressed by the project
Objective 5: To conserve heritage assets, nationally protected landscapes and ensure that decisions consider the seascape of the local area.	Policy SOC2: Proposals that may affect heritage assets should demonstrate, in order of preference: a) that they will not compromise or harm elements which contribute to the significance of the heritage asset b) how, if there is compromise or harm to a heritage asset, this will be minimised c) how, where compromise or harm to a heritage asset cannot be minimised it will be mitigated against or d) the public benefits for proceeding with the proposal if it is not possible to minimise or mitigate compromise or harm to the heritage asset. Policy SOC3: Proposals that may affect the terrestrial and marine character of an area should demonstrate, in order of preference: a) that they will not adversely impact the terrestrial and marine character of an area b) how, if there are adverse impacts on the terrestrial and marine character of an area, they will minimise them c) how, where these adverse impacts on the terrestrial and marine character of an area cannot be minimised they will be mitigated against d) the case for proceeding with the proposal if it is not possible to minimise or mitigate the adverse impacts.	The proposed decommissioning strategy is not anticipated to have an impact on any heritage assets or the character of the marine area.
Objective 6: To have a healthy, resilient and adaptable marine ecosystem in the East marine plan areas.	Policy ECO1: Cumulative impacts affecting the ecosystem of the East marine plans and adjacent areas (marine, terrestrial) should be addressed in decision-making and plan implementation.	Refer to section 7 for an assessment of potential impacts to biodiversity.
	Policy ECO2 The risk of release of hazardous substances as a secondary effect due to any increased collision risk should be taken account of in proposals that require an authorisation.	Refer to section 7 for an assessment of potential collision risk.
Objective 7: To protect, conserve and, where appropriate, recover biodiversity that is in or dependent upon the East marine plan areas.	Policy BIO1: Appropriate weight should be attached to biodiversity, reflecting the need to protect biodiversity as a whole, taking account of the best available evidence including on habitats and species that are protected or of conservation concern in the East marine plans and adjacent areas (marine, terrestrial).	Refer to section 7 for an assessment of potential impacts to biodiversity. The proposed decommissioning strategy reduces any potential impact on biodiversity in the East Marine Plan and terrestrial areas.
Objective 8: To support the objectives of Marine Protected Areas (and other designated sites around the coast that overlap or are adjacent to the East marine plan areas), individually and as part of an ecologically coherent network.	Policy MPA1: Any impacts on the overall Marine Protected Area network must be taken account of in strategic level measures and assessments, with due regard given to any current agreed advice on an ecologically coherent network	The proposed decommissioning strategy will not impact on the SACs located within the East Marine Plan area.
Objective 10: To ensure integration with other plans, and in the regulation and management of key activities and issues, in the East marine plans, and adjacent areas	Policy GOV2: Opportunities for co-existence should be maximised wherever possible. Policy GOV3 Proposals should demonstrate in order of preference:	Refer to section 7 for an assessment of potential impacts to other users.

Relevant objectives	Associated policies	Addressed by the project
	a) that they will avoid displacement of other existing or authorised (but yet to be implemented) activities b) how, if there are adverse impacts resulting in displacement by the proposal, they will minimise them c) how, if the adverse impacts resulting in displacement by the proposal, cannot be minimised, they will be mitigated against or d) the case for proceeding with the proposal if it is not possible to minimise or mitigate the adverse impacts of displacement.	

6. Environnemental impacts identification (ENVID)

6.1 ENVID workshop

Potential environmental impacts of the decommissioning activities were identified through an ENVID workshop conducted on 27th August 2025. The workshop attendees included relevant engineering and environmental disciplines from PUK, Petrodec and GHD. The workshop was chaired by an environmental specialist with experience in marine environmental impacts and risks. A full list of the workshop attendees can be found in Appendix A.

6.2 ENVID approach

The key objective of the ENVID Workshop was to identify all relevant issues resulting from the proposed decommissioning work and to agree practicable measures to ensure that throughout the duration of the operations there is minimal harm to the environment.

The workshop commenced with a presentation on the assets proposed for removal and the methods that are to be used. The presentation then identified key environmental and social receptors for consideration. The workshop attendees went through a tailored risk matrix and identified:

- key activities that could impact upon environmental or social receptors (e.g., vessel use causing emissions to air, energy consumption, sea surface presence, discharges to sea etc.)
- what receptors these impacts would affect (e.g., emissions to air impacting air quality and climate)
- the nature of the impact and built in mitigation measures to reduce impact (e.g., localised reductions in air quality from fuel combustion partly mitigated through use of MARPOL compliant fuels)
- the residual significance of the risk of the impact and any additional mitigation measures required (a factor of the magnitude of the impact and the sensitivity of the impact receptors).

For completeness, unplanned and accidental impacts such as a vessel collision, were discussed. These events were further assessed to identify the likelihood of the event occurring and the overall risk (a factor of the impact significance and event likelihood). However, it is noted that under OPRED guidance there is no requirement to assess the impact of accidental events e.g., spills from vessels (OPRED, 2018).

The definition used for impact and risk evaluation can be found in Appendix A. These definitions are also used in the impact assessment presented in section 7.

6.3 ENVID conclusions

The results of the ENVID can be found in the full risk matrix provided in Appendix A. Impacts identified through the ENVID process have been assessed in section 7.

6.3.1 Planned activities

The ENVID concluded that the planned decommissioning activities would not give rise to impacts of Moderate or Major significance. All other planned activities were determined to have minor or negligible impact on the environment or other users of the sea. These impacts are discussed in detail in section 7.

6.3.2 Unplanned events

The ENVID concluded that unplanned decommissioning activities would give rise to no impacts of Major significance. Unplanned events that could give risk to an impact of Moderate significance included:

- leakage of hydrocarbons and or NORM material from pipework
- vessel collision resulting in a loss of containment

– breach of a live pipeline from an anchor or dropped object.

However, when the likelihood of these events were factored in the overall risk level, each of these had a risk significance of Minor. All other accidental events considered in the ENVID had risk ratings of Minor or Negligible.

7. Environmental and social impact assessment

7.1 Assessment Methodology

7.1.1 Introduction

This section describes the methodology used to determine if the project is likely to have any significant effects on the environment. The methodology follows EIA good practice guidance (European Commission, et al. 2017; CIEEM 2018).

The terms "impact" and "effect" have different definitions in EIA, and one may occur as a result of the other. Impacts are defined as changes to the environment as a direct result of project activities and can be either beneficial or adverse.

Effects are defined as the consequences of those impacts upon receptors. Impacts that could potentially result in significant effects are then subject to detailed assessment based on best available scientific evidence and professional judgement so that, where necessary, measures can be taken to prevent, reduce or offset what might otherwise be significant adverse effects on the environment through design evolution or operational mitigation measures.

Residual effects are those that are predicted to remain assuming the successful implementation of the identified mitigation measures and are reviewed by PUK to confirm that the project complies with legal requirements and does not adversely impact the East Offshore Marine Plan policy goals and objectives.

7.1.2 Project activities that could have an impact

The process commences with the identification of project activities that could impact environmental and socio-economic receptors (i.e., components of the receiving environment), with consideration given to both planned (routine) activities and unplanned (accidental) events. The project activities identified included:

– operation of the jack-up HLV and supporting vessels
– waste management (including dismantling, management of hazardous waste, disposal of marine growth and onshore work)
– cutting and lifting the bridges
– cutting and removing pipework with potential contamination
– jacket removal including dredging, cutting and lifting
– subsea pipeline riser section removal, including:
  - cutting and removal of buried pipeline section
  - remediation of remaining pipeline
– post-decommissioning work, including:
  - post-decommissioning survey and inspection activities
  - 500 m safety zone (ROV hand-picking seabed).
– Unplanned (accidental) events that could impact receptors were identified as:
  - vessel collision
  - dropped objects (infrastructure, scaffolding, other equipment)

- live pipeline breach.

7.1.3 Identification of Impacts

For each activity identified (refer section 7.1.2), the associated environmental impacts (such as seabed disturbance) were identified. Types of impacts from project activities included:

– emissions to air
– resource use
– discharges to sea
– seabed disturbance
– underwater noise
– waste generation
– socio-economic effects
– impacts to protected areas and their conservation objectives
– cumulative impacts
– in-combinations impacts.

The environmental and social receptors impacted by these project activities (such as benthic habitats) were then identified. An evaluation of the likely significance of effects on the environment from these impacts was then undertaken using the significance criteria defined in section 7.1.4.

The results of the assessment are documented in section 7.2 and 7.3. For some project activities, potential impacts have been identified, but none of the resulting effects are likely to be significant. These impacts have therefore been scoped out from detailed assessment.

Despite potential significance, in accordance with OPRED guidance (OPRED, 2018), there is no requirement to assess accidental events such as spills from vessels within the EA. This has therefore been scoped out of further detailed assessment.

7.1.4 Evaluation of impact significance

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

Planned activities

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

– the magnitude and spatial extent of the impact (geographical area and size of the population likely to be affected)
– the nature of the impact
– the transboundary nature of the impact
– the intensity and complexity of the impact
– the probability of the impact
– the expected onset, duration, frequency, and reversibility of the impact
– the accumulation of the impact with the impact of other existing and / or approved projects and / or projects not yet approved, but that PUK is aware of
– the possibility of effectively reducing the impact.
– Significance of impacts was evaluated as an output of receptor sensitivity and impact magnitude.

Sensitivity Criteria

Sensitivity is a function of the value of the receptor (a measure of its importance, rarity and worth), its capacity to accommodate change when a pressure is applied (resistance or tolerance), and its subsequent recoverability (resilience). The criteria presented in Table 7.1 has been used as a guide in this assessment to determine the sensitivity of receptors.

Table 7.1 Determining sensitivity

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

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

Magnitude of Impact Criteria

The magnitude of impact considers the characteristics of the change that are likely to arise (e.g., a function of the spatial extent, duration, reversibility, and likelihood of occurrence of the impact) and can be adverse or beneficial. Where it is not possible to quantify impacts, a qualitative assessment has been carried out, based on best available scientific evidence and professional judgement. The criteria presented in Table 7.2 has been used as a guide in this assessment to define the magnitude of impact.

Table 7.2 Determining magnitude of impact

Magnitude	Definitions
Substantial	– Permanent or long-term (>5 years) change in baseline environmental conditions, which is certain to occur. – Impact may be one-off, intermittent, or continuous and/or experienced over a very wide area (i.e., transboundary in scale). – Impact is likely to result in environmental quality standards or threshold criteria being routinely exceeded.
Major	– Medium to long-term (1 – 5 years), reversible change in baseline environmental conditions, which is likely to occur. – Impact may be one-off, intermittent, or continuous and/or experienced over a wide area (i.e., national in scale). – Impact could result in one-off exceedance of environmental quality standards or threshold criteria.

