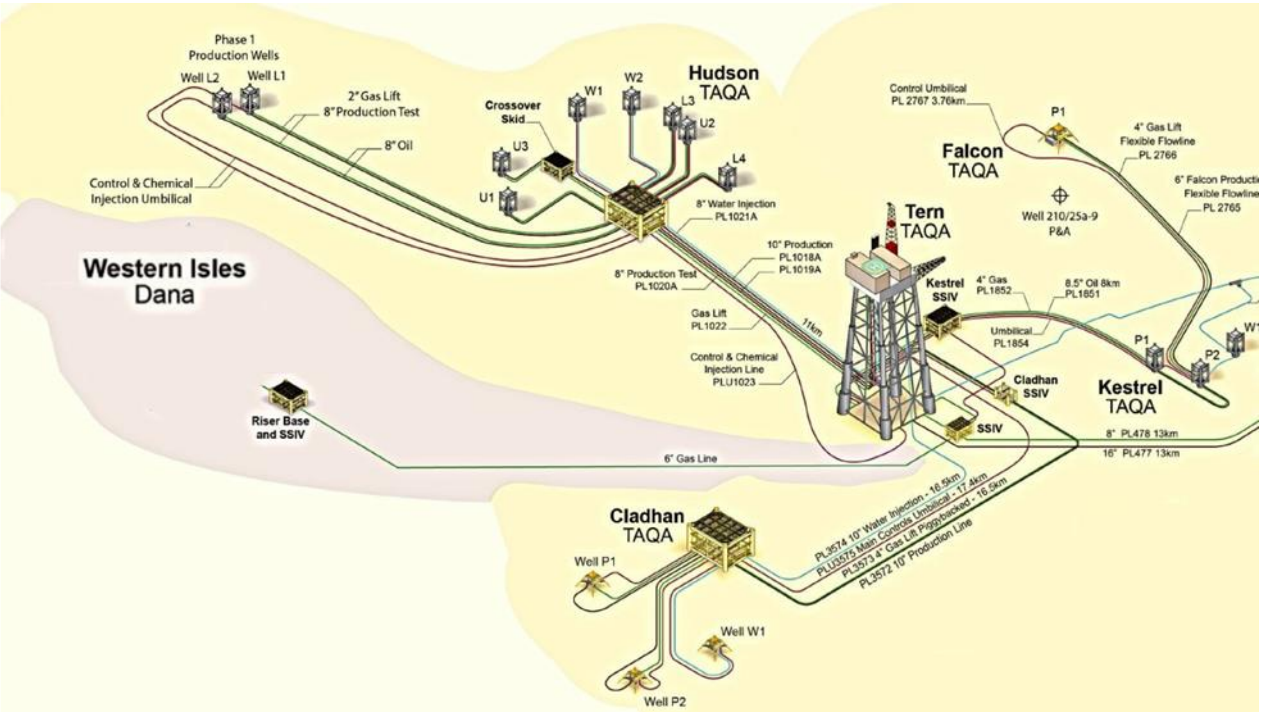
TERN AREA DECOMMISSIONING

Tern Area Subsea Environmental Appraisal



77IFS-188133-H99-0001

Consultation Draft

TAQA INTERNAL REVISION SUMMARY						
Document Owner:	TAQA Bratani Limited					
Revision No:	08		**Revision Date:**	26/03/2025		
Revision Summary:						
Authorisation:	**Prepared by**		**Verified by**		**Approved by**	
	Xodus					

OPRED REVISION SUMMARY			
Revision No.	Reference	Changes/Comments	Issue Date
08	Consultation Draft	Revised in line with OPRED comments	March 2025

DISTRIBUTION LIST		
Company	Name	No. Copies
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ABBREVIATIONS

Abbreviation	Meaning
AIS	Automatic Identification System
ALARP	As low as reasonably practicable
APE	Alkylphenol Ethoxylates
AWMP	Active Waste Management Plan
BAP	Biodiversity Action Plan
BAT	Best Available Technique
BEP	Best Environmental Practice
CA	Comparative Assessment
CCS	Carbon Capture and Storage
CNRI	Canadian Natural Resources International Ltd
CoP	Cessation of Production
CPR	Continuous Plankton Reader
CSV	Construction Support Vessel
DECC	Department for Energy and Climate Change
DESNZ	Department for Energy Security and Net Zero
DoB	Depth of Burial
DP	Decommissioning Programme
DSV	Dive Support Vessel
DTI	Department of Trade and Industry
EA	Environmental Appraisal
EC	European Commission
EEMS	Environmental Emissions Monitoring System
EHC	Electro-Hydraulic Control
EIA	Environmental Impact Assessment
EMS	Environmental Management System
ERL	Effects Range Low
ESDV	Emergency Shut Down Valve
EU	European Union
EUNIS	European Nature Information System
EWC	European Waste Catalogue Codes
FFS	Fishing Friendly Structure
FOCI	Feature of Conservation Interest
FPSO	Floating Production Storage Offloading
FRS	Fisheries Research Services
FSM	Field Signature Method
GHG	Greenhouse Gas

Abbreviation	Meaning
GIS	Geographical Information Systems
GJ	Gigajoules
HC	Hydrocarbons
HDPE	High Density Polyethylene
HP	Hydrostatic Pressure
HSE	Health, Safety and Environment
HSSE	Health, Safety, Security and Environment
ICES	International Council for the Exploration of the Sea
IEEM	Institute of Ecology and Environmental Management
IEMA	Institute of Environmental Management and Assessment
INTOG	Innovation and Targeted Oil and Gas
IPCC	Intergovernmental Panel on Climate Change
IPR	Interim Pipeline Regime
IUCN	International Union for Conservation of Nature
JAMP	Joint Article Management Promotion-consortium
JNCC	Joint Nature Conservation Committee
LTOBMs	Low Toxicity OBMs
mLAT	metres below Lowest Astronomical Tide
MarLIN	Marine Life Information Network
MARPOL	International Convention for the Prevention of Pollution from Ships
MCZ	Marine Conservation Zone
MDAC	Methane-derived authigenic carbonates
MeOH	Methanol
MEG	Monoethylene Glycol
MFE	Mass Flow Excavation
MMO	Marine Management Organisation
MoD	Ministry of Defence
MPA	Marine Protected Area
MPE	Ministry of Petroleum and Energy
MtC	Million tonnes Carbon
NCMPAs	Nature Conservation Marine Protected Areas
NMP	National Marine Plan
NMPI	National Marine Plan Interactive
NNS	Northern North Sea
NORM	Naturally Occurring Radioactive Material
NorOG	Norsk Olje and Gass
NSTA	North Sea Transition Authority

Abbreviation	Meaning
OBMs	Oil-based Muds
OEUK	Offshore Energies United Kingdom
OGA	Oil and Gas Authority (Now the NSTA)
OGUK	Oil and Gas UK
OPEP	Oil Pollution Emergency Plan
OPRED	Offshore Petroleum Regulator for Environment and Decommissioning
OSPAR	The Oslo Paris Convention
P&A	Plug and Abandonment
PCB	Polychlorinated Biphenyls
PCO	Precipitated Carbonates
PETS	Portal Environmental Tracking System
PMF	Priority Marine Feature
POC	Particulate Organic Carbon
PON	Petroleum Operations Notice
ROV	Remotely Operated Vehicle
ROVSV	Remotely Operated Vehicle Support Vessel
SAC	Special Areas of Conservation
SAHFOS	Sir Alister Hardy Foundation for Ocean Science
SAM	Subsea Accumulator Module
SACFOR	Super-Abundant, Abundant, Common, Frequent, Occasional, Rare
SBM	Synthetic-based Mud
SCM	Subsea Control Module
SCOS	Special Committee on Seals
SDU	Subsea Distribution Unit
SEA	Strategic Environmental Assessment
SEPA	Scottish Environment Protection Agency
SFF	Scottish Fishermen's Federation
SkoFlo	Trade name for pressure independent injection system
SMRU	Sea Mammal Research Unit
SOPEP	Shipboard Oil Pollution Emergency Plan
SOSI	Seabird Oil Sensitivity Index
SPAs	Special Protection Areas
SSIV	Subsea Isolation Valve
SSS	Side Scan Sonar
SUT	Subsea Umbilical Termination
TBT	Tributyl Tin
Te	Tonnes

Abbreviation	Meaning
THC	Total Hydrocarbon Content
TOC	Total Organic Carbon
TUTU	Topside Umbilical Termination Unit
UKBAP	United Kingdom Biodiversity Action Plan
UKCS	United Kingdom Continental Shelf
UKHO	UK Hydrographic Office
UKOOA	UK Offshore Operators Association
UNESCO	The United Nations Educational, Scientific and Cultural Organisation
WBM	Water-based Mud
WHPS	Wellhead Protection Structure

Tables

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1 EXECUTIVE SUMMARY

1.1 Introduction and Background

This Environmental Appraisal (EA) has been conducted to assess the potential environmental impacts that may result from undertaking the activities required to execute the decommissioning of the Cladhan, Hudson, Kestrel and Falcon fields (Tern Area) pipelines and subsea infrastructure. The purpose of the EA is to understand and communicate the potential significant environmental impacts associated with the proposed decommissioning activities.

The Tern Area infrastructure lies in Northern North Sea (NNS) United Kingdom Continental Shelf (UKCS) Blocks 210/24, 210/25, 210/29, 210/30, 211/16 and 211/21 in a water depth of between approximately 148 and 170 m with a trend of water depth increasing slightly to the north. The Tern platform (which represents a central location for the infrastructure) is located approximately 104 km northeast of Unst in Shetland and 47 km west of the UK/Norway median line. The Tern Area fields produced to the Tern platform, from which oil was exported to the North Cormorant platform via a 16-inch subsea pipeline and then via the Brent Oil Pipeline System to Sullom Voe terminal on the Shetland Islands.