Magnitude	Definitions
Moderate	– Short to medium-term (< 1 year), temporary change in baseline environmental conditions, which is likely to occur. – Impact may be one-off, intermittent, or continuous and/or regional in scale (i.e., beyond the area surrounding the Project site to the wider region). – Impact is unlikely to result in exceedance of environmental quality standards or threshold criteria.
Minor	– Short-term (a few days to weeks), temporary change in baseline environmental conditions, which could possibly occur. – Impact may be one-off, intermittent and/or localised in scale, limited to the area surrounding the proposed Project site. – Impact would not result in exceedance of environmental quality standards or threshold criteria.
Negligible	– Immeasurable or undetectable changes (i.e., within the range of normal natural variation).

Significance of effect

For planned activities, the overall significance of an effect has been determined by cross referencing the sensitivity of the receptor with the magnitude of impact, using the matrix shown in Table 7.3.

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

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

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

Table 7.3 Significance Evaluation Matrix (Planned Activities)

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

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

7.1.5 Evaluation of risk from unplanned (accidental) events

For unplanned (accidental) events a further assessment was undertaken to evaluate the risk of impacts based on the likelihood of the event occurring and the significance of the risk if it did. The criteria used for this evaluation are presented in Table 7.4 and Table 7.5, below.

Table 7.4 Likelihood criteria for an unplanned (accidental) event

Likelihood	Definitions
A	– Never heard of in the industry - Extremely remote – Has never occurred within the industry or similar industry but theoretically possible
B	– Heard of in the industry – Remote

Likelihood	Definitions
	– Similar event has occurred somewhere in the industry or similar industry but not likely to occur with current practices and procedures
C	– Has happened in the Organisation or more than once per year in the industry – Unlikely – Event could occur within lifetime of similar facilities. Has occurred at similar facilities.
D	– Has happened at the location or more than once per year in the Organisation – Possible – Could occur within the lifetime of the development
E	– Has happened more than once per year at the location – Likely – Event likely to occur more than once at the facility.

Table 7.5 Risk of an unplanned (accidental) event criteria

		Likelihood of Unplanned (Accidental) Event				
		A	B	C	D	E
Impact Significance	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
	Minor	Negligible	Negligible	Minor	Minor	Minor
	Minor / Moderate	Negligible	Minor	Minor	Moderate	Moderate
	Moderate	Minor	Minor	Moderate	Moderate	Major
	Moderate / Major	Moderate	Moderate	Moderate	Major	Major
	Major	Major	Major	Massive	Massive	Massive

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

7.2 Insignificant impacts

In the context of this assessment, effects classed as **Negligible** or **Minor** are considered to be “insignificant” in EIA terms and therefore existing mitigation measures are sufficient in order to prevent, reduce, or offset adverse significant effects or enhance beneficial effects.

All of the impacts associated with the planned project activities were deemed to be of either Negligible or Minor significance. The aspects for which PUK consider there to be minimal or non-significant impact and therefore have been screened out from further detailed assessment within this EA report are described below.

7.2.1 Unplanned (accidental) events

Vessel collision

The most significant unplanned event which could impact the environment would be a vessel collision resulting in a loss of containment from the vessel. Loss of containment would result in pollution of the marine ecosystem, organic enrichment, and chemical contamination. However, it is noted that the HLV planned to undertake this work carries a maximum of 500 cubic metres of fuel and will be carrying limited amounts of chemical, as no plug and abandonment works are planned. The work is also taking place 90 km from shore, reducing the impacts that would occur to shoreline receptors.

The likelihood of a vessel collision occurring would be reduced by undertaking the majority of the works within the 500 m safety zone around Inde 23A. Regardless, a Collision Risk Management Plan would be in place to manage the works. Standard navigation notification would be followed, and the Navaids used where required.

Any potential loss of containment from the vessel will be managed in line with MARPOL requirements, including the requirement to operate an Oil Pollution Emergency Plan (OPEP) for hydrocarbon spills to sea and a Communication and Interface Plan (CIP) to a coordinated spill approach between the platform and the rig. Any spills would be responses to in accordance with these plans.

Risks from vessel collision will also be addressed in the Consent to Locate.

Results of the assessment are as follows:

– Magnitude: Moderate
– Sensitivity: High
– Significance: Moderate
– Likelihood: B
– Risk: Minor.

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

As a result, no further assessment is required.

Dropped objects

The potential for impacts from dropped objects during lifting were considered for small objects, such as scaffolding or grout bags, and large objects, such as the topsides, bridges or jackets. Transportation of the installations to port would likely occur via a barge and as such, the risk of drop for these assets are focused during the assets' lifts.

If the topsides, jackets or bridges are dropped during lifting or from the lift vessel or barge while in transit, there would be an immediate impact on the seabed and could also present a source of contamination. However, it is noted that the installations will be deemed as hydrocarbon safe prior to lifting, reducing potential impacts from drops. It is anticipated that all dropped objects would be recovered to prevent the objects from causing navigational or fishing (snagging) impacts.

The likelihood that a drop would occur would be reduced by following an approved Lift Plan and company procedures regarding securing assets while in transit. A detailed emergency response procedure will be created to plan a response in case of a drop. If a drop occurs, proper notifications will be followed and the object will be recovered, if feasible, and any require remediation will be undertaken.

Once the installations are removed, the 500m zone around each platform will be cleared by an ROV and handpicking to ensure all objects have been retrieved. A post-decommissioning seabed survey will be carried out in the vicinity of the Inde 23A to confirm all materials have been removed. Results of the assessment are as follows:

– Magnitude: Moderate
– Sensitivity: Medium
– Significance: Minor
– Likelihood: C
– Risk: Minor.

Best practices will be employed to minimise the potential for drops and to minimise any impacts should they occur.

As a result, no further assessment is required.

Pipeline breach

There are a number of still operational, live pipelines connected to Inde 23AT, as shown in Figure 35. If an anchor or dropped object where to collide with a still operational pipeline, then that event could result in a breach.

It is also theoretically possible that a drop of a jacket or other asset off a barge could occur onto a live pipeline. While crossing pipelines during transit to shore is unavoidable, this risk is considered highly unlikely as proper measures will be undertaken to secure assets on the barges.

A breach could result in the uncontrolled release of hydrocarbons into the marine environment, leading to water contamination, harm to marine life, and potential air pollution from volatile organic compounds. Gas releases can also pose a fire or explosion risk if they reach the surface and are ignited, as well as contribute to greenhouse gas emissions, further affecting the environment.

The likelihood that a breach could occur is lessened due to the fact that the pipelines that are connected to Inde 23AC (PL2356 and 2355) are disused and deemed HCS. The only remaining live pipelines are connected to Inde 23AT.

A number of mitigation measures are in place to reduce the likelihood of this occurring further. Seabed surveys have been undertaken to confirm the precise location of nearby live pipelines. This survey information is used to inform an Anchor Plan which dictates vessel approach and where the HLV spudcans and anchors are to be situated. This plan will include sufficient clearance to that no anchors drop near any live pipelines.

As discussed above, objects will be secured to cranes and lifts managed with best practice life management procedures. If a breach were to occur, then spill procedures as discussed above would be acted upon to respond to the emergency.

Results of the assessment are as follows:

- Magnitude: Major
- Sensitivity: Medium
- Significance: Moderate
- Likelihood: A
- Risk: Minor.

Best practices will be employed to ensure proper clearance so that no anchors are placed near live pipelines, nor lifts occurring where a drop zone could include a live pipeline.

As a result, no further assessment is required.

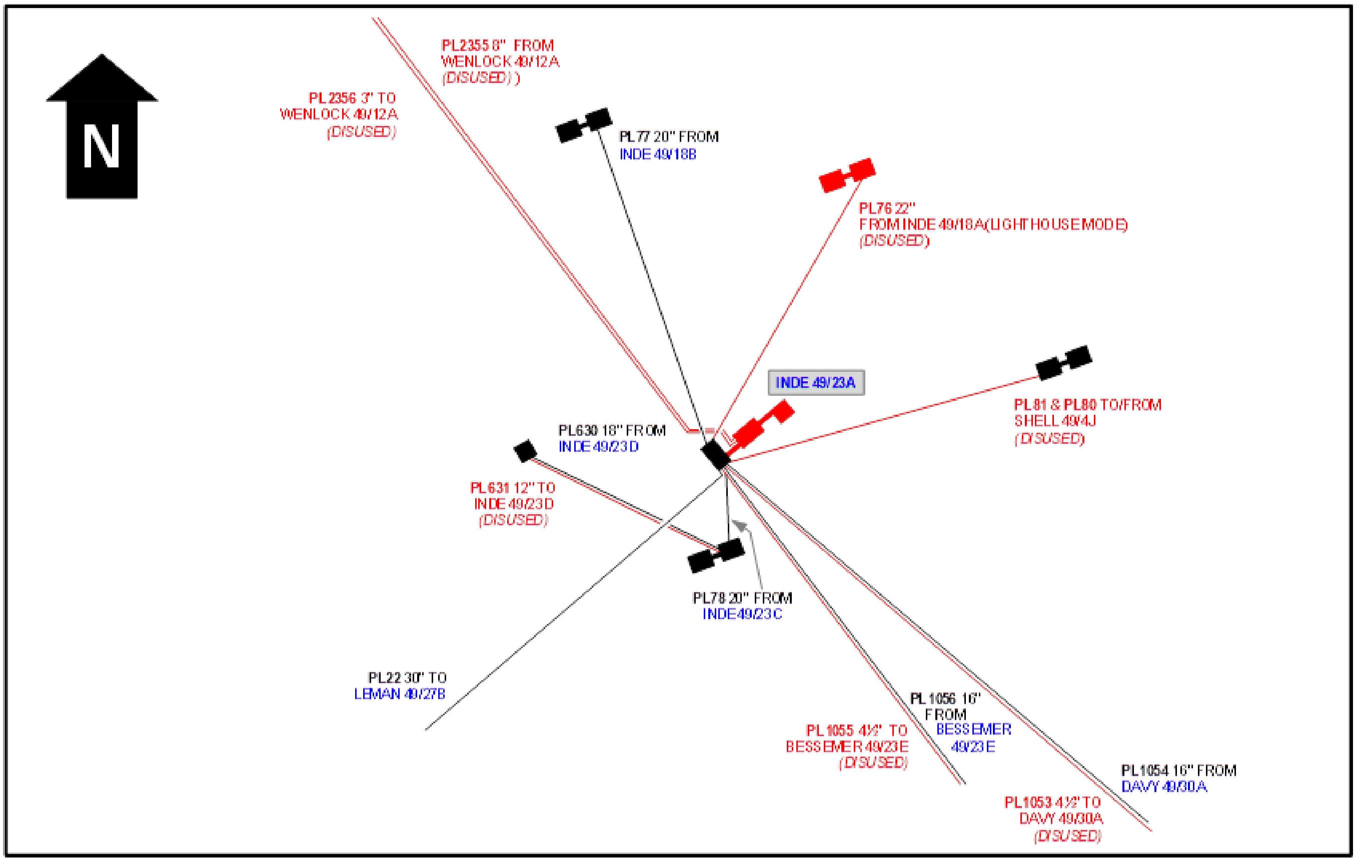


Figure 35 Disused and still operations pipelines connected to Inde 23A (PUK, 2024)

Exposure of hazardous materials

Inde 23A contains several types of hazardous wastes that require careful management during decommissioning. These include Naturally Occurring Radioactive Material (NORM), likely fluorinated gases (F-gases) used as refrigerants within the accommodation systems, asbestos in building materials, and heavy metals such as lead and chromium in paint coatings. Improper handling or disturbance of these materials could result in worker exposure, contamination of the marine environment, and breaches of environmental regulations. Therefore, strict controls and specialist removal procedures are essential to minimise health and environmental risks.

To ensure the safe and compliant management of hazardous materials during the decommissioning of Inde 23A, a structured sequence of mitigation measures will be implemented.

Before any physical work begins, all relevant hazardous waste documentation—including the asbestos register and other hazardous waste records—will be handed over to the Principal Decommissioning Contractor or responsible contractor. A comprehensive Hazardous Materials (HazMat) survey will be completed to identify all hazardous substances, ensuring coverage of all areas, including those with potential fluorinated gas (F-gas) refrigerants. A dedicated F-gas register will be maintained. The NORM (Naturally Occurring Radioactive Material) storage area on the AC will be emptied in preparation for decommissioning works.

The removal phase will include managing any NORM-contaminated pipework that remains unflushed in advance of the main works, conducted under permit and by trained specialist contractors to ensure safe treatment. A Waste Management Plan will be implemented to guarantee all hazardous materials are handled safely and in compliance with legislation. A trained Radiation Protection Supervisor (RPS) will be present onboard to oversee hazardous waste removal and to test pipework and other materials for NORM contamination before cutting. All NORM-related activities will be performed under permit by specialist contractors, adhering strictly to relevant regulations and safety protocols.

If possible, asbestos-containing building materials will not be cut during dismantling; instead, the entire affected module will be lifted intact to allow asbestos to be safely managed and disposed of onshore by licensed specialists.

Following removal, all hazardous waste will be clearly marked and transferred to licensed waste disposal facilities. Where international waste shipments are necessary, International Waste Shipment (IWS) approvals will be obtained. Disposal of NORM-contaminated equipment and materials will follow the Local Rules for Work with Ionising Radiation (PUK-SMS-OH-015) and comply fully with the installation’s Radioactive Substances Act Certificate of Authorisation and PUK’s disposal permits.

Results of the assessment are as follows:

- Magnitude: Moderate
- Sensitivity: Medium
- Significance: Minor
- Likelihood: A
- Risk: Negligible.

Overall, the risk of release or exposure of hazardous waste is considered to be appropriately managed through the mitigation measures described above.

As a result, no further assessment is required.

Hydrocarbon leakage from pipework

There is a risk of residual condensate build up even in a pipeline that has already been flushed of hydrocarbons and considered out of service. Over time, small amounts of hydrocarbon vapour left in the line can cool and condense, especially in low points or dead legs of the pipeline. This can lead to the accumulation of liquid condensate, which may go unnoticed. If the pipeline is later cut or opened without proper precautions, this trapped condensate can be unexpectedly released, resulting in an accidental discharge or leakage. Such incidents pose safety and environmental risk.

As a mitigation measure, pipelines and vessels are now typically opened up or vented to atmosphere—also known as air-gapping—prior to cutting and removal. This allows any residual hydrocarbon vapours to dissipate safely, reducing the risk of pressure buildup, condensate accumulation, or accidental discharge during the work.

Results of the assessment are as follows:

- Magnitude: Moderate
- Sensitivity: Medium
- Significance: Minor
- Likelihood: B

– Risk: Negligible.

7.2.2 Discharges to air and energy use

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

It is likely that three separate Heavy Lift Vessel (HLV) mobilisation may be required to decommission the infrastructure due to its size and complexity. These separate mobilisations would involve the removal and transport of the:

1. AT-AC bridge to separate Inde 23AT and AC from the operational Inde 23AQ.
2. AC-AQ bridge, and the Inde 23AQ topside and jacket.
3. Inde 23AC topside and jacket.

It has been assumed that the HLV will be in its operational phase for up to two weeks to remove the AT-AC bridge, and up to 90 days for each of the other mobilisations.

The decommissioning activities will give rise to emissions of a range of gaseous combustion products including carbon dioxide (CO_2), sulphur dioxide (SO_2), and oxides of nitrogen (NO_x) as well as trace quantities of unburned hydrocarbons, including methane (CH_4), and others collectively classed as volatile organic carbons (VOC).

Offshore emissions to air will be due to vessels' propulsion, their onboard services demand, and from the running of trenching, cutting and lifting equipment. Fuel use will likely be reduced through:

– using a jack-up HLV instead of dynamically positioned vessels (which tend to use more fuel)
– minimising vessel movement where possible.

Emissions of SO_2, NO_x, CH_4 and VOC reduce air quality locally, including through contributing to low level ozone concentrations. Emissions of SO_2 and NO_x can also lead to formation of respective acids, contributing to acid rain on a regional scale. Emissions to the air will be temporary and into an area classified as having low shipping density (refer section 5.13.1). Inde 23A is located far from the coast (90 km) and emissions are expected to rapidly disperse from air circulation. All fuels used will be MARPOL compliant and as such degradation of local air quality is expected to be localised and short-term impacts on air quality, typical of general shipping.

Emissions of CO_2 and CH_4 also both contribute to global greenhouse gas (GHG) emissions, and ultimately to climate change. The total emissions will contribute an extremely small percentage to the offshore and UK total Carbon Dioxide equivalent ($CO2_e$) emissions (refer Appendix B). As stated above, fuel use will be reduced where possible. The project will also be compliant with Petrodec Atmospheric Emissions and GHG Management Procedures.

Results of the assessment are as follows:

– Magnitude: Minor
– Sensitivity: Medium
– Significance: Minor.

Best practices will be employed to minimise this environmental footprint. This includes optimal pipeline cutting and topside and jacket removal operations, planning and procurement of vessel which minimise their emissions.

As a result, no further assessment is required.

7.2.3 Physical presence of vessels in relation to other sea users

Vessels will be deployed in order to complete the decommissioning works. This will likely include a HLV as well as supporting supply and tug vessels, in up to three mobilisations. Vessel presence can interrupt navigation from other maritime users, reduce the area available for fishing and interrupt use of the sea surface from marine fauna (notably foraging seabirds).

As discussed, Inde 23A is in relatively lower activity fishing area (refer section 5.13.2), a low density shipping area (refer section 5.13.1), and is in area sometimes used by sea birds (refer section 5.11). Impacts to other sea users is expected to be minimal as the majority of works would take place within the existing 500 m safety zone which excludes other sea users from access.

Transit of the vessels to Inde 23A would be managed through standard maritime notification and navigation rules. Other sea users would be consulted in accordance with legal requirements.

The works would be supported by a Collision Risk Management Plan and a Consent to Locate. The Consent to Locate will be supported by a vessel traffic study which will inform the navigational risk assessment.

Results of the assessment are as follows:

– Magnitude: Minor
– Sensitivity: Low
– Significance: Minor.

The majority of works will take place within the 500 m safety zone around Inde 23A with transit of vessel managed by standard notice to mariners and vessel navigational rules. Statutory notifications will be submitted to relevant bodies regarding the travel of the vessel to Inde 23A location, it's presence at the installation, and its transit back to shore.

As a result, no further assessment is required.

7.2.4 Light emissions

The vessels and HLV used for the project will be in operation 24 hours a day resulting in additional light emission. Light can disorient or attract birds and marine fauna such as plankton and fish. This light will be temporary in nature and would be in keeping with the existing environment at the Inde 23A platform as it is also lit.

Results of the assessment are as follows:

– Magnitude: Minor
– Sensitivity: Low
– Significance: Minor.

Additional light emissions from the vessels would be short-term. Once the decommissioning works are complete and the structure removed the area would return to pre-existing conditions.

As a result, no further assessment is required.

7.2.5 Discharges to sea

The decommissioning works will require minimal discharges to sea. Discharges associated with wastewaters generated on vessels are controlled by standard requirements of vessels operating in the North Sea for compliance with the International Convention for the Prevention of Pollution from Ships (MARPOL).

There will likely be some discharge to sea associated with the HLV and other vessel operations. This would likely include the vessels' sanitary water, bilge water and ballast water. These liquids are managed under MARPOL Annex IV and the International Convention on the Control and Management of Ship's Ballast Water and Sediments. These minimise the potential impact on the water column from shipping activities.

Discharge of deck water collected through the vessels' drainage systems could also be discharged. Deck water can pick up contaminants on vessel decks, such as hydrocarbons. Water quality impacts from deck water is relatively low as there are limited hydrocarbons presence on the HLV. If discharge of deck water is required, this will be managed under an appropriate permit, which will state the method of analysis and the maximum oil content of discharge water allowed (generally less than 30 ppm).

PUK and their Contractors will assess how to reduce vessel discharges to sea. All discharges to sea will be managed with PUK and Contractor procedures, including the 'Drainage and Discharge Procedure' (Petrodec, 2023) which stipulates how various water types should be treated and how discharges should be managed and monitored.

It is expected that the leg piles of the jackets will be cut by internal cutting equipment. Water jets can release mobilised material, such as swarf from the cutting activity and sediments that have settled in the gap between the pile and the jacket leg, which can cause reduced localised water quality. However, mobilised materials tend to be inert. The discharges will result in suspended solids in the water column which can cause smothering of benthic organisms. However, suspended solids will eventually settle out and these impacts are expected to be temporary and localised.

Prior to the lifting the Inde 23 jackets and PL riser sections, the risers will be cut subsea close to the jacket allowing the internal pipeline fluid to enter the open sea. The riser sections have been flushed clean and are filled with seawater to a standard agreed upon with OPRED and rendered HCS. As such, any potential residual hydrocarbon and chemical volumes that may escape the pipeline during cutting are expected to be minimal. Requirements for a discharge permit will be considered under the individual consent application for the decommissioning activities through the Portal Environment Tracking System.

Results of the assessment are as follows:

- Magnitude: Minor
- Sensitivity: Low
- Significance: Minor.

Potential discharges to sea from cutting operations will be assessed and permitted under an Oil Discharge Permit and Chemical Permit applied for via the UK energy portal.

Vessel based discharges will be limited to those generally associated with the decommissioning HLV and supporting vessels via established methods under MARPOL and internal procedures.

As a result, no further assessment is required.

7.2.6 Seabed disturbance

Activities causing seabed disturbance

The following activities will cause disturbance to the seabed:

- positioning the jack-up rig legs x 3
- placement of anchors and anchor lines x 3
- mobilisation of material from use of abrasive water jet cutters legs and piles
- uncovering and reburying PL2355 and PL2356 pipelines
- removal of subsea infrastructure (jackets, riser section)
- seabed picking.