The Tern field started production in 1989, Hudson in 1993, Kestrel in 1997, Falcon in 2000 and Cladhan in 2015. A Cessation of Production (CoP) application was submitted in Q4 2019 and accepted by the Oil and Gas Authority (OGA, now the North Sea Transition Authority [NSTA]) in November 2020 with a CoP anticipated to be in Q4 2023 at the time. Production from the Tern Platform and associated subsea facilities ceased in Q1 2024.

The facilities included in the Tern Area subsea decommissioning campaign and therefore the scope of this EA, are listed below.

1.1.1 Cladhan:

- Cladhan manifold;
- Cladhan Subsea Isolation Valve (SSIV);
- Three Wells;
- Production pipeline, gas lift pipeline, water injection pipeline and control umbilical connecting the Cladhan manifold and the Tern platform; and
- Pipelines and umbilicals connecting the wells to the Cladhan manifold.

1.1.2 Kestrel and Falcon:

- Kestrel SSIV;
- Kestrel Subsea Distribution Unit (SDU);
- Kestrel SkoFlo Skid, at Well P1;
- Kestrel SkoFlo Skid, at Well P2;
- Nine Sentry Bollards with Piles;
- Three Kestrel Wells;
- One Falcon Well;
- Production pipeline, gas lift pipeline and control umbilical connecting the Tern Platform to the Kestrel wells;

- Production pipeline, gas lift pipeline and control umbilical connecting the daisy chained falcon well (210/25a-10z) back to the Kestrel field; and
- Pipelines connecting the Kestrel well locations to the manifold.

1.1.3 Hudson:

- Hudson manifold structure;
- Nine Wells;
- Crossover Skid;
- Field Signature Model (FSM) structure;
- Production pipelines gas lift (PL1022), water injection (PL1021/A, PL1021 (disused)) and control umbilical (PL1023) connecting the Hudson manifold to the Tern Alpha platform;
- Production pipeline, gas lift pipeline, water injection pipeline and control umbilical connecting the W2 well locations to the Hudson manifold; and
- Pipelines and umbilicals connecting the well locations to the Hudson manifold.

1.1.4 Stabilisation Materials Throughout the Tern Area:

- Concrete mattresses;
- Grouted supports;
- Grout bags; and
- Rock cover.

1.2 Regulatory Context

The decommissioning of offshore oil and gas infrastructure in the UKCS is principally governed by the Petroleum Act 1998, as amended by the Energy Act 2008, which sets out the requirements for a formal Decommissioning Programme (DP) and the approval process. The Offshore Petroleum Regulator for Environment and Decommissioning (OPRED) which sits within the Department for Energy Security and Net Zero (DESNZ) published Guidance Notes on Decommissioning of Offshore Oil and Gas Installations and Pipelines under the Petroleum Act 1998 (BEIS 2018). This Guidance describes a proportionate process that culminates in a streamlined EA Report to support the DP, which focuses on scoping out of non-significant impacts and presents a detailed assessment of potentially significant impacts.

The Guidance Notes (BEIS, 2018) also state that subsea installations (e.g. drilling templates, wellheads, and risers) must, where practicable, be completely removed for reuse or recycling or final disposal on land. With regards to pipelines (including flowlines and umbilicals), the Guidance Notes (BEIS, 2018) require that these should be considered on a case-by-case basis and highlights instances where pipelines could be decommissioned *in situ*. For example, pipelines that are adequately buried or trenched or which are expected to self-bury could be considered as candidates for *in situ* decommissioning. Where an Operator is considering decommissioning pipelines *in situ*, the decision-making process must be informed by a Comparative Assessment (CA) of the feasible decommissioning options. Finally, the Guidance Notes (BEIS 2018) state that mattresses and grout bags installed to protect pipelines should be removed for disposal onshore if their condition allows.

1.3 Proposed Schedule

The precise timing of the decommissioning activities is not yet confirmed and will be subject to market availability of decommissioning services and contractual agreements. The potential window for Tern Area subsea infrastructure decommissioning activities is between 2024 – 2034.

1.4 Options for Decommissioning

TAQA used a CA process in line with the recommendations in relevant Guidance (BEIS, 2018) to determine the preferred decommissioning options for the Tern Area subsea infrastructure. Each decommissioning option was assessed against five criteria – safety, environment, technical, societal, and economic. The CA outlined the decommissioning options available for the various types of pipelines. Recommended options for pipelines include:

- De-burial via Mass Flow Excavation (MFE) where required for buried pipelines;
- Full removal of surface laid umbilicals, jumpers, and spools by cut and lift techniques or reverse installation;
- Full removal of spools by cut and lift removal techniques;
- Removal of flexible flowline and umbilical ends/lines to be decommissioned *in situ* with ends remediated with rock cover; and
- Removal and/or remediation of midline free-spans and exposures for buried/rigid pipelines to be decommissioned *in situ*. Removal of pipeline ends and remediation with rock cover.

Stabilisation materials (including mattresses, grout bags and grouted supports) will be removed from the seabed. Where difficulties arise, TAQA will discuss and agree with OPRED alternative decommissioning solutions.

1.5 Environmental and Socio-Economic Baseline

The key environmental and social sensitivities in the Tern Area are summarised in Table 1-1.

Table 1-1 Key Environmental and Social Sensitivities for the Tern Area

Physical characteristics
The overall water depth ranges from 148 – 170 m below Lowest Astronomical Tide (mLAT) across the Tern Area. Most of the fields in the Tern Area have similar or overlapping depth ranges, although there is a trend of water depth increasing slightly to the north. In the south of the Tern Area, the mean wave height ranges from 2.11 - 2.40 m whilst in the north it ranges from 2.41 - 3.30 m and wave energy is classified as 'low'. The direction of residual water movement in this area is generally to the south or east and the mean residual current through the Tern Area is approximately 0.05 to 0.1 m/s. The physical seabed characteristics recorded from survey work show a high degree of uniformity across the Tern Area. Sediments across the Tern Area are mostly sandy, with fine sand reported at Kestrel and Falcon, fine-silty sand at Cladhan, muddy sand at Hudson and very fine sand at Tern. Under the European Nature Information System (EUNIS) habitat classification, the predicted broad-scale seabed type around most of the Tern area is A5.27 "deep circalittoral sand" which represents offshore (deep) circalittoral habitats with fine sands or non-cohesive muddy sands. This habitat type falls within the broad habitat Priority Marine Feature (PMF) "offshore sands and gravels". In addition, localised areas of EUNIS habitat complex A5.45 "Deep circalittoral mixed sediment", A5.37 "Offshore circalittoral mud" and A5.35 "Circalittoral sandy mud" are predicted to occur. Numerous pockmarks have been identified across the Tern Area, particularly around the Tern platform and the Hudson manifold. The largest pockmark observed measured 13 m in diameter. The Cladhan, Kestrel and Falcon wells were drilled with water-based muds (WBM) and thus any associated cuttings accumulations would not be expected to pose a potential for significant environmental

effects (IOGP, 2016; Bakke *et al*, 2013). However, cuttings piles have been identified at the Tern platform, the Hudson manifold and the Hudson satellite wells. The Tern cuttings pile has a pile volume of 13,470 m^3 which would be categorised as a medium cuttings pile (5,000-20,000 m^3). The Hudson manifold cuttings pile has a pile volume of 6,819 m^3 which would also be categorised as a medium cuttings pile. The extent of the cuttings pile at the Hudson satellite wells has a volume of 1,156 m^3 which would be categorised as a small cuttings pile (<5,000 m^3).

Sediment chemical composition

Hydrocarbon concentrations within the wider area surrounding the Tern Area infrastructure are generally within expected background levels for the northern North Sea but increase with proximity to infrastructure. However, at several stations within 500 m of the Tern platform and the Hudson manifold there was evidence of drilling related hydrocarbon contamination (exceeding the UK Offshore Operators Association (UKOOA) 95th percentile for the NNS) in the form of barium.

Surveys were undertaken of the Tern and Hudson cuttings piles to determine their chemical composition. A gradient of Total Hydrocarbon Content (THC) levels decreased with distance from both locations, suggesting a point source of hydrocarbons most likely related to drilling discharges, with all THC levels sampled exceeding the Oslo Paris Convention (OSPAR) ‘ecological effect’ threshold in the Tern cuttings pile and some samples exceeding this threshold in the Hudson cuttings piles. The sediment leachate analysis results indicated that both the oil loss to the water column and the persistence of the Tern cuttings pile fell below the relevant OSPAR threshold values and could generally be ascribed as typical for cuttings piles at North Sea installations.

Seabed habitats and species

In broad terms, the infauna present as characterised by the most abundant species present, appears very similar in all surveys undertaken in the Tern Area. Species consistently appearing in the lists of most abundant taxa centre around polychaetes and the bivalve molluscs.

The epifauna present in all areas is generally noted as sparse (in direct contrast to the infauna) and typically features mobile species that have wide distributions throughout the North Sea. These include, for example, hermit crabs, various starfish and sea urchins.

Fish and shellfish

The Tern Area represents low intensity or undetermined intensity spawning ground for saithe, Norway pout, whiting and haddock. Cod is the only species with a high intensity spawning in the Kestrel field.

The Tern Area is a potential nursery ground for anglerfish, blue whiting, European hake, haddock, herring, ling, mackerel, spurdog, whiting and Norway pout. Blue whiting is the only species with a high intensity nursery ground in the Tern Area while other species have a lower nursery intensity.