If required, stabilisation material, most likely gravel bags, may be placed on the seabed to stabilise the jack-up and provide scour protection. If internal cutting is not feasible then some dredging may be required around the legs of the jacket to create an external subsea cut.

All of these activities would cause temporary impacts resulting in a localised effect. The effects of these activities are discussed in the following subsections.

The seabed characteristics and benthic habitat at Inde 23A are discussed in section 5. The sediment has some fine content and contaminates present (refer to sections 5.5 and 5.6).

Seabed impacts

Table 7.6 describes the expected environmental seabed impact during the activities. The proposed decommissioning works will result in seabed disturbance potentially resulting in changes seafloor finer scale topography, mobilisation of sediments, burial and smothering of benthic fauna and changes in habitat.

Table 7.6 Summary of seabed impacts from proposed decommissioning option

Activities	Impact duration				
	Altered bathymetry	Suspended sediments	Release of contaminants	Burial and smothering	Change in habitat
Positioning the jack-up rig legs	Temporary	Temporary	Limited	Temporary	Short-term
Placement of anchor lines	Temporary	Temporary	Limited	Temporary	Short-term
Mobilisation of material due to use of abrasive water jet cutters	Temporary	Temporary	Limited	Temporary	Short-term
Uncovering and reburying PL2355 and PL2356	Temporary	Temporary	Limited	Temporary	Short-term
Removal of subsea infrastructure	Temporary	Temporary	Limited	Temporary	Short-term
Seabed picking	Temporary	Temporary	Limited	Temporary	Short-term
Potential placement of stabilisation material (retrievable gravel bags)	Temporary	Temporary	Limited	Temporary	Short-term
Potential dredging if internal leg cuts found not to be feasible	Temporary	Temporary	Limited	Temporary	Short-term

Seabed footprint

Interaction with the seabed will be reduced as much as possible during the works.

Movement of the HLV will be reduced in the number of times that the legs need to be placed on the seabed floor. The anchor lines will be equipped with buoys to avoid pipelines and minimise drag. Stabilisation material will be minimised and only placed around the HLV legs, if required during the longer duration works. If stabilisation material is required, then gravel bags will likely be used so that these can be retrieved at the completion of the works.

Positioning the jack-up rig legs (three HLV deployments)

As discussed in section 4.3, a worst-case scenario assumes three mobilisations of the HLV will be required to complete the planned decommissioning works. Consequently, the HLV will need to be positioned three times. It is expected that the HLV may need to lower its jack-up legs twice during each mobilisation: first at a stand-off position where anchor wires, chains, and anchors will be deployed, and then again at the final working position adjacent to the platform. After the initial deployment, the legs will be jacked up, and the HLV repositioned before the legs are lowered again.

The HLV is expected to have six legs, each with a spud can footprint of 260 m^2, resulting in a total footprint of 1,560 m^2 per placement. Assuming a seabed penetration depth of 3 m, each placement will disturb approximately 4,680 m^3 of seabed material. Therefore, each mobilisation (two placements) will result in a seabed footprint of 3,120 m^2 and a total disturbed volume of 9,360 m^3. Across three mobilisations, the cumulative seabed footprint is 9,360 m^2, and the total disturbed volume is 28,080 m^3.

Placement of HLV anchors and anchor lines (three HLV deployments)

The HLV anchors and anchor mooring lines will likely be placed beyond the 500 m safety zone. While the exact anchor configuration is not known it is assumed that 8 anchors, each of a disturbance area of 13.5 m^2 will be placed. An additional 5 m buffer around the 13.5 m^2 anchor disturbance area has been assumed for any settlement of sediments for an impact area of 157 m^2 per anchor. Therefore, an overall disturbance of 1,257 m^2 is estimated for the 8 anchors per HLV deployment for a total of 3,772 m^2 for all three HLV deployments.

It has been assumed that the anchors will impact the seabed surface only, and as such a depth of 0.1 m metres has been applied to estimate a sediment disturbance volume of 377 m^3 for the use of eight anchors across three deployments of the HLV.

The anchor chains / mooring lines have a length of up to 645 m each. Buoys will be attached to the anchor chains to reduce their contact with the seabed, and thus it is estimated that only 250 m of each chain will be lain on the seabed. Assuming a lateral movement of 30 m by these chains to account for drag between the initial and final

HLV positions (with the anchored point being fixed), seabed disturbance from each chain is estimated to be 3,750 m^2. This area accounts for a triangular area of impact with a 250 m length of chain on seabed floor and 30 m drag from re-positioning the HLV. As such, an overall disturbance of 30,000 m^2 for 8 chains per HLV deployment has been estimated. Therefore, across three HLV deployments the impact area from the anchor chains is expected to be approximately 90,000 m^2.

As with the anchor deployment, it has been assumed that the anchors chains will impact the seabed surface only, and as such a depth of 0.1 m metres has been applied to estimate a sediment disturbance volume of 9,000 m^3 for the use of eight anchors chains across three deployments of the HLV.

Internal dredging of the jacket legs for internal cutting

A small amount of seabed material may be dredged from inside the piles to remove any potential soil plugs formed, in order to ensure clear access for the high-abrasion internal cutting tool. The estimated dredging volume is based on the internal space of the jacket legs being filled with sediment to a depth of 3 m. The Inde 23AC jacket has eight legs with an internal diameter of approximately 1.32 m, and the Inde 23AQ jacket has four legs with an internal diameter of approximately 0.99 m. Using these dimensions, the total internal volume across all 12 legs is estimated at approximately 42 m^3. This volume of material would be released into the water column. Given the low volume of sediment released would likely be absorbed into background concentrations of mobilised sediment.

Internal cutting of the jacket legs

To avoid external dredging, if possible, internal subsea leg cuts will be undertaken. It is intended that all piles will be cut internally using abrasive water jet technology to sever the steel at approximately 3 m below the seabed. The cutting head will likely use a high-pressure stream of water mixed with garnet as the abrasive medium, and the garnet discharged during cutting will settle on the seabed near the jacket, causing localised disturbance.

It is assumed that about 356 kg of garnet will be required for each leg cut, giving an estimated garnet volume of 0.09 m^3 per leg. To account for operational contingency during cutting, this figure was doubled to 0.18 m^3 per leg. Multiplying across all 12 piles gives a total volume of garnet used is estimated to be approximately 2 m^3.

As the cut will be performed 3 m below the mudline, and garnet is heavier than seawater, it is likely that the majority of the garnet will be retained below the mudline at the cutting depth of 3 m. However, a small volume may be carried to the seabed when the piles are removed. As such, the seabed disturbance from the garnet assumes a localised spread of 1 m depth for a footprint of 2 m^2.

Jacket lifting

During jacket removal, the extraction of legs from the seabed is expected to mobilise the surrounding sediments. To estimate this impact, it has been assumed that disturbance will extend 2 m outward from the outer edge of each jacket leg. For the Inde 23AC jacket, this results in an impact area of approximately 22 m^2 per leg, and for the Inde 23AQ jacket, approximately 20 m^2 per leg. Combining all legs from both jackets, the total footprint for jacket lifting is estimated at approximately 256 m^2. As the legs will be cut to a depth of 3 m below the mudline, the sediment volume disturbed from jacket lifting has been estimated as 768 m^3.

External cutting of the jacket legs, if internal cutting proves unfeasible

It is noted that if internal cutting proves unfeasible, then excavation around the piles will be required to enable external cutting with a diamond wire saw. It has been estimated that excavation around the legs would be required in an area 3 m from the jacket legs in all directions up to a depth of 3.5 m. Across the Inde 23AC and Inde 23AQ legs, the excavation would equate to seabed area of 490 m^2 and a sediment volume of 1716 m^3 will be disturbed.

Pipeline riser cutting

PL 2355 and PL 2356 pipelines will also be uncovered in order to be cut prior to lifting. Uncovering and cutting of the pipelines will only occur at the base of the Inde 23AC jacket. The pipelines will then be re-buried after the lift has been completed. A conservative disturbance area of 200 m^2 per pipeline has been applied (400 m^2 altogether), assuming an excavation trench of 10 m × 20 m per pipeline. It is assumed that each trench will be excavated to a depth of 3 m, resulting in a total excavation volume of approximately 1,200 m^3 for both pipelines combined.

Removal of pipeline sections using subsea baskets adds an additional 32 m² footprint, based on two placements of a subsea basket (16 m² each). In total, the estimated seabed disturbance for pipeline cutting and removal activities is approximately 432 m². As the subsea baskets will only rest on the seabed surface, a shallow disturbance depth of 0.1 m has been assumed, giving an additional volume of approximately 3 m³. In total, the estimated seabed disturbance for pipeline cutting and removal activities is approximately 432 m², with a combined volume of about 1,203 m³.

Debris removal

Following recovery of subsea infrastructure and debris, where necessary, the seabed will be subjected to debris sweeps to confirm that the seabed is clear. This will likely be conducted by an ROV. The ROV will identify and collect any debris that may have accumulated during the operational life of the installation, placing these items into a subsea basket for removal. As the exact quantity and size of debris are currently unknown, a conservative estimate has been applied, assuming disturbance over 0.1% of the 500 m safety zone (approximately 8,011 m²).

Summary

An estimate of seabed disturbance caused by the proposed works is provided in Table 7.7. The majority of the seabed disturbing works (positioning jack-up rig legs, material mobilisation from use of cutters, seabed excavation, and removal of subsea infrastructure) will occur within the 500 m safety zones around Inde 23A.

Therefore, the total area of seabed disturbance from the proposed decommissioning works is estimated to be 111,833 m², if internal cutting is possible. If internal cutting is not possible, then the disturbance area is estimated to be 112,065 m². This disturbance would occur across the three HLV deployments, each lasting approximately 90 days, over the course of the 8.5-year decommissioning programme (refer Figure 9).