Seabirds

In the NNS, the most numerous species present are likely to be northern fulmar, black-legged kittiwake and common guillemot.

The Tern Area is located within or in the vicinity of a wider area of aggregation (or hotspots) for northern fulmar, northern gannet, European storm petrel, Arctic skua, great skua, black-legged kittiwake, herring gull, Arctic tern, guillemot, razorbill and Atlantic puffin during their breeding season.

Seabird sensitivity to oil pollution in the Tern Area is considered low throughout most of the year, with the exception of December and January when sensitivity is expected to be extremely high across most of the Tern Area.

Marine mammals

Harbour porpoise, Atlantic white-sided dolphin, minke whale and beaked whale are the most abundant species recorded in the Tern Area. The harbour porpoise is by far the most frequently recorded cetacean in the Tern Area, which is reflective of these being the most abundant and widely distributed cetaceans in the North Sea.

Both grey and harbour seal densities are known to be low in the Tern Area and densities are predicted to be between 0 and 0.001% of the British Isles at-sea population per 25 km^2 for both species.

Conservation

There are no Nature Conservation Marine Protected Areas (NCMPAs), Special Areas of Conservation (SAC) or Special Protection areas (SPAs) within 40 km of the Tern Area. The closest protected site is the Pobie Bank Reef SAC, approximately 72 km west of the Tern platform.

The seabed in the Tern Area is located within a wider area of 'subtidal sand and gravels', a seabed type designated as a PMF in Scottish waters, which supports fish populations.

With regards to free-swimming fish species, ling, which are a PMF, were observed within the Falcon field in 2009 and during the recent surveys of the Hudson field in 2022. Amongst other species observed during the Hudson survey were cod and saithe, which are both PMF species. Additionally, cod is an OSPAR listed threatened and/or declining species. Other species were present but were less frequently observed such as anglerfish which are also a PMF.

Numerous pockmarks which may be classified as ‘Submarine structures made by leaking gases’ (Annex I Habitat) were identified across the Tern Area, particularly around the Tern platform and the Hudson manifold. The largest pockmark observed measured 13 m in diameter. The lack of Methane-Derived Authigenic Carbonate (MDAC) present in pockmarks identified across the Tern Area indicates that Annex I ‘Submarine structures caused by leaking gases’ are not present.

Ocean quahog is listed on the OSPAR list of threatened and/or declining species and habitats and this species is designated as a PMF. Individuals were identified at Tern and Hudson but not in aggregations.

The habitat 'Seapen and burrowing megafauna communities' is also on the OSPAR list of threatened and/or declining habitats and species and is a PMF. Surveys identified evidence of this habitat at Tern and Hudson, but macrofauna burrows were not at a density high enough to be classified as an OSPAR habitat.

Fisheries and shipping

The Tern Area is located in International Council for the Exploration of the Sea (ICES) rectangles 51F0 and 51F1. This region is primarily targeted for demersal species, however, pelagic fish have also been targeted more recently with a negligible contribution from shell fisheries. Fishing effort is dominated by trawl fishing gears. Annual fishery landings by weight and value are considered low to moderate for demersal and pelagic fisheries in comparison to other areas of the North Sea.

Shipping density in the Tern Area is very low or low, with a localised increase in vessel activity around surface installations including the Tern platform, due to the presence of operational and maintenance vessels.

Other sea users

The proposed decommissioning operations will be located in a well-developed area for oil and gas extraction. The closest piece of surface infrastructure is the North Cormorant platform, 13 km southeast of the Tern platform.

There are no other cables or pipelines in the vicinity, no designated military practice and exercise areas, no offshore renewable or wind farm activity and no designated or protected wrecks nearby.

1.6 Impact Assessment Process

The environmental impact assessment has been informed by several different processes, including identification of potential environmental issues through project engineer and marine environmental specialist reviews during a desktop scoping exercise, and consultation with key stakeholders (Marine Directorate, Joint Nature Conservation Committee (JNCC) and Scottish Fishermen's Federation (SFF)).

An impact assessment exercise addressed the proposed decommissioning activities (Section 3.5) and any potential impacts these may pose. This discussion identified nine potential impact areas based on the chosen proposed removal method. Seven potential impacts were screened out of further assessment based on the low level of severity, or likelihood of significant impact occurring and two were carried forward for further assessment. An overview of the nine potential impacts is provided in Table 1-2, together with a rationale for the scoping decisions and proposed mitigation measures.

Based on the initial scoping, two aspects warrant further assessment within the EA as having potential environmental and/or socioeconomic impacts. These are disturbance to the seabed and the physical presence of infrastructure decommissioned *in situ* in relation to other sea users. These two aspects are assessed further in Sections 6.3 and 6.4 of this EA respectively.

Table 1-2 Environmental Impact Scoping Summary for the Tern Area Subsea Infrastructure Decommissioning

Impact Area	Further Assessment?	Reasoning	Proposed Mitigation and Best Practice
Emissions to air	No	• Emissions generated by decommissioning activities are small relative to life-time production. • Estimated carbon dioxide (CO_2) emissions generated by the selected decommissioning options are 87,269 Tonnes (Te), equating to approx. 0.42% of total UKCS emissions in 2023. • Most of these emissions are related to operation of vessels offshore (50,956 Te CO_2). Scoping discussions concluded that decommissioning emissions are inevitable but direct project emissions are considered to be of a minor magnitude and ultimately of low consequence. TAQA do however acknowledge the potential contribution of GHG emissions to climate change, and are dedicated to minimising emissions from decommissioning operations, in line with Net Zero targets, regulatory attainment targets and as far as is reasonable for each project. TAQA is committed to working with the supply chain and joint ventures as part of meeting these commitments.	• Vessel management. • Minimal vessel use/movement. • Vessel sharing where possible. • Engine maintenance.

Impact Area	Further Assessment?	Reasoning	Proposed Mitigation and Best Practice
Disturbance to the seabed	Yes	• Potential for disturbance to seabed during subsea decommissioning activities. • Seabed impacts may range in duration from temporary sediment suspension, cuttings disturbance or smothering to permanent impacts, such as the introduction of new substrate or any consequential habitat or community level changes which may transpire. • Potential disturbance to cuttings piles located at Tern, Hudson manifold and Hudson satellite wells. • Potential impact of long-term discharges from degrading infrastructure on the receiving environment. Impacts to the seabed from project activities are considered to be of a moderate consequence (significant) and are therefore assessed further in Section 6.3. • The clearing of a small quantity of marine growth from subsea infrastructure to enable their safe removal is considered to be of a negligible consequence (not significant) and is therefore not assessed further.	• See Section 6.3.
Discharges to sea	No	• Pipelines will be flushed prior to decommissioning where feasible. Where this is not possible, this will be discussed with OPRED and a mutual solution will be agreed. • Discharges from vessels are typically well-controlled activities. Discharges to sea are considered to be of a negligible consequence (not significant) and are therefore not assessed further.	• MARPOL compliance. • Compliance with Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005 • Compliance with the Offshore Chemical Regulations 2002 (as amended) • Bilge management procedures. • Contractor management procedures.
Physical presence of vessels in relation to other sea users	No	• Limited in duration. • Similar vessels to those currently deployed for oil and gas installation operation and decommissioning activities. • Vessel activity will not occupy 'new' areas.	• Minimal vessel use/movement. • Notifications to Mariners. • Kingfisher notification system.

Impact Area	Further Assessment?	Reasoning	Proposed Mitigation and Best Practice
		• Other sea users will be notified in advance of, and subsequent to, operations. • The decommissioning of the Tern Area subsea infrastructure is estimated to require up to five vessels. • Decom activities will be carried out across the Tern Area using a campaign approach. The vessels will not all be at one location at the same time. The physical presence of vessels in relation to other sea users is considered to be of a negligible consequence (not significant) and is therefore not assessed further.	• Opening up of 500 m safety exclusion zones following close-out.
Physical presence of infrastructure decommissioned *in situ* in relation to other sea users	Yes	Scoping considered the highly unlikely but potentially major consequences on the fishing industry of decommissioning the infrastructure and drill cuttings piles *in situ*. The physical presence of infrastructure decommissioned *in situ* in relation to other sea users (namely commercial fisheries) has been fully assessed in Section 6.4.	• See Section 6.4
Underwater noise emissions	No	• Aside from vessel noise and cutting activities, there will be no other noise generating activities. • Vessel presence and cutting activities will be limited in duration. • The project is not located within an area protected for marine mammals. • With industry-standard mitigation measures and adherence to JNCC guidance, EAs for offshore oil and gas decommissioning projects typically show no injury, or significant disturbance associated with these projects. • The cutting technique is likely to be diamond wire, or possibly abrasive water jet. Recently published DESNZ (2023) guidance states that "Sound radiated from the diamond wire cutting of a conductor or abrasive water jets is not easily discernible above the background noise."	• Vessel management. • Minimal vessel use/movement. • Vessel sharing where possible. • Cutting activities will be minimised and carried out in isolation where possible.

Impact Area	Further Assessment?	Reasoning	Proposed Mitigation and Best Practice
		Underwater noise emissions are considered to be of minor consequence (not significant) and are therefore not assessed further.	
Resource use	No	• Limited raw materials required (largely restricted to fuel use). • Estimated total energy usage for the activities is 1,072,409 Gigajoules (GJ). • 691,196 GJ of this total is associated with offshore operation of vessels and 325,865 GJ with the remanufacture of recyclable materials decommissioned *in situ*. • Material returned to shore as a result of project activities will be managed in line with the waste hierarchy. Resource use is considered to be of a negligible consequence (not significant) and is therefore not assessed further.	• Adherence to the Waste Hierarchy. • Vessel management. • Minimal vessel use/movement. • Vessel sharing where possible. • Engine maintenance.
Onshore impacts/ Waste	No	The waste to be brought to shore, which will be routine in nature, will be managed in line with TAQA's Waste Management Strategy and the Waste Hierarchy, as part of the project's Active Waste Management Plan (AWMP), using approved waste contractors and in liaison with the relevant Regulators. Waste management was considered to be of a minor consequence during scoping discussions due to the highly regulated and routine nature of the activity. On this basis, no further assessment of waste is necessary.	• 'Duty of Care' obligations. • Adherence to Waste Management Strategy. • Active waste tracking including close-out reporting. • Adherence to the Waste Hierarchy. • Selection of suitably authorised site and contractors. • Communication with relevant Regulator(s) - e.g., the Scottish Environment Protection Agency (SEPA). • Environmental Management System (EEMS) tracking. • Close-out reporting. • Contractor management.

Impact Area	Further Assessment?	Reasoning	Proposed Mitigation and Best Practice
Unplanned events	No	• The Tern Area Oil Pollution Emergency Plan (OPEP) (TAQA, 2018a) will be updated to cover the Tern Area decommissioning activities. Any spills from vessels in transit and outside the 500 m zones are covered by a separate Shipboard Oil Pollution Emergency Plan (SOPEP). • Vessel fuel inventories are split between a number of separate fuel tanks, significantly reducing the likelihood of an instantaneous release of a full inventory. • Dropped object procedures are industry-standard and there is only a very remote probability of any interaction with any live infrastructure. The *in situ* decommissioning of some infrastructure will also limit the potential for dropped objects or dislodged materials/objects. Scoping discussions centred around the potential damage to sensitive receptors from an oil or diesel spill and the very low likelihood of an unplanned event, given the established mitigation measures in place. The potential impacts are not anticipated to be significant and therefore do not warrant further assessment.	• OPEP in place for operations. • SOPEP on all vessels. • Navigational warnings in place. • 500 m zones operational until seabed clearance certified. • Spill response procedures. • Contractor management and communication. • Lifting operations management of risk. • PON1 / PON2 submissions. • Careful planning, management, and implementation of activities. • The location of any dropped or dislodged material will be accurately recorded and reported via Hydrographic Office and Kingfisher notification system.

1.7 Environmental Management

The project has limited activity associated with it beyond the main period of decommissioning. The main focus of environmental performance management for the project, is to ensure that the activities that will take place during the limited period of decommissioning happen in a safe, compliant, and acceptable manner without unacceptable environmental consequences following decommissioning. The primary mechanisms by which this will occur is through TAQA's certified Environmental Management System (EMS) and Health, Safety, Security and Environment (HSSE) Policy.

To support this, a project Health, Safety and Environment (HSE) Plan will be developed which outlines how HSE issues will be managed and how the policy will be implemented effectively. The plan will apply to all work carried out, both onshore and offshore. Performance will be measured to satisfy both regulatory requirements, compliance with environmental consents and to identify progress on fulfilment of project objectives and commitments.

TAQA also operates a Waste Management Strategy and will develop an AWMP for the project to identify and describe the types of materials identified as decommissioning waste and to outline the processes and procedures necessary to support the DPs for the Tern Area. The AWMP will detail the measures in place to ensure that the principles of the waste management hierarchy are followed during decommissioning.

TAQA is committed to working towards the government policy of Net Zero in line with the NSTA Stewardship Expectation 11. This commitment includes decommissioning activities and is intended to drive increased energy efficiencies and minimise emissions. TAQA seeks to influence its joint venture partners and suppliers to ensure that everyone is striving to reduce and manage the emissions associated with the Tern Area subsea decommissioning.

In terms of activities in the northern North Sea, the National Marine Plan (NMP) has been adopted by the Scottish Government to help ensure sustainable development of the marine area. This Plan has been developed in line with UK, European Union (EU) and OSPAR legislation, directives and guidance. With regards to decommissioning, the NMP states that 'where re-use of oil and gas infrastructure is not practicable, either as part of oil and gas activity or by other sectors such as carbon capture and storage, decommissioning must take place in line with standard practice, and as allowed by international obligations. As part of the conclusions to this assessment (Section 7), TAQA has given due consideration to the Scottish NMP during project decision making.

1.8 Conclusions

This EA has considered the Scottish NMP, adopted by the Scottish Government to help ensure sustainable development of the marine area. TAQA considers that the proposed decommissioning activities align with its own objectives and the objectives and policies contained in the NMP.

Having reviewed the project activities and taken into consideration: the remote offshore location of the Tern Area; that the activities will have a small area of impact; that the benthos is likely to have a degree of natural resilience to sediment suspension (natural or contaminated); the availability of similar habitats within the context of the wider North Sea, as well as mitigation measures to limit impact, there is not expected to be a significant impact on the seabed environment or any European or nationally designated protected sites in proximity to the Tern Area decommissioning activities.

The Tern Area experiences a low-moderate level of fishing activity. Trawling activity in the area is mostly concentrated along midline sections of the Hudson pipeline where there are minimal exposures. The average depth of burial for the Hudson pipelines ranges from 1.09 m to 1.68 m. A further survey was conducted along the Cladhan pipelines in 2022. In line with previous surveys, there are no mid-line exposures identified for the rigid pipelines, however, the depth of burial could not be confirmed. A program for monitoring pipelines scheduled to be decommissioned *in situ* will be agreed with OPRED. Should any subsequent exposures or spans appear, these shall be appropriately mitigated where necessary. Pipelines scheduled to be decommissioned *in situ* which have existing exposures or free spans along their lengths will be appropriately remediated during decommissioning; no snagging risk should remain to fisheries. The drill cuttings piles to be decommissioned *in situ* fall below the relevant OSPAR threshold values for contamination and trawling is not expected to spread contaminants in amounts or at rates that would pose serious wider contamination or toxicological threats to the marine environment. Overall, there is not expected to be an impact on commercial fisheries from buried infrastructure or drill cuttings decommissioned *in situ*.

2 INTRODUCTION

In accordance with the Petroleum Act 1998, TAQA Bratani Limited (TAQA), an established United Kingdom Continental Shelf (UKCS) operator and on behalf of the Section 29 notice holders, is applying to The Offshore Petroleum Regulator for Environment and Decommissioning (OPRED) to obtain approval for decommissioning the subsea infrastructure associated with the area surrounding the Tern platform.

This Environmental Appraisal (EA) has been conducted to assess the potential environmental impacts that may result from undertaking the subsea decommissioning activities as part of the decommissioning of the Cladhan, Hudson, Kestrel and Falcon fields (Tern Area) pipelines and subsea infrastructure (Figure 2-1). These locations have been combined within a single EA due to the close proximity of the infrastructure and similar environmental conditions, allowing for the cumulative impacts to be assessed. This EA supports the combined Decommissioning Programmes (DPs) submitted to OPRED, the offshore decommissioning regulator under the Department for Energy Security and Net Zero (DESNZ). The DPs are submitted under Section 29 of the Petroleum Act 1998, and covers:

1. The Cladhan field subsea installations, pipelines, and umbilicals as a combined DP
2. The Hudson field subsea installations, pipelines, and umbilicals as a combined DP.
3. The Kestrel and Falcon fields subsea installations, pipelines, and umbilicals as a combined DP.

The Tern platform topsides were the subject of a separate DP (TAQA, 2018b) that was issued in November 2020 and subsequently approved by OPRED. The Tern substructure will be addressed by two further DPs covering the Upper Jacket and Footings.

2.1 Project Overview

The Tern Area infrastructure lies in the northern North Sea (NNS) in UKCS Blocks 210/24, 210/25, 210/29, 210/30, 211/16 and 211/21 in a water depth of between approximately 148 and 170 metres below Lowest Astronomical Tide (mLAT) with a trend of water depth increasing to the north. The Tern platform (which represents a central location for the infrastructure) is located approximately 104 km northeast of Unst in Shetland and 47 km west of the UK/Norway median line (Figure 2-2). The Cladhan, Hudson and Kestrel and Falcon fields, before ceasing production in Q1 2024, produced to the Tern platform, from which oil was exported to the North Cormorant platform via a 16-inch subsea pipeline and then via the Brent Oil Pipeline System to Sullom Voe terminal on the Shetland Islands. The history and CoP date for the Tern Area is outlined in Table 2-1.