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

Table 7.7 Estimated seabed impact from proposed decommissioning works

Seabed impact activities	Single Campaign			Three campaigns	
	Total area (m^2)	Depth (m)	Total volume (m^3)	Total area (m^2)	Total volume (m^3)
HLV spud cans (1st placement)	*1,560*	*3*	*4,680*	*4,680*	*14,040*
HLV spud cans (2nd placement)	*1,560*	*3*	*4,680*	*4,680*	*14,040*
Spud can placement	**3,120**	**3**	**9,360**	**9,360**	**28,080**
8 x Anchors plus 5 m buffers	*1,257*	*0.1*	*125*	*3,771*	*377*
8 x Anchor chains	*30,000*	*0.1*	*3,000*	*90,000*	*9,000*
Anchor placement	**31,257**	**0.1**	**3,125**	**93,771**	**9,377**
Excavation for 2 x pipelines	*400*	*3*	*1,200*	*N/A*	*N/A*
Subsea basket placement to remove 2 x pipeline sections	*32*	*0.1*	*3*	*N/A*	*N/A*
Pipeline air-gapping	**432**	**N/A**	**1,203**	**N/A**	**N/A**
Internal jacket leg dredging (potential impact)	*N/A*	*3*	*42*	*N/A*	*N/A*
Jacket leg cutting with garnet	*2*	*1*	*2*	*N/A*	*N/A*
Jacket lifting	*256*	*3*	*768*	*N/A*	*N/A*
Removal of jacket	**258**	**N/A**	**812**	**N/A**	**N/A**
Debris removal in 0.1% of safety zone	*8,011*	*0.1*	*801*	*N/A*	*N/A*
Seabed picking	**8,011**	**0.1**	**801**	**N/A**	**N/A**
TOTAL – Internal cutting				**111,832**	**40,273**
External dredging if internal leg cuts found not to be feasible (potential impact)	*490*	*4*	*1,716*	*N/A*	*N/A*
TOTAL – External cutting				**112,064**	**41,177**

Bathymetry

The proposed decommissioning works will result in seabed disturbance potentially resulting in changes to the seafloor's finer scale topography. Each of the activities that interact directly with the seafloor may leave a temporary mark on the bathymetry. However, these are all expected to be temporary and fill in over time.

As discussed, an HLV will likely be mobilised three times, once for the removal of the AQ-AC bridge, and then once for each of the AC and AQ installations. As shown in Figure 13, placement of HLV spud cans on the seafloor can leave depressions which remove finer scale topography features such as mega-ripples.

It is estimated that the HLV to be used has six spudcans, each with a footprint of 260 m^2, which could penetrate up to 3 m into the seafloor. The HLV is expected to be mobilised three times, each with a stand-off and a final position. This could result in up to 36 spudcan holes being left in the seafloor. Evidence from bathymetry data collected between 2021 and 2023, shown in Figure 15, suggests that at Inde 23A these depressions would likely fill in within a year or two.

Anchoring and anchor chains can also leave impressions on the seafloor. Although sediment dynamics vary, a previous investigation into the duration of anchor scars in soft sediments (muddy substrata and coarse sand like at Inde 23A) found that anchor scars had filled in within three months (Griffiths, Langmead, Readman, & Tillin, 2017). It is noted that anchoring has previously occurred at the Inde 23A site, anchor scar cannot be identified in the bathymetry data (refer Figure 14). DEFRA undertook a review of anchoring and mooring impacts in English and Welsh MPAs and found overall that anchoring or mooring to be a management concern for seafloors even within UK MPAs (Griffiths, Langmead, Readman, & Tillin, 2017).

Some excavation may also be required around the jacket legs and the pipeline riser sections to enable external cutting and to re-bury the pipelines so they do not pose a snagging risk. These works would be occurring within the scour holes beneath Inde 23AC and Inde 23AQ shown in Figure 14, and would not cause further damage to surrounding intact seabed. As with the spudcans, the seabed is expected to recover once the works are complete.

Although the works will temporarily impact the seabed bathymetry, removing the installation is expected to restore more natural hydrodynamic conditions to resume eventually filling in the scour holes beneath Inde 23AC and Inde 23AQ, shown in Figure 14, which can enhance sediment redistribution and support the long-term ecological recovery of the area. This is supported by the relatively quick recovery of the seabed between 2021 and 2023 shown in Figure 15.

Suspended sediments

Some localised disturbance and mobilisation of suspended sediments will occur due to the seabed disturbing activities. Mobilisation of soft sediments results in a temporary increase in turbidity and suspended sediment loads which may impact water quality and light attenuation (limited photosynthesis). The extent, concentration and duration of increased suspended sediment depend on the fine content of the material being disturbed, the equipment and methodology used, as well as meteorological and oceanic conditions at the time of the works.

Locally, the distributed coarser sediments would settle out of suspension almost immediately, while the finer sediments could mobilise in a turbid plume over a greater area before resettling over the nearby surrounding seabed (see discussion on burial and smothering below). The impact from this decommissioning option is expected to be relatively minor as work will be localised, short-term and will prioritise methods that reduce seabed impacts where possible.

The Norfolk Boreas Offshore Wind Farm is 25.70 km from Inde 23A and in similar sediments (5% gravel, 65-100% sand and 10% mud) (refer section 5.5) (Royal HaskoningDHV, 2019). Sediment transport modelling undertaken for the Norfolk Boreas Offshore Wind Farm found that most of the sediment mobilised from its construction activities would fall rapidly (minutes or tens of minutes) to the seabed within a few tens of meters. The finer material would create a modest concentration plume (tens of mg/l) for around half a tidal cycle (up to six hours) before settling within a few hundred metres up to around a kilometre. The proposed works are significantly less extensive than that of windfarm construction (both in terms of the volumes of sediment disturbed and the number of locations where sediment is disturbed) as such suspended sediments plumes are not expected to last for longer than 6 hours nor further than a few hundred metres.

Release of contaminants

The resuspension and spread of contaminants present within the seabed footprint may lead to additional environmental impacts through the re-suspension of sediment contaminations. As discussed in section 5.6, there are some elevated levels of metals specifically Cd and Hg at I23A_01 and Cu at Inde23A_03. However, as discussed when compared to background levels for the North Sea, Cd and Hg concentrations were not notably high. Inde 23A_01 is also 500 m southwest of the platform and not expected to be a site of excavation.

Mobilising contaminated sediments can have acute or long-term toxic effects on marine organisms, which can be magnified up the food chain where bioaccumulation occurs in predators. However, as the extent of sediment disturbance from the decommissioning activities are relatively low, the potential mobilisation of seabed contamination around the jackets are also expected to be minimal. Therefore, the proposed decommissioning method is unlikely to lead to mobilisation of significant levels into the water column.

Burial and smothering

Mobilised sediments can also settle on the surrounding habitat, smothering benthic communities, causing injury or lethal effects. A description of the benthic habitats found at Inde 23A can be found in section 5.7 and section 5.8. During the EBS, an impoverished macrobenthic assemblage was identified across the survey area. The seabed habitat at Inde 23A was classified as Circalittoral muddy sand (SS.SSa.CMuSa / A5.26) but with benthic fauna more closely resembling *Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sand' (SS.SSa.IMuSa.FfabMag / A5.242).

The species associated with A5.242 can be broadly characterized as either opportunist species that rapidly colonize disturbed habitats and increase in abundance, or species that are larger and longer-lived and that may be more abundant in an established, mature assemblage (Tilin & Watson, 2024; Tillin, 2022). The benthic faunae within these communities were assessed to have low sensitivity to light smothering changes (<5 cm in a single event) and medium sensitivity to heavy smothering changes (up to 30 cm in a single event) (Tilin & Watson, 2024; Tillin, 2022). There are limited filter feeders present in the benthic communities present around Inde 23A thus reducing the overall potential impact sediment sediments.

It is anticipated that any impacted seabed would be recolonised by benthic fauna typical of the area as a result of natural settlement by larvae and plankton through the migration of mobile animals from adjacent areas. Due to the limited nature of the activity, both spatially and temporally, any effects from physical damage to the seabed and the resulting settlement of suspended sediments would be small in nature and duration. As a result, no significant impacts on benthic species are expected.

Seabed recovery

Estimates of when seabed and benthic community recovery are expected to vary and often based on intensive marine aggregate extraction or dredging (MMS, 1999; Tilin & Watson, 2024; Tillin, 2022; Lopez Lopez, et al., 2025). The Minerals Management Service (MMS) (1999) quote various sources and report that recolonisation takes 1 to 3 years in areas of strong currents but up to 5 to 10 years in areas of low current velocity. As discussed, bathymetry data collected in 2023 showed that spud can holes left by works that occurred in 2021 had almost completely filled, suggested a quicker recovery time in this area (refer Figure 15). Overall, seabed recovery is expected relatively quickly given the minor nature of the works as well as the generally finer sediments, tidal flow and benthic community types found at site.

Mitigation measures

Movement of the HLV will be reduced to minimise the number of times that the legs need to be placed on the seabed floor, as far as possible. The anchor lines will be equipped with buoys to reduce drag. Stabilisation will only be placed at the HLV legs if required. If stabilisation material is required, then gravel bags will be used if possible, so that these can be retrieved. Internal subsea leg cuts will be used if possible. The pipeline ends will then be re-buried after the lift has been completed.

Assessment

While the proposed operations will cause limited seabed impact, this will be temporary, occur over a very limited area, and is not expected to cause any significant impacts on the wider area or to protected species / habitat.

Results of the assessment are as follows:

– Magnitude: Moderate
– Sensitivity: Medium
– Significance: Minor.

The works will be planned to minimise impacts to the seabed as far as possible. Ultimately, the removal of the jackets and pipeline riser sections will allow more natural hydrodynamic movement to resume providing higher quality benthic habitat in the long term.

As a result, no further assessment is required.

7.2.7 Snagging

Unrecovered items lying on the seabed can create a snagging risk for fishing equipment. To prevent snagging risks, the jackets and the PL2355 and PL1256 riser sections will be cut subsea. To cut PL2355 and PL1256, the pipelines will be uncovered near the base of the jacket and cut prior to the HLV arriving. The remaining pipeline ends will be re-buried and as such should not cause any snagging. The time between the pipeline cut and reburying will be minimised and should be covered by the 500 m safety zone during this time.

Results of the assessment are as follows:

– Magnitude: Negligible
– Sensitivity: Medium
– Significance: Negligible.

Following the Inde 23AC and 23AQ removal campaign, an as-left survey/debris removal with ROV will be completed. A 500 m safety zone will remain around the Inde 23AT installation so snagging risks associated with remaining infrastructure will be considered at a later date when the Inde 23AT jacket is decommissioned.

As a result, no further assessment is required.

7.2.8 Seabirds

There is potential that the decommissioning activities could disrupt seabirds if they are present or nesting during the removal of the Inde 23A topsides, bridges and jackets. As discussed in section 5.11, seabirds often use manned and unmanned offshore structures for roosting, nesting and as access to feeding grounds. In particularly, Black-legged kittiwakes have been known to use offshore installations for nesting in SNS.

As discussed in section 5.2, no bird species have been recorded nesting at the Inde 23A platforms in annual surveys conducted from 2023 to 2025. However, seabird presence is unpredictable, and as such, having no history of nesting birds does not guarantee that lack of presence will continue in the future, particularly given the other anthropogenic pressures on bird populations. As such, the potential disturbance to seabirds requires assessment.

Decommissioning activities for Inde 23A are expected to begin in Q2 2027. Where feasible, PUK plans to avoid the nesting season when removing the topsides, bridges and jackets. Despite no evidence of nesting in 2025 or previous years, a further assessment on the presence of nesting will be carried out prior to the works starting. Should any nesting be observed, options will be discussed with OPRED.