Table 2-1 Tern Area Production History

Field	Discovered (Year)	Production Started (Year)	CoP Date
Tern	1975	1989	Q1 2024
Hudson	1987	1993	
Kestrel	1997	2001	
Falcon	2000	2011	
Cladhan	2010	2015	

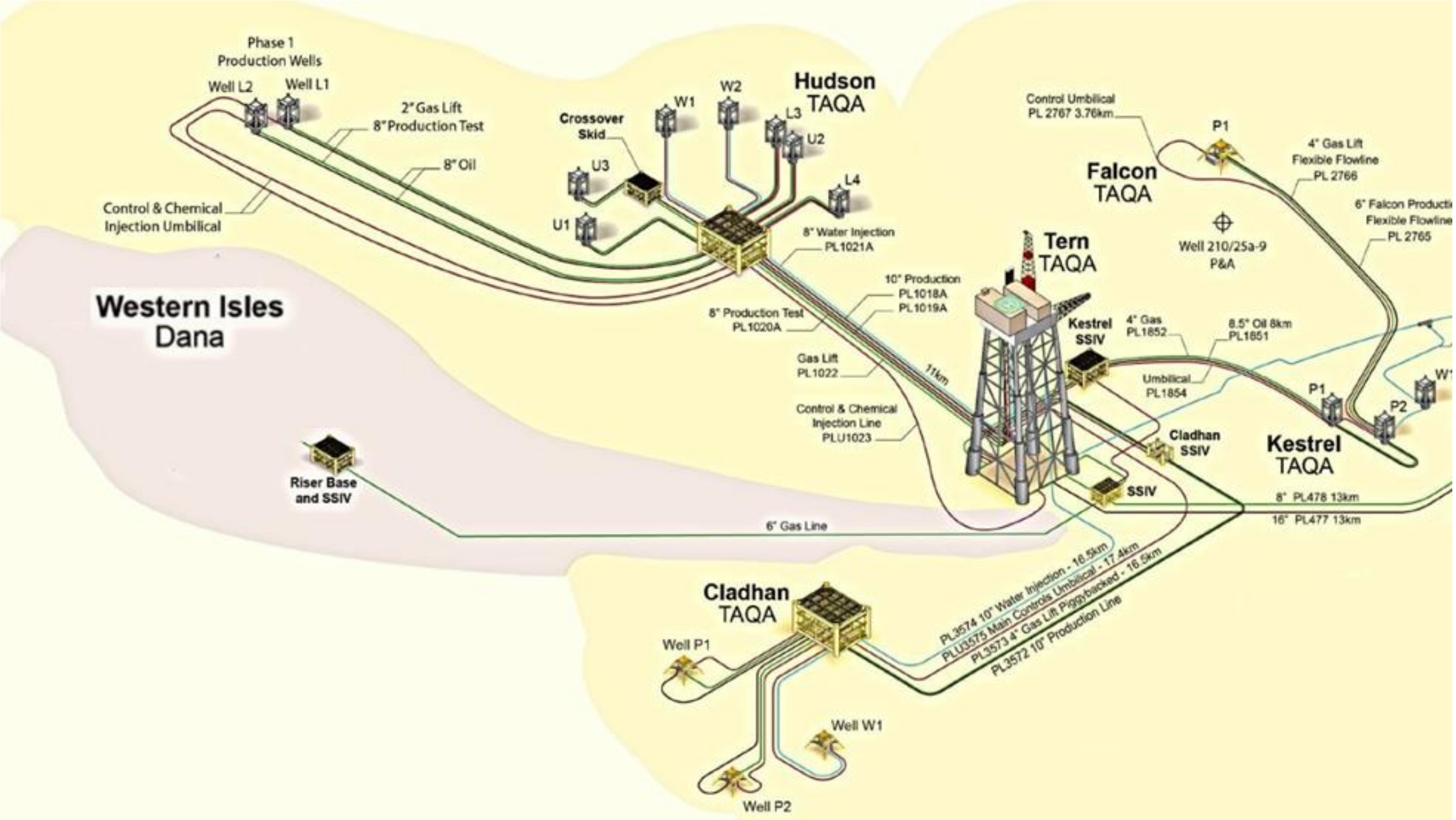


Figure 2-1 The Tern Area Pipelines and Subsea Infrastructure

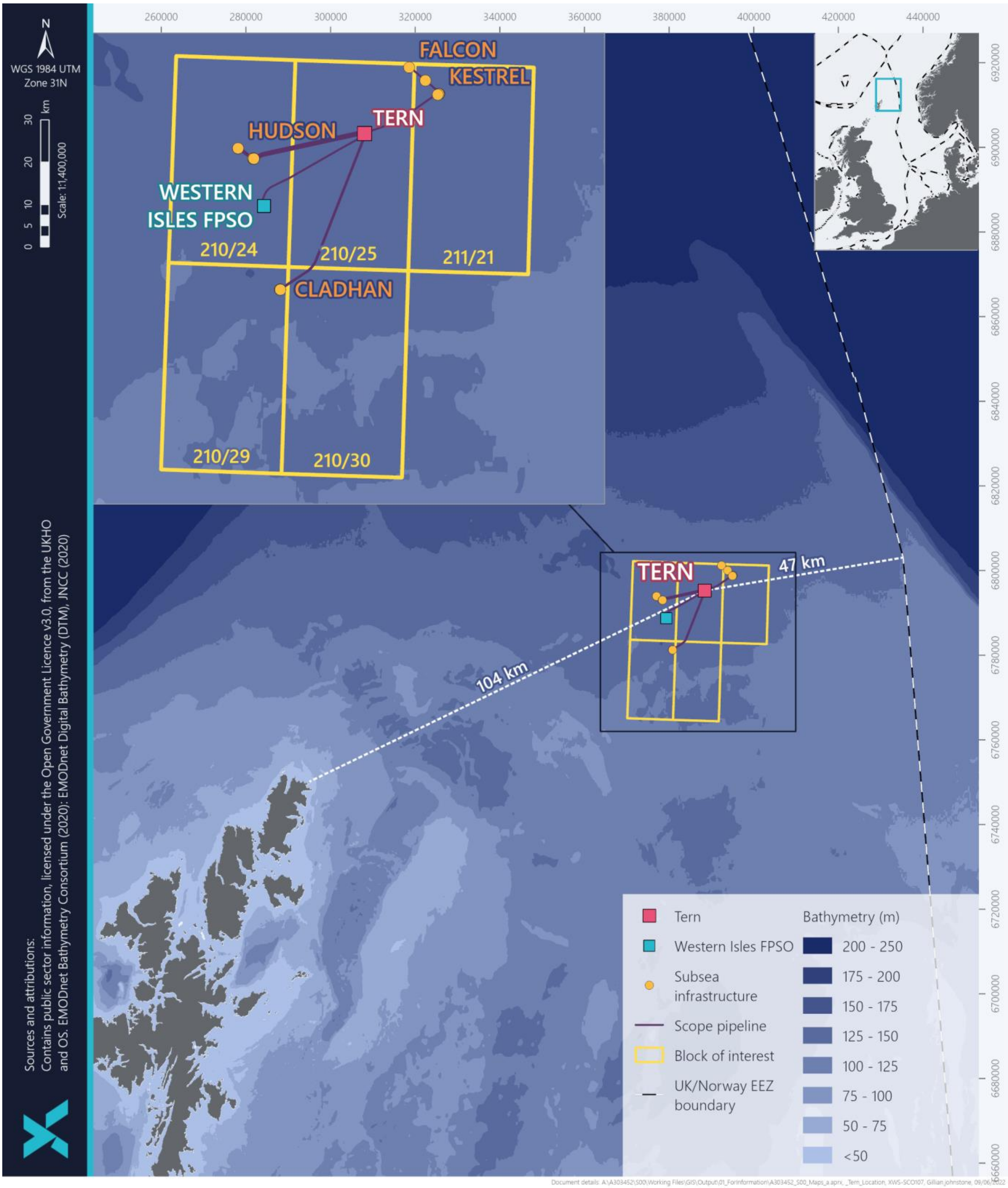


Figure 2-2 Location of the Tern Area Subsea Infrastructure

2.1.1 Purpose of the Environmental Appraisal

This EA assesses the potential environmental impacts associated with the proposed Tern Area subsea decommissioning activities. The impact identification and assessment process accounts for stakeholder engagement, comparison of similar decommissioning projects undertaken in the UKCS, expert judgement, and the results of supporting studies. This EA documents this process and details, in proportionate terms, the extent of any potential impacts and any necessary mitigation/control measures proposed.

2.2 Regulatory Context

2.2.1 Legislation and Guidance

The decommissioning of offshore oil and gas installations and pipelines on the UKCS is controlled through the Petroleum Act 1998 (as amended). Decommissioning is also regulated under the Marine and Coastal Act 2009 and Marine (Scotland) Act 2010. The UK's international obligations on decommissioning are primarily governed by the 1992 Convention for the Protection of the Marine Environment of the Northeast Atlantic (OSPAR Convention). The responsibility for ensuring compliance with the Petroleum Act 1998 rests with OPRED.

The Petroleum Act 1998 (as amended) governs the decommissioning of offshore oil and gas infrastructure, including pipelines, in the UKCS. The Act requires the operator of an offshore installation or pipeline to submit a draft DP for statutory and public consultation, and to obtain approval of the DP from OPRED before initiating decommissioning works. The DP must outline in detail the infrastructure being decommissioned and the method by which the decommissioning will take place.

The latest guidance (BEIS, 2018) states that subsea installations (e.g. drilling templates and wellheads) must, where practicable, be completely removed for reuse, recycling or final disposal on land. Any foundation piles used to secure such installations in place should be cut below natural seabed level at such a depth as to ensure that any remains are unlikely to become uncovered. Should an Operator wish to make an application to decommission a subsea installation *in situ* because of the difficulty of removing it, justification in terms of the environmental, technical or safety reasons would be required. With regards to pipelines (including flowlines and umbilicals), these should be considered on a case-by-case basis. The guidance does provide general advice regarding removal for two categories of pipelines:

- *For small diameter pipelines (including flexible flowlines and umbilicals) which are neither trenched nor buried, the guidance states that they should normally be entirely removed; and*
- *For pipelines covered with rock protection, the guidance states that these are expected to remain in place unless there are special circumstances warranting removal.*

The guidance also highlights instances where pipelines could be decommissioned *in situ*. For example, pipelines that are adequately buried or trenched or which are expected to self-bury could be considered as candidates for *in situ* decommissioning. Where an Operator is considering decommissioning pipelines *in situ*, the decision-making process must be informed by a 'Comparative Assessment' (CA) of the feasible decommissioning options. The CA takes account of safety, environmental, technical, societal, and economic factors to arrive at a preferred decommissioning solution.

Finally, the guidance states that:

"Mattresses and grout bags installed to protect pipelines should be removed for disposal onshore if their condition allows. If the condition of the mattresses or grout bags is such that they cannot be

removed safely or efficiently, any proposal to leave them in place must be supported by an appropriate Comparative Assessment of the options."

The primary guidance for offshore decommissioning from the regulator (BEIS, 2018) details the need for an EA to be submitted in support of the DP(s). The guidance sets out a framework for the required environmental inputs and deliverables throughout the approval process. The OPRED guidance is supported by Decom North Sea's (Decom North Sea, 2017) Environmental Appraisal Guidelines for Offshore Oil and Gas Decommissioning, which provide further definition on the requirements of the EA report.

In terms of activities in the NNS, the Scottish National Marine Plan (NMP) has been adopted by the Scottish Government to help ensure sustainable development of the marine area and will be considered throughout this EA. The NMP has been developed in line with UK, European Union (EU) and OSPAR legislation directives, and guidance. With regards to decommissioning, the Plan states that:

"Where re-use of oil and gas infrastructure is not practicable, either as part of oil and gas activity or by other sectors such as carbon capture and storage, decommissioning must take place in line with standard practice, and as allowed by international obligations. Re-use or removal of decommissioned assets from the seabed will be fully supported where practicable and adhering to relevant regulatory process."

TAQA has given due consideration throughout this EA to the NMP during Project decision making and the interactions between the decommissioning activities and the NMP.

2.3 Scope and Structure of this Environmental Appraisal Report

This EA report sets out to describe, in a proportionate manner, the potential environmental impacts of the proposed activities associated with decommissioning of the Tern Area subsea infrastructure, and to demonstrate the extent to which these can be mitigated and controlled to an acceptable level. This is achieved in the following sections, which cover:

- A description of the proposed decommissioning activities split by DP for clarity (Section 3);
- The process by which TAQA has arrived at the selected decommissioning strategy (Section 3.4);
- A summary of the baseline sensitivities and receptors relevant to the assessment area that support this EA (Section 4);
- A review of the potential impacts from the proposed decommissioning activities and justification for the assessments that support this EA (Section 6);
- Assessment of key issues (Section 6); and
- Conclusions (Section 7).

3 PROJECT SCOPE

For clarity, this section outlines the Tern Area infrastructure by DP as follows:

Section 3.1: Cladhan field infrastructure

Section 3.2: Kestrel and Falcon fields infrastructure and

Section 3.3: Hudson field infrastructure

3.1 Cladhan Field Infrastructure

3.1.1 Decommissioning Campaign

The facilities included in the Cladhan subsea decommissioning campaign and therefore within the scope of this EA, include the infrastructure listed below. Information on the dimensions, weights and status of this infrastructure is included in Table 3-1 to Table 3-5.

Subsea installations (Table 3-1):

- Cladhan manifold
- Cladhan SSIV
- Three Wells (Phase 3 decommissioning)

Pipelines and umbilicals (Table 3-2):

- The production pipeline (PL3572), gas lift pipeline (PL3573), water injection pipeline (PL3574) and control umbilical (PLU3575) connecting the Cladhan manifold and the Tern platform.
- Jumpers and umbilicals connecting the P1, P2 and W1 well locations to the Cladhan manifold (PL3572JWP1, PL3573JWP1, PLU3575JWP1 and PL3572JWP2, PL3573JWP2, PLU3575JPW2 and PLU3574JWP1, PLU3576, PL3577 respectively).

Stabilisation materials:

- Concrete mattresses (Table 3-3)
- Grout bags (Table 3-4)
- Rock cover (Table 3-5)

3.1.2 Well Decommissioning

The Cladhan wells 210/29a-8 (P1), 210/29a-7z (P2) and 210/29a-6z (W1) will be Phase 1 and 2 decommissioned prior to the subsea decommissioning activities described herein. As part of the scope of this EA, the wells will be Phase 3 decommissioned, in accordance with the OEUK well decommissioning guidelines (OEUK, 2022). Well decommissioning activities associated with Cladhan Phase 3 wells decommissioning are included in the Cladhan Subsea Facilities Decommissioning Programme (TAQA, 2024a) and in this EA.

Table 3-1 Cladhan Field Subsea Installations

Item	Number	Size (m) [LxWxH]	Weight (Te)	Location		Comments / Status
Wellheads/ Xmas Trees	3	7.6 x 7.6 x 5.6	71.3	WGS84 Decimal	61.1478 N 00.7853 E	P1 wellhead and over-trawlable Xmas tree. Includes SCM/SAM.
				WGS84 Decimal Minute	61° 08’52.076” 00° 47’07.281”	
		7.6 x 7.6 x 5.6	71.3	WGS84 Decimal	61.1476 N 00.7859 E	P2 wellhead and over-trawlable Xmas tree. Includes SCM/SAM.
				WGS84 Decimal Minute	61° 08’51.194” 00° 47’09.237”	
		7.6 x 7.6 x 5.6	71.3	WGS84 Decimal	61.1476 N 00.7861 E	W1 wellhead and over-trawlable Xmas tree. Includes SCM/SAM.
				WGS84 Decimal Minute	61° 08’51.638” 00° 47’10.074”	
Cladhan Manifold	1	10 x 6.5 x 4	87	WGS84 Decimal	61.1479 N 00.7859 E	The manifold structure includes piping spools and valves and is secured to the seabed by four steel piles. (piles will be cut at -3 m)
				WGS84 Decimal Minute	61° 08’52.592” 00° 47’09.300”	
Cladhan SSIV	1	13 x 6 x 4	75.08	WGS84 Decimal	61.2741 N 00.9193 E	The SSIV structure is located within the Tern platform 500 m zone and is a gravity-based structure.
				WGS84 Decimal Minute	61° 16’26.934” 00° 55’09.547”	

Table 3-2 Cladhan Field Pipelines and Umbilicals

Description	Pipeline No	Diameter	Length (km)	Component Parts	Product Conveyed	From – To	Burial Status	Pipeline Status	Current Content
Production Pipeline	PL3572	10”	16.859	Steel	Hydrocarbons (HCs)	Manifold Tie-In Flange – Tern Platform Production ESDV	Trenched and buried	Out of Use	Seawater
P1 Production Jumper	PL3572J WP1	6”	0.064	Flexible	HCs	Production Well P1 – Manifold Tie-In Flange	Surface Laid	Out of Use	Dyed MEG
P2 Production Jumper	PL3572J WP2	6”	0.077	Flexible	HCs	Production Well P2 – Manifold Tie-In Flange	Surface Laid	Out of Use	Dyed MEG
Gas Lift Pipeline[1]	PL3573	4”	16.866	Steel	Lift Gas	Tern Platform Gas Lift ESDV – Manifold Tie-In Flange	Trenched and buried	Out of Use	Seawater
P1 Gas Lift Jumper	PL3573J WP1	4”	0.038	Flexible	Lift Gas	Manifold Tie-In Flange – Production well P1	Surface Laid	Out of Use	Seawater
P2 Gas Lift Jumper	PL3573J WP2	4”	0.052	Flexible	Lift Gas	Manifold Tie-In Flange – Production well P2	Surface Laid	Out of Use	Seawater
Water Injection Pipeline	PL3574	10”	16.648	Steel	Water	Tern Platform Water Injection Piping – Manifold Tie-In Flange	Trenched and buried	Out of Use	Seawater
W1 Water Injection Jumper	PL3574J WP1	7”	0.048	Flexible	Water	Manifold Tie-In Flange – Water Injection Well W1	Surface Laid	Out of Use	Seawater
EHC Control Umbilical	PLU3575	144 mm	16.844	Umbilical	Chemicals & Power	Tern Platform Cladhan TUTU – Manifold	Trenched and buried	Out of Use	Seawater

Description	Pipeline No	Diameter	Length (km)	Component Parts	Product Conveyed	From – To	Burial Status	Pipeline Status	Current Content
P1 Control Jumper	PLU3575 JWP1	N/A	0.067	Umbilical	Chemicals & Power	Manifold – Production Well P1	Surface Laid	Out of Use	Methanol, Wax Inhibitor; Scale Inhibitor, Demulsifier, Hydraulic fluid
P2 Control Jumper	PLU3575 JPW2	N/A	0.082	Umbilical	Chemicals & Power	Manifold – Production Well P2	Surface Laid	Out of Use	Methanol, Wax Inhibitor; Scale Inhibitor, Demulsifier, Hydraulic fluid
W1 Control Jumper	PLU3576	N/A	0.079	Flexible	Chemicals & Power	Manifold – Water Injection Well W1	Surface Laid	Out of Use	Hydraulic Fluid
SSIV Control Umbilical	PLU3577	118.1 mm	0.534	Flexible	Electrical, Hydraulic & Chemical	Tern – Cladhan SSIV	Surface Laid, covered with mattresses	Out of Use	Hydraulic Fluid, Methanol

Table 3-3 Cladhan Field Concrete Mattresses

Location	Number	Total Weight (Te)*	Exposed/Buried/Condition
From P1 well to Cladhan Manifold	21	98.7	Exposed on seabed
From P2 well to Cladhan Manifold	18	84.6	
On PL3572/PL3573 from Cladhan Manifold to full trench depth	55	258.5	
On PL3572/PL3573 from Cladhan SSIV to full trench depth	41	192.7	
On PL3572/PL3573/PLU3577 from Cladhan SSIV to full trench depth	6	37.9 (6.3 Te each)	
On PL3572/PL3573/PLU3577/PLU3575 from umbilical crossing to riser touch down point	87	408.9	
On PL3572/PL3573/PLU3577/PLU3575 from umbilical crossing to riser touch down point	38	178.6	
On PL3574	63	296.1	
On PL3574	54	253.8	
On PLU3575 from umbilical crossing to umbilical full trench depth	36	169.2	
On PLU3575 from Cladhan Manifold to umbilical full trench depth	59	277.3	
Total	**478**	**2,256.3**	

* Each mattress weighs approximately 4.7 Te unless otherwise stipulated. Approximate mattresses dimensions are 6 m (L) x 3 m (W) x 0.15 m (H).