Activity of vessels on transit to and from site can also disturb seabirds and their foraging activities. The presence of vessels may reduce the ability of seabirds to use this area for foraging particularly if the support vessel come into port near or within a bird-related MPA. However, the vessels presence will be temporary and only a very small portion of foraging habitat will be affected. Vessel movement would be similar to other activities occurring in the SNS.

Results of the assessment are as follows:

– Magnitude: Minor
– Sensitivity: Low
– Significance: Minor.

No impacts on nesting birds are expected from the proposed decommissioning activities. However, should nesting birds be identified on the platform during breeding season PUK will assess ongoing activities to determine the potential for disturbance. Impacts to bird foraging habitat are expected to be short-term and minor.

As a result, no further assessment is required.

7.2.9 Noise and vibration from decommissioning activities

Context for underwater noise

Ambient noise in the ocean is background sound generated by natural (e.g., wind, waves, tectonic activity, rain and marine organisms) and human (e.g., background shipping traffic and onshore and offshore construction) sources. The characteristics of the sound produced, in terms of the amplitude, range of frequencies and temporal features, varies with the type of activity and equipment.

Marine fauna use sound for navigation, communication and prey detection and as such the introduction of anthropogenic underwater sound has the potential to impact on marine animals. Impacts on marine animals can range from behaviour response such as the animal avoiding the area to impacts to the animal's ability to use and receive sounds and in the most extreme cases, excessive underwater can damage animal's hearing organs.

As discussed in section 5.10, a number of fish species use the area for nursery and / or spawning grounds at different times of the year including sandeel, cod, herring, mackerel, plaice, nephrops, sprat, whiting and tope shark. As discussed in section 5.12, a number of marine mammal species can also be observed in the vicinity of Inde 23A including Harbour porpoise, Bottlenose dolphin, White-beaked dolphin, Common dolphin, Minke whale, Grey seal and Harbour seal.

The Conservation of Offshore Marine Habitats and Species Regulations 2017 make it an offence to injure or disturb European Protected Species (EPS), the list of which includes many marine mammals. The Regulation defines 'injury' as a permanent threshold shift and 'disturbance' as the likelihood of impairing their ability to survive, to breed or reproduce, or to rear or nurture their young, or migrate. It also includes a likelihood of significantly affecting the local distribution or abundance of the species. As such, new developments must assess if their activity, either alone or in combination with other activities, is likely to cause an offence involving an EPS.

The potential for injury or disturbance depends on the amplitude and frequencies of the sound source, the sensitivity of a receptor animal to sounds of the source frequencies, as well as the distance and propagation of sound between the source and the receptor.

Source of underwater noise

Decommissioning will give rise to sources of noise related to:

- vessels of various types
- cutting tools
- dredging, pipeline uncovering and burying
- post-decommissioning seabed surveys.

The noise associated with these sources are discussed below.

No high energy noise sources, such as the use of explosives, piling or deep sediment penetration seismic equipment, will be required for the decommissioning works.

Vessels

The Inde 23A jackets, bridges and riser decommissioning will mobilise a variety of vessels such as an HLV, support vessels, tugs and survey vessels and / or Remotely Operated Vehicle Support Vessels. These vessels are typical of routine oil and gas industry operations. The HLV anticipated to be used is equipped with a jack-up rig and as such does not use dynamic positioning systems to maintain and adjust its position when working. However, some other vessels may use dynamic positioning systems.

Vessels are often the primary source of noise in decommissioning operations (Fernandez-Betelu, et al., 2024) with noise being generated from the propellers, the propulsion of the vessel through the water and other machinery on board (Smith & Rigby, 2022).

In general, vessel sound is continuous and results from narrowband tonal sounds at specific frequencies as well as broadband sounds. Acoustic energy is strongest at frequencies below 1 kHz and is the dominant noise source in deeper water between 20 – 500 Hz (Ulrick, 1983). Acoustic broadband source levels typically increase with increasing vessel size, with smaller vessels (<50 m) having a source root mean square (rms) sound pressure level (SPL) of 160-175 dB re 1 µPa at 1 m, medium size vessels (50-100 m) 165-180 dB re 1µPa at 1 m and large vessels (> 100 m) 180-190 dB re 1 µPa at 1 m (Richardson, Greene, Malme, & Thomson, 1995), although sound levels depend on the operating status of the vessel and can vary considerably in time.

Cutting

The decommissioning works will also require cutting activities, including cutting of the jacket legs and the pipeline risers. Mechanical methods of cutting underwater structures use hard cutting tools that produce a sawing or machining action. Examples include hydraulic shears, diamond wire and abrasive water jet cutters.

A recent paper reported that the noise from underwater diamond wire cutting, during the severance of a 0.76 m (30″) diameter conductor at a platform in the North Sea, was barely discernible above background noise levels, including the noise of associated vessel presence (Pangerc, Robinson, Theobald, & Galley, 2016). Similarly, Fernandez-Betelu et al. (2024) did not detect an increase in noise above the general vessel noise during decommissioning works in the Scottish North Sea.

Reported underwater noise measurements for underwater cutting tools are up to 170.5 dB re. 1 µPa @ 1 m for high pressure jets (Pangerc, Robinson, Theobald, & Galley, 2016).

Dredging, pipeline uncovering and burying

PL 2355 and PL2356 riser sections will need to be uncovered in order to be cut. The remaining pipeline will then need to be re-buried. There is also potential that dredging may be needed to uncover the jacket legs if internal cutting is not found to be possible. A variety of tools may be used to uncover and re-bury the pipeline including ploughs, jet trenchers and mechanical trenchers.

Information on pipeline burying works is limited. However, noise monitoring conducted during the burying of the North Hoyle wind farm offshore transmission cable using a mechanical trencher found source noise levels were reported to be 178 dB re 1µPa at 1m (Nedwell, Langworthy, & Howell, 2003). The noise levels were highly variable and were directly related to the seabed type. It is noted that the pipeline riser would only be uncovered and buried at the riser near the jacket within sandy-gravelly material.

Underwater sound caused by dredging activities is typically low frequency, with strongest sound below 1 kHz and reported recorded noise levels ranging between 157 and 190 dB re 1µPa (Jones & Marten, 2015). The review of dredging studies undertaken by Jones and Marten (2015) found that the highest levels of sound are generated when dredging vessels are in transit, rather than when digging. It was also noted that sandier material is less noisy compared to dredging in gravel material.

Post-decommissioning seabed surveys

A post-decommissioning seabed survey will be carried out in the vicinity of the Inde 23A to confirm all materials have been removed. The survey will likely employ a combination of acoustic surveying devices, including SSS, MBES and SBP.

Source levels of SSS are typically in the range of 200 to 230 dB re 1 µPa-m, although available information and measurements are limited. In order to provide higher resolution imaging of the seabed the frequencies used by side-scan sonar systems are relatively high (100 to 500 kHz) (JNCC, 2017a).

MBES use multiple transducers to send out a swath of sound covering a large, fan-shaped area of the seabed either side of the vessel track. They work using a range of sound frequencies, with higher frequencies used in shallower waters that are normally outside the hearing range of cetaceans (JNCC, 2017a).

SBP systems are employed to identify and characterise layers of sediment or rock under the sea floor. Equipment that periodically emits a high frequency ‘ping’, typically operating on a range of single frequencies between 3.5 to 7 kHz (JNCC, 2017a).

Hearing sensitivity of receptors

Marine mammals

Different marine mammal species are sensitive to sounds over different frequency ranges. Mammals are often considered in relation to their hearing frequency range, which includes Low frequency cetaceans (such as Minke whales), High frequency cetaceans (such as dolphins), Very high-frequency cetaceans (such as Harbour porpoise) and Phocid carnivores in water (such a Grey seals and Harbour seals). Table 7.8 presents the hearing ranges for marine mammals observed within the vicinity of Inde 23A.

Table 7.8 Hearing range of marine mammals observed around Inde 23A

Species	Hearing frequencies
Harbour porpoise	275 Hz to 160 kHz
Bottlenose dolphin	150 Hz to 160 kHz
White-beaked dolphin	150 Hz to 160 kHz
Common dolphin	150 Hz to 160 kHz
Minke whale	7 Hz to 160 kHz
Grey seal	50 Hz to 86 kHz
Harbour seal	50 Hz to 86 kHz
Sourced from Southall et al. (2007) and South et al. (2019).	

Fish

There is limited data available on hearing frequencies for fish species, but Popper et al. (2014) have defined criteria for injury to fish based on a review of impacts to fish, fish eggs, and larvae from various high-energy sources. The most sensitive species are those with a swim bladder that is also used for hearing, for which Popper et al. (2014) determined a threshold for mortality, or potential mortal injury, of a peak SPL of 207 dB re 1 µPa.

Potential for impacts from underwater noise

Vessel noise

The DP will require around 194 days to complete. During this time, vessel noise will be generated through the use of support vessels, tug boats etc, movement of the HLV etc. This will make a small addition to the background levels of vessel density, where the shipping levels are comparatively low with an average of 7.374 vessels passing through per week (refer section 5.13.1).

Vessel noise will likely be somewhat reduced by the use of an HLV with a jack-up rig, rather than a crane vessel with dynamic positioning that produces constant noise from the engine re-adjusting the vessel’s position (Benhemma-Le Gall, Thompson, Merchant, & Graham, 2023) .

Fernandez-Betelu et al. (2024) carried out a review of underwater noise generated during the decommissioning of an oil and gas platform in northeast Scotland in 2021 and the consequential effect on Harbour porpoise (the most common mammal type in the vicinity of Inde 23A). They found that the daily average pressure levels during the five-day decommissioning programme were between 30 dB and 40 dB higher than the background levels prior to its decommissioning. The noise increase was within the frequency range from around 100 Hz up to around 48 kHz. No additional peaks in noise were observed on top of this general increase in noise during cutting or other key decommissioning activities. As such, they found that the dominant source of noise during the decommissioning period appeared to be associated with the presence of the vessels carrying out the decommissioning activities rather than specific activities such as cutting, drilling or ROV operation.

Using passive acoustic monitoring Fernandez-Betelu et al. (2024) observed levels of Harbour porpoise displacement linked to the decommissioning activities. They found that the decommissioning activities did create Harbour porpoise avoidance near the installation (<2km) during the 5-day decommissioning works. This displacement was like recorded responses to other large vessels within the study area. However, they found Harbour porpoise returned immediately afterwards to forage, suggesting that shedding marine growth may have attracted them. Overall, they found no differences in Harbour porpoise occurrence before and after decommissioning activities and, as such, that impacts on harbour were small scale and short term.

JNCC considers that temporary vessel traffic is unlikely to cause more than trivial disturbance to marine mammals (JNCC, 2010). The increase in underwater sound from vessels mobilised for the decommissioning will therefore be slight and the impact on the environment minor.

Cutting

As discussed above, Fernandez-Betelu et al. (2024) found that cutting works during a decommissioning activity in the North Sea were drowned out by vessel noise with no additional sound peaks observed. Similarly, Pangerc et al. (2016) found that sound radiated from diamond wire cutting was not easily detectable above background noise. Non-explosive cutting technology produces relatively little noise (JNCC, 2010), are not likely to cause significant disturbance to marine fauna.

Dredging, pipeline uncovering and burying

Noise from uncovering and burying PL2355 and PL2356 pipelines would likely be similar to that of dredging. Noise from dredging activities, taken as a proxy for trenching, generates peak levels similar to that from vessels, and the risk of injury to mammals from this noise is considered negligible (JNCC, 2010).

Post-decommissioning seabed surveys

The high frequency sound produced by SSS and MBES in relatively shallow waters (<200 m) is outside the hearing range of marine mammals and attenuates rapidly. The risk of injury or disturbance from the operation of this type of equipment is considered negligible, and no mitigation is required (JNCC, 2017a).

Sound generated be SBP pingers is within the audible range of most marine mammals and sound levels at the source can be at levels that could cause injury to some marine mammals. As such, use of SBP requires consent issued under the Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 usually supported by a noise impact assessment. Noise modelling tends to find impacts from SBP to be negligible; however, an assessment will be undertaken prior to the survey once specific equipment and timing are known.

Mitigation measures

As discussed, noise impacts from the works are not expected to be significant. However, potential impacts from underwater noise can be reduced further through the application of control measures. The decommissioning works will be planned to reduce vessel movement as much as possible. Lower noise methods will be selected where possible. For example, internal cuts using diamond wire will be prioritised if feasible. Cutting activities will also be minimised and carried out in isolation where possible. Dredging will only be carried out if required and the project will not use any explosives. All equipment will be subject to proper preventive maintenance to ensure that it is properly functioning, and unnecessary noise is not generated.

Any required post-decommissioning surveys will be scheduled and planned efficiently to minimise vessel operation time. JNCC guidelines for minimising noise impacts from surveys will be followed, where applicable (JNCC, 2017a).

Assessment

Results of the assessment are as follows:

- Magnitude: Minor
- Sensitivity: Medium
- Significance: Minor.

Operational planning will be used to minimise vessel movement as much as possible. Cutting, pipeline uncovering and dredging will be planned and carried out efficiently to prevent elevated noise as far as possible. Techniques will prioritise lower noise generate methods, such as internal cutting and diamond wire saw cutting where possible.

Any required post-decommissioning surveys will be scheduled and planned efficiently to minimise vessel operation time. JNCC guidelines for minimising noise impacts from surveys will be followed. An assessment for potential noise impacts will be undertaken for survey consent application where required.

As a result, no further assessment is required.

7.2.10 Waste management

Waste created as part of the decommissioning works will include the jackets, bridges, and pipeline riser section. The majority of the generate waste material will be steel (approximately 10,311 te, followed by non-ferrous metals (approximately 89 te). A breakdown of the materials found within the assets to be decommissioned is provided in Figure 36.

Required waste management activities, including onshore dismantlement and waste treatment, will likely lead to onshore impacts such as noise, odour, and energy consumption. The eventual fate of materials will in part be controlled by the type of waste and how it is regulated.

The EA Guidance Note for decommissioning states that there is *“no expectation for the EA to include an assessment of wastes or waste management returned to shore for treatment or disposal as this is considered an onshore issue and not relevant to impacts in the marine environment”* (OPRED, 2018). However, it is noted that the PUK will have an Active Waste Management Plan for the project that will detail the following:

- intentions for the active management of offshore waste
- process of advising various waste regulators (onshore and trans-boundary)
- identification and categorisation of the waste streams
- an inventory of waste in accordance with the Waste Framework / Waste Hierarchy, Waste Inventory, Waste Categorisation and Waste management obligations.

PUK will meet their duty of care to ensure that waste is managed correctly. This includes proper storage of waste, only transferring waste to an appropriate operator, and ensuring that when it is transferred, it is sufficiently well described to enable its safe recovery or disposal without harming the environment. Only licensed contractors with demonstrable experience will be used for waste handling and treatment / disposal. If the transfer of waste outside of UK is required, then this activity will be covered by an International Waste Shipment permit. An audit trail will be maintained for waste materials from all vessels, through to the onshore decommissioning yard, and on to the recycling facility or disposal site. The onshore yard contractor will keep an inventory of the types, quantities and dates of waste received and the quantities and dates of dispatch from the site. The recycling facilities and disposal sites will certify the type.

Waste recycling and reuse will be prioritised over disposal, where feasible. It is expected that the majority of the non-hazardous material will be recycled or sent to an Energy from Waste facility. Prioritisation of recycling and reuse will be considered as part of the procurement process for waste providers to incentivise this.

Other non-hazardous waste which cannot be reused or recycled will be disposed of at a licenced landfill site. Hazardous waste will be disposed of in accordance with established waste legislation and as discussed in section 7.2.1.

Tests for Naturally Occurring Radioactive Material (NORM) will be undertaken offshore by the Radiation Protection Supervisor, and any NORM encountered will be dealt with under an appropriate permit and disposed of in accordance with guidelines and company policies. It is noted that Inde 23A has a history of having NORM. As such, NORM wastes will be managed in accordance with best practice and monitoring will continue to be carried out throughout the decommissioning.

A previous Hazardous Materials survey identified Asbestos Containing Materials and paints will heavy metal on the Inde 23A installation. As discussed in section 7.2.1, cutting into or exposing hazardous waste will be avoided offshore. The dismantling contractor will have processes in place to aid the identification of asbestos and for the treatment of such materials that are found. This could include the mobilisation of a licence asbestos removal contractor.

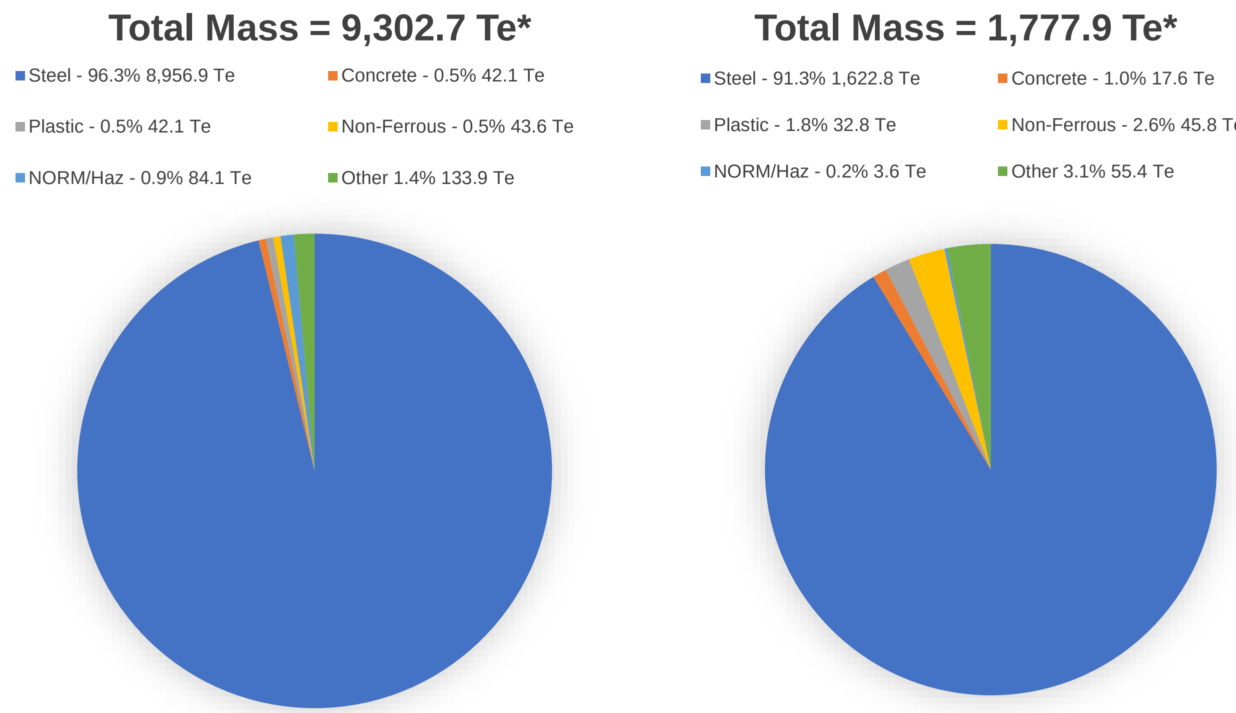


Figure 36 ***Material estimates for decommissioned assets. Left – Inde 23AC. Right – Inde 23AQ.***

Results of the assessment are as follows:

– Magnitude: Minor
– Sensitivity: Medium
– Significance: Minor.

No further assessment is required.

7.2.11 Protected areas and their conservation objectives

As discussed in section 5.14.1, Inde 23A is within 10 km of the North Norfolk Sandbanks and Saturn Reef SAC (4.96 km east). The conservation objectives for the North Norfolk Sandbanks and Saturn Reef SAC are (JNCC, 2017b):

"For the features to be in favourable condition thus ensuring site integrity in the long term and contribution to Favourable Conservation Status of Annex I Sandbanks which are slightly covered by sea water all of the time and Annex I Reefs. This contribution would be achieved by maintaining or restoring, subject to natural change:

– *The extent and distribution of the qualifying habitats in the site;*
– *The structure and function of the qualifying habitats in the site; and*
– *The supporting processes on which the qualifying habitats rely."*

The proposed works are not likely to impact the North Norfolk Sandbanks and Saturn Reef SAC unless they create a sediment plume that travels across the boundary of the SAC. If this occurred, mobilised sediments could settle on sandbanks within the SAC potentially leading to smothering.

However, it is highly unlikely that sediment disturbed from the works would reach the North Norfolk Sandbanks and Saturn Reef SAC. The Norfolk Boreas Offshore Wind Farm is 25.70 km from Inde 23A and in similar sediments (5% gravel, 65-100% sand and 10% mud) (refer section 5.5) (Royal HaskoningDHV, 2019). Sediment transport modelling undertaken for the Norfolk Boreas Offshore Wind Farm found that most of the sediment mobilised from its construction activities would fall rapidly (minutes or tens of minutes) to the seabed within a few tens of meters.

The windfarm assessment found that some of the finer sand and mud would be likely to stay in suspension for longer and form a passive plume which would become advected by tidal currents. It was estimated that due to the sediment sizes present, the plus would have measurable but modest suspended sediments (tens of mg/l) for around half a tidal cycle (up to six hours). Sediment would eventually settle to the seabed in proximity to its release (within a few hundred metres up to around a kilometre along the axis of tidal flow) within a short period of time (hours).

The proposed Inde 23A are likely to cause a smaller sediment mobilisation that than required for drilling wind turbines into the seabed as assessed in the Norfolk Boreas Offshore Wind Farm Environmental Statement. As such, it is not expected that sediment plume mobilised would extend any further than a kilometre along the axis of tidal flow. As such, it is unlikely that the sediment plume would reach the North Norfolk Sandbanks and Saturn Reef SAC.