Table 3-4 Cladhan Field Grout Bags

Location	Type	Number	Total Weight (Te)**	Exposed/Buried/Condition
From P1 well to Cladhan Manifold	25 kg grout bags	840	21	Exposed on seabed
From P2 well to Cladhan Manifold		840	21	
On PL3572/PL3573 from Cladhan Manifold to full trench depth		480	12	
On PL3572/PL3573 from Cladhan SSIV to full trench depth		560	14	
On PL3572/PL3573/PLU3577/PLU3575 from Cladhan SSIV to riser touch down points		680	17	
On PL3572/PL3573/PLU3577/PLU3575 adjacent to Cladhan SSIV		200	5	
On PL3574		680	17	
On PL3574		720	18	
From W1 well to Cladhan Manifold		600	15	
On PLU3575 from Cladhan Manifold to umbilical full trench depth		520	13	
Total		**6,120**	**153.0**	

** Each grout bag weighs 25 kg.

Table 3-5 Cladhan Field Rock Placement (As-Laid)

Location	Total Weight (Te)	Exposed/Buried/Condition
PL3572/PL3573 between Cladhan and Tern Platform	12,000	Exposed on seabed
PL3574 – between Cladhan and Tern Platform	5,000	
PLU3575 – between Cladhan and Tern Platform	5,000	
Total	**22,000**	

3.2 Kestrel and Falcon Fields Infrastructure

3.2.1 Decommissioning Campaign

The facilities included in the Kestrel and Falcon fields subsea decommissioning campaign and therefore the scope of this EA includes the infrastructure listed below. Information on the dimensions, weight and status of this infrastructure is included in Table 3-6 to Table 3-10.

Subsea installations (Table 3-6):

- Kestrel SSIV
- Kestrel SDU
- Kestrel SkoFlo Skid, at Well P1
- Kestrel SkoFlo Skid, at Well P2
- Nine Sentry Bollards each with a foundation pile
- Three Kestrel wells (Phase 3 decommissioning)
- Falcon (Phase 3 decommissioning)

Pipelines and Umbilicals (Table 3-7):

- The production pipeline PL1851, gas lift pipeline PL1852 and umbilical PLU1854 connect the Tern platform (via the SSIV) to the Kestrel well (211/21a-17z P1). Additionally, the production pipeline PL2765, gas lift pipeline PL2766 and control umbilical PLU2767 connect the daisy-chained Falcon well (210/25a-10z) back to the Kestrel field.
- Jumpers connecting the (211/21a-17z P1), (211/21a-19 P2) and (211/21a-20 W1) well locations within the Kestrel field includes PL1851, PL1852, PLU1854, PLU(J)1854(P1), PLU(J)1854(P2) and PL1317JKEU/W1.

Stabilisation materials:

- Concrete mattresses (Table 3-8)
- Grout bags (Table 3-9)
- Rock cover (Table 3-10)

3.2.2 Well Decommissioning

The Kestrel wells 211/21a-17z (P1), 211/21a-19 (P2), 211/21a-20 (W1) and the Falcon well 210/25a-10z will be Phase 1 and 2 decommissioned prior to the subsea decommissioning activities described herein. As part of the scope of the EA, the wells will be Phase 3 decommissioned, in accordance with the OEUK well decommissioning guidelines (OEUK, 2022). Well decommissioning activities associated with Kestrel and Falcon Phase 3 wells are included in the Kestrel and Falcon Subsea Facilities Decommissioning Programme (TAQA, 2024b) and this EA.

3.2.3 Pipeline Wax Management

Pipelines have been flushed in accordance with best environmental practices and outcomes.

Dissolved wax can be present in crude oil and may be deposited on the internal surfaces of pipelines and other production equipment under certain conditions. Wax will not be present in gas or water injection pipelines, nor in umbilicals that convey chemicals or hydraulic fluid. Wax is composed of long chain molecules containing between 18 and 50 carbon atoms. It may be deposited if the fluid temperature in a pipeline falls below the Wax Appearance Temperature (WAT) but disperses if the fluid temperature is above the Wax Dispersion Temperature (WDT). The presence of water in produced fluids in oil pipelines may reduce the likelihood of wax deposition, as the water tends to increase the temperature of the fluids. This is particularly the case towards CoP at the end of field life when the proportion of water in the fluids increases.

TAQA developed a Wax Management Strategy. This included assessing the Tern area subsea pipelines and umbilicals using the criteria below. These were formulated as questions in a decision tree, to determine whether the presence of wax was “Possible” or “Unlikely”:

- Did the pipeline or umbilical convey crude oil? If not wax will not be present.
- Was the arrival temperature at the downstream end of the pipeline above the WDT at CoP? If yes, then the presence of wax is Unlikely, as any wax that may have been deposited early in field life will have dispersed in later field life.
- Was the arrival temperature of the fluid above the WAT throughout field life? If yes, then the presence of wax is Unlikely, as wax will not have been deposited during field life.
- Was wax inhibitor used as required throughout field life? If yes, then the presence of wax is Unlikely, as the inhibitor will have prevented wax deposition.
- Was an appropriate cleaning pig run through the pipeline after CoP? If yes, then the presence of wax is Unlikely as the pig run will have removed it.
- Was the pipeline multiphase, i.e. did it convey a mixture of oil, gas and water, was it insulated and was there any history of wax in the line? If the answers to these questions were respectively, “yes”, “yes” and “no” then the presence of wax is Unlikely. This is because the presence of water tends to elevate the temperature of the fluids, insulation tends to keep the fluids warm and a history of no wax being present in the line demonstrates that it is very unlikely to be present.

Using these criteria, TAQA concluded that wax is Unlikely to be present in any of the Tern area subsea oil pipelines and will not be present in water injection pipelines, gas pipelines or umbilicals.

In parallel with the development of the Wax Management Strategy TAQA also commissioned a Wax Discharge Environmental Assessment (Xodus, 2024b). This assessed the environmental impact of any wax that may be present in pipelines decommissioned *in situ*, notwithstanding that this eventuality is Unlikely. The following paragraphs provide an overview of any potential environmental impacts should any pipelines decommissioned *in situ* contain any residual wax.

The Xodus (2024b) study considers the following aspects in the instance that pipelines with wax are decommissioned *in situ* with no further treatment:

- The physical, chemical, and ecological properties of wax
- Potential release pathways to the marine environment
- Environmentally sensitive receptors and their potential mechanism of interaction with wax
- Potential environmental impacts from wax dissolving chemical cleaning

Any wax that enters the sedimentary environment from a degrading pipeline could be ingested by benthic organisms that rework the sediment and as a result may bioaccumulate and enter the food chain potentially causing toxicity. However, paraffinic hydrocarbons with carbon numbers greater than 14 show no chronic toxicity (CONCAWE, 2001). Additionally, due to low temperatures (~4˚C) at the seabed, any residual wax in the pipelines will have low mobility and a restricted pathway to reach the seabed. Wax is often classed as a stable chemical since it is unaffected by most common chemical reagents and at seabed conditions, no further chemical activity is envisaged. Microbial activity could, in principle, change the composition of wax over time, although this is not expected due to the limited availability of nitrogen, phosphorus and oxygen required to enable biological activity.

If released from an open pipeline, as wax has a density of less than seawater, it would rise through the water column and not interact with the seabed. Adverse impact is therefore not expected for benthos or demersal fish species.

In the water column, the limited exposure duration and low toxicity result in a negligible environmental hazard and adverse impact is not expected for the water column, pelagic fish species, marine mammals, or plankton. On reaching the sea surface although the temperature is above that at the seabed, it remains below the melting point of wax. Hence wax would remain a hard substance which will not form surface sheens or emulsions. Adverse impact is therefore not expected for seabirds either.

It can therefore be concluded that the potential environmental hazard of discharging any residual wax treatment chemical from pipelines would be greater than the limited hazard presented from leaving the immobile non-toxic wax *in situ*. The environmental impact assessment concludes that the decommissioning *in situ* with no additional intervention approach, proposed by TAQA can be considered Best Available Technique (BAT)/Best Environmental Practice (BEP).