7.2.12 In-combination impacts

In-combination effects may occur when multiple distinct impacts simultaneously affect a single receptor, and in this additive effect may pose a significant effect. In this case, there may be potential in-combination effects of the geophysical survey on marine receptors, particularly marine species.

Marine species may experience in-combination risks from the project due to:

– physical presence of vessels temporarily disrupting the natural behaviour of marine species, leading to temporary displacement, resulting in increased energy expenditure and potential impacts on breeding success.
– underwater noise disrupts mammals and diving birds, causing them to avoid underwater environments.

Benthic species may experience in-combination risks from the project due to the following:

– direct lethal and sub-lethal effects caused by locating items on the seafloor such as jack-up rig legs, stabilisation material, anchors etc.
– indirect impacts caused by increased turbidity or smothering caused by sediment mobilisation.

Additionally, although the risk of unplanned events such as a spill are low (discussed in section 7.2.1), such an event could result in a more significant in-combination effect.

To reduce the potential in-combination risks to marine species, the following mitigation measures will be implemented:

– PUK will work efficiently and proactively to try and reduce the number of days for the activities.
– JNCC guideline’s underwater noise management measures will be implemented, where applicable, to reduce noise impacts from the project.
– Collision risk reduction and the spill risk reduction measures discussed in section 7.2.1 will be followed to minimise the chance of unplanned events.

Implementation of the above appropriate mitigation measures is expected to reduce the risk of an in-combination impact on marine species to as low as possible. With the implementation of these mitigation measures, and given the temporary nature of the activities, the risk of in-combination impacts from the project is considered to be low.

7.2.13 Cumulative and Transboundary Impacts

Cumulative

There is a potential for adverse effects on the surrounding environment due to the project's impacts when considered in conjunction with simultaneous projects in the vicinity of the work area. As discussed in section 5.13.3, Inde 23A is in a mature oil and gas exploration and production area with a number of facilities in late life operations and scheduled for decommissioning in the coming decade.

The Inde18A installation, located approximately 5km away, is scheduled to be decommissioned in Q3 2026. This may overlap with decommissioning of the Inde 23 AC-AT bridge. However, the Inde 23 AC-AT bridge removal is not expected to have significant impacts and only project to take up to two weeks. As such, no cumulative impacts for the overlapping of these works are expected.

As discussed in section 5.13.5, the Norfolk Boreas Wind Farm is a consented windfarm located 25.70 km southeast of Inde 23A. Construction on the wind turbines are likely to begin in the next couple of years and as such may overlap with the Inde 23A decommissioning works. However, due to the distance of the windfarm cumulative impacts from the works are unlikely to occur.

Currently no other works in the vicinity of Inde 23A are known.

Transboundary

The closest transboundary line (UK / Netherlands) is located approximately 31.5 km to the east. As discussed in section 7.2.11, it is highly unlikely that finer sediment will remain in suspension and spread beyond UK waters, and as such no impacts are expected.

7.3 Significant impacts

No significant impacts were identified as part of the ENVID workshop. The highest significant impacts were found to be if an unplanned (accidental) event occurred (discussed in section 7.2.1), including:

- an accidental vessel collision led to a loss of containment
- a loss of containment was cause from an anchor or dropped object hitting a live pipeline
- of a spill of hazardous waste occurred.

However, when the likelihood of these accidental events was considered, then the overall risk of these events was considered Minor. Proper mitigation measures will be applied to reduce risk and impacts as far as possible.

8. Assessment conclusions

A detailed review of the proposed decommissioning activities, the environmental and social baseline, and potential impacts on environmental and social receptors as occurs as part of this EA. This review has determined that the decommissioning works are unlikely to cause any significant impacts. The decommissioning option is well understood and can be managed through established mitigation measures. This EA is considered by PUK to be alignment with objectives and marine planning policies of the East Marine Plan area.

9. Environmental management

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

9.1 Introduction

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

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

9.2 Scope of the SEMS

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

The SEMS focuses on:

- clear assignment of responsibilities
- excellence in HSE performance
- sound risk management and decision making
- efficient and cost-effective planning and operations
- legal compliance throughout all operations
- a systematic approach to HSE critical business activities; and
- continuous improvement.

9.3 Principle of the SEMS

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

9.3.1 Improvement Programmes and the Management of Change

The purpose of employing an improvement programme is to:

- ensure the continuous development of the PUK policy commitment.
- introduce changes and innovations that ensure the achievement of performance standards where current performance is below expectations.

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

9.3.2 Roles and responsibility

PUK will review existing environmental roles and responsibilities for staff participating in the Inde 23A decommissioning activities. These will be amended and recorded in individual job descriptions to ensure that they take into account any changes required for the management of the impacts identified in this EA.

9.3.3 Training and Competence

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

9.3.4 Communication

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

9.3.5 Document Control

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

9.3.6 Records

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

9.3.7 Monitoring and Audit

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

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

Monitoring and inspection activities focus on checks that:

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

9.3.8 Incident Reporting and Investigation

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

9.3.9 Non-confidence and Corrective Action

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

9.3.10 Review

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

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Appendices

Appendix A

ENVID worksheet

Appendix B

Air emissions assessment

B-1 Introduction

An air emission assessment was conducted for estimated vessel fuel usage for the decommissioning works. Table B.1 provides expected fuel usage as part of the project.

It is noted that these are estimates only at this stage, as exact fleet arrangements have not yet been determined.

The table assumes that three separate Heavy Lift Vessel (HLV) mobilisation may be required to decommission the infrastructure due to its size and complexity. These separate mobilisations would involve the removal and transport of the:

1. AT-AC bridge to separate Inde 23AT and AC from the operational Inde 23AQ – 2-week operation.
2. AC-AQ bridge, and the Inde 23AQ topside and jacket – 90-day operation.
3. Inde 23AC topside and jacket – 90-day operation.

As such, the table assumes the HLV will be in use for a total of 194 days, plus three 4-day periods (12 days) where the HLV is being transported to site. Four tug vessels have been assumed to require four days to position the HLV at Inde 23A for each mobilisation. The calculation has also assumed a support vessel will be used for duration that the HLV is in position.

No fuel usage has been provided for moving the HLV away from Inde 23A as it is likely that the HLV will be taken straight to its next decommissioning project site, and as such, fuel usage would be captured in the next decommissioning programme.

Emissions from onshore waste transportation and treatment have not been accounted for.

These vessels project to be used as part of the project will likely use either gas oil or marine gas oil. All fuel use will meet MARPOL specifications including maximum sulphur content.

Table B.1 Estimates vessel fuel usage during decommissioning works

Vessel	Estimate number of vessels	Fuel Type	Fuel consumption / day per vessel (tonnes)	Days in use	Fuel use (tonnes)
HLV	1	Gas oil	6.00	194.00	1164.00
Tug Vessels	4	Gas oil	2.00	12.00	96.00
Support Vessel	1	Marine gas oil	2.45	194.00	475.30

B-2 GHGs

To estimate the GHG emissions from this fuel usage, the emissions factors presented in Table B.2 have been used. These emissions factors have been sourced from the 2024 UK Government Conversion Factors for the relevant fuel types (DESNZ, 2024a). All conversion factors presented in Table B.2 are in units of 'kilograms of carbon dioxide equivalent of Y per X' (kg CO_2e of Y per X), where Y is the gas emitted, and X is the unit activity. This allows the relative warming contribution of different GHGs to be compared.

Table B.2 Emission factors used for GHG estimates (DESNZ, 2024a)

Fuel type	Unit	kg CO_2e of CO_2 per unit	kg CO_2e of CH_4 per unit	kg CO_2e of N_2O per unit	kg CO_2e
Gas oil	tonnes	3190.00	3.6848	32.89379	3226.57859
Marine gas oil	tonnes	3205.99	0.9072	38.40721	3245.30441

The estimated GHG contributions in terms of CO_2e from CO_2, CH_4 and N_2O, and their overall warming effect (presented in total CO_2e) are presented in Table B.3.

Table B.3 Estimated GHG emissions from vessel fuel usage

Vessel	Fuel Type	CO_2e of CO_2 (tn)	CO_2e of CH_4 (tn)	CO_2e of N_2O (tn)	Total CO_2e (tn)
HLV	Gas oil	3,713.16	4.29	38.29	3,755.74
Tug Vessels	Gas oil	306.24	0.35	3.16	311.55
Support Vessel	Marine gas oil	1,523.81	0.43	18.25	1,542.49
Total	-	**5,543.21**	**5.07**	**59.70**	**5,609.78**

A comparison between the estimated total CO_2e emissions and the UK total is provided in Table B.4. Although the proposed works will result in a GHG emission, the total emissions will contribution a small percentage to the UK oil and gas and UK total emissions.

Table B.4 GHG emissions from oil and gas industry and UK total, and contribution from proposed decommissioning works

Vessel	CO_2e (tn) (2023)	% contribution from Inde 23A works
Upstream oil and gas industry[1]	12,900,000	0.04349%
All UK emissions[2]	384,200,000	0.00146%
Notes: 1. (DESNZ, 2024b) 2. (DESNZ, 2024b).		

B-3 Other emissions

The 2024 UK Government Conversion Factors do not have conversion rates for NO_x, SO_2, CO or VOCs, as these are not the main GHGs that contribute to climate change, as covered by the Kyoto Protocol (DESNZ, 2024a).

However, these emissions can still cause air quality impacts and, as such, have been calculated. Emission estimates for these have used the EEMS Atmospheric Emissions Calculations provided in Table B.5, using diesel (engine) as a proxy (EEMS, 2008). By multiplying the fuel use by the emission factor, the masses of each emission gas can be calculated.

Table B.5 Emission factors used for emissions of NO_x, SO_2, CO and VOCs (EEMS, 2008)

Proxy fuel	NO_x	SO_2	CO	VOC
Diesel (Engine)	0.0594	0.004	0.0157	0.002

The estimated emissions of NO_x, SO_2, CO or VOCs from the fuel usage are presented in Table B.6. Although the proposed decommissioning works will result in a short term and localised increase in emission from the proposed operation these are expected to disperse rapidly.

Table B.6 Estimated NO_x, SO_2, CO or VOCs emissions from vessel fuel usage during decommissioning works

Vessel	NO_x (tn)	SO_2 (tn)	CO (tn)	VOC (tn)
HLV	69.14	4.66	18.27	2.33
Tug Vessels	5.70	0.38	1.51	0.19
Support Vessel	28.23	1.90	7.46	0.95
Total	**103.08**	**6.94**	**27.24**	**3.47**

B-4 Conclusions

PUK will take steps to reduce vessel time and fuel use as far as possible. The Inde 23A topsides, jackets, bridges and riser sections decommissioning works have been combined which will reduce vessel use substantially. Preventive maintenance works will be carried out by PUK and its contractors to ensure machinery is operating as efficiently as possible, and MARPOL compliant fuel will be used.

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