Table 3-6 Kestrel and Falcon Fields Subsea Installations

Item	Number	Size (m) [LxWxH]	Weight (Te)	Location		Comments / Status
Kestrel SSIV	1	8 x 4 x 3	20	WGS84 Decimal	61.3096° N 00.9175° E	Gravity based
				WGS84 Decimal Minute	61° 16' 34.52 " N 00° 55' 03.13 " E	
Kestrel SDU	1	2.52 x 2.02 x 2.2	1	WGS84 Decimal	61.3093° N 01.0401°E	Gravity based
				WGS84 Decimal Minute	61° 18' 33.43 " N 01° 02' 25.91 " E	
Kestrel SkoFlo Skid (Well P1)	1	1.4 x 0.6 x 0.7	0.4	WGS84 Decimal	61.3093° N 01.0403°E	Gravity based
				WGS84 Decimal Minute	61° 18' 33.33 " N 01° 02' 25.39 " E	
Kestrel SkoFlo Skid (Well P2)	1	1.4 x 0.6 x 0.7	0.4	WGS84 Decimal	61.3093° N 01.0404°E	Gravity based
				WGS84 Decimal Minute	61° 18' 33.50 " N 01° 02' 25.33 " E	

Item	Number	Size (m) [LxWxH]	Weight (Te)	Location		Comments / Status
Kestrel P1 Well Xmas Tree	1	4.24 x 3.86 x 3.35	61.24	WGS84 Decimal	61.3091° N 01.0400°E	P1 Weight includes Xmas Tree, Flowbase & Wellhead.
				WGS84 Decimal Minute	61° 18' 32.62 " N 01° 02' 24.17 " E	
Kestrel P2 Well Xmas Tree	1	3.91 x 3.66 x 3.6	59.56	WGS84 Decimal	61.3093° N 01.0404°E	P2 Weight includes Xmas Tree, Flowbase & Wellhead.
				WGS84 Decimal Minute	61° 18' 33.46 " N 01° 02' 25.37 " E	
Kestrel W1 Well Xmas Tree	1	3.91 x 3.66 x 3.6	64.44	WGS84 Decimal	61.3094° N 01.0412°E	W1 Weight includes Xmas Tree, Flowbase & Wellhead.
				WGS84 Decimal Minute	61° 18' 33.85 " N 01° 02' 28.35 " E	
Kestrel Sentry Bollards each with a Foundation Pile	9	4 x 2 x 1.5 18 x 0.76 Ø	338.6 (total)	WGS84 Decimal	61.3092° N 01.0402°E	The bollards and piles are located in a 90 m radius centred at the given location. (Bollards will be removed, and foundation piles will be cut to -3 m).
				WGS84 Decimal Minute	61° 18' 33.05 " N 01° 02' 24.89 " E	
Falcon Xmas Tree and Wellhead	1	5.1 x 5.1 x 4.4	59.05	WGS84 Decimal	61.3301° N 00.9894° E	Weight includes over-trawable Xmas Tree, Subsea Accumulator Module (SAM) & Wellhead (To be cut to -3 m and removed).
				WGS84 Decimal Minute	61° 19' 48.18 " N 00° 59' 21.70 " E	

Table 3-7 Kestrel and Falcon Fields Pipelines and Umbilicals

Description	Pipeline No	Diameter	Length (km)	Component Parts	Product Conveyed	From – To	Burial Status	Pipeline Status	Current Content
Water Injection Jumper	PL1317JKEU-W1	9.473"	0.495	Flexible	Water	Tern to Eider reducing Cross – Kestrel Well KEU-W1	Surface Laid	Out of Use	Seawater
Kestrel Production Flowline	PL1851	12.66"	8.04	Flexible	HCs	Kestrel Well P2 – Tern Kestrel ESDV	Trenched and buried	Out of Use	Seawater
Kestrel Gas Lift Pipeline	PL1852	5.5"	8.04	Flexible	HCs	Tern Platform ESDV – Kestrel Well P2	Trenched and buried	Out of Use	Seawater
Kestrel Umbilical	PLU1854	14.74"	7.99	Umbilical	Chemicals	Tern TUTU – SUT	Trenched and buried	Out of Use	Chemicals
Kestrel Chemical Jumper	PLU1854J P1	5.15"	0.05	Umbilical	Chemicals	SUT – Tree P1	Surface laid	Out of Use	Chemicals
Kestrel Chemical Jumper	PLU1854J P2	5.15"	0.05	Umbilical	Chemicals	SUT – Tree P2	Surface laid	Out of Use	Chemicals
Kestrel Control / Chemical Umbilical	PLU2976	2.913"	0.01	Umbilical	Chemicals / Hydraulic fluid	Kestrel BUTA3 – Kestrel SDU	Surface laid	Out of Use	Chemicals / Hydraulic Fluid
Kestrel Control / Chemical Umbilical	PLU2977J P1	2.913"	0.08	Umbilical	Chemicals / Hydraulic fluid	Kestrel SDU – Kestrel Well P1	Surface laid	Out of Use	Chemicals / Hydraulic Fluid
Kestrel Control / Chemical Umbilical	PLU2977J P2	2.913"	0.01	Umbilical	Chemicals / Hydraulic fluid	Kestrel SDU – Kestrel Well P2	Surface laid	Out of Use	Chemicals / Hydraulic Fluid
Kestrel Control / Chemical Umbilical	PLU2978J W1	2.913"	0.06	Umbilical	Chemicals / Hydraulic fluid	Kestrel SDU – Kestrel Well W1	Surface laid	Out of Use	Chemicals / Hydraulic Fluid

Description	Pipeline No	Diameter	Length (km)	Component Parts	Product Conveyed	From – To	Burial Status	Pipeline Status	Current Content
Kestrel Control / Chemical Umbilical	PLU2979	2.913”	0.01	Umbilical	Chemicals / Hydraulic fluid	Kestrel SDU – Kestrel BUTA5	Surface laid	Out of Use	Chemicals / Hydraulic Fluid
Kestrel Control umbilical	PLU6295	2.913	0.052	Umbilical	Chemicals	Adjacent to Well P2 - Adjacent to Well W1	Surface laid	Out of Use	MEG/Water
Falcon Production Pipeline	PL2765	6”	3.801	Flexible	HCs	Falcon Well – Kestrel P2 Well	Trenched and rock covered	Out of Use	Seawater
Falcon Gas Lift Pipeline	PL2766	4”	3.812	Flexible	HCs	Kestrel P2 Well - Falcon Well	Trenched and rock covered	Out of Use	Seawater
Falcon Electro-Hydraulic Control (EHC) Umbilical	PLU2767	3.641”	3.851	Umbilical	Chemicals / Hydraulic fluid	Kestrel P2 Well - Falcon Well	Trenched and rock covered	Out of Use	Chemicals / Hydraulic Fluid

Table 3-8 Kestrel and Falcon Fields Concrete Mattresses

Location	Number (dimension)	Total Weight (Te)	Exposed/Buried/Condition
At Tern platform	1 (6 x 3 x 0.3 m)	8.3	Partially buried in sediment
PL1851, trench transition at Kestrel drill centre	3 (6 x 3 x 0.3 m)	25.0	
At Tern platform	27 (6 x 3 x 0.15 m)	127.3	
Kestrel drill centre and water injection jumper	128 (6 x 3 x 0.15 m)	603.7	
Falcon PL2765, PL2766, PLU2767 tie-in and crossing locations	16 (6 x 3 x 0.3 m)	132.8	Partially buried in sediment
Falcon PL2765, PL2766, PLU2767	322 (6 x 3 x 0.15 m)	1,518.2	
PL2765, PL2766 at Falcon well	2 (6 x 3 x 0.15 m)	3.9	
Total	**499***	**2,419.2**	

* Kestrel Mattresses: Total number = 159. Total weight = 764.3 Te; Falcon Mattresses: Total number = 340. Total weight = c. 1,655.0 Te

Table 3-9 Kestrel and Falcon Fields Grout Bags

Location	Type	Number	Weight (Te)*	Exposed/Buried/Condition
Kestrel drill centre	Grout Bags	330	8.3	Partially buried in sediment
Falcon, PL2765, PL2766, PLU2767 (various locations)		5,540	138.5	Partially buried in sediment
	Total	**5,870**	**146.8**	

*Each grout bag weighs 25 kg.

Table 3-10 Kestrel and Falcon Fields Rock Placement

Location	Weight (Te)	Exposed/Buried/Condition
PL2765 (various locations)	Estimated 51,388	Partially buried within trench
Total	**51,388****	

**Distributed along the length of PL2765 for upheaval buckling and pipeline crossing protection between Falcon well P1 210/25a -10z and Kestrel well P2 211/21a-19.

3.3 Hudson Field Infrastructure

3.3.1 Decommissioning Campaign

The facilities included in the Hudson subsea decommissioning campaign and therefore the scope of this EA, include the infrastructure listed below. Information on the dimensions, weight and status of this infrastructure is included in Table 3-11 to Table 3-15.

Subsea installations (Table 3-11):

- Hudson manifold
- Crossover skid
- Field Signature Model (FSM) structure
- Nine wells (Phase 3 decommissioning)

Pipelines and Umbilicals (Table 3-12):

- The production pipelines (PL1018/A, PL1019/A, PL1020/A, PL1018 (disused), PL1019 (disused), PL1020 (disused)), gas lift (PL1022), water injection (PL1021/A, PL1021 (disused)) and control umbilical (PL1023 and all associated indents) connecting the Hudson manifold to the Tern platform.
- Pipelines, jumpers, and umbilicals connecting the L1, L2, L3, L4, U1, U2, U3 W1 and W2 well locations to the Hudson manifold (PL1024/A, PL1025/A, PL1022.1, PL1022.2, PL1024 (disused), PL1025 (disused).

Stabilisation materials:

- Concrete mattresses (Table 3-13)
- Grout bags and grouted supports (Table 3-14)
- Rock cover (Table 3-15)

3.3.2 Well Decommissioning

The Hudson wells 210/24a-A1 (L1), 210/24a-A2 (L2), 210/24a-B1 (L3), 210/24a-B2 (L4), 210/24a-B6Z (U1), 210/24a-B5Z (U2), 210/24a-B7Z (U3), 210/24a-B4 (W1) and 210/24a-B3 (W2) will be Phase 1 and 2 decommissioned prior to the subsea decommissioning activities described herein. As part of the scope of this EA, the wells will be Phase 3 abandoned, in accordance to the OEUK well decommissioning guidelines (OEUK, 2022). Well decommissioning activities associated with Hudson Phase 3 well decommissioning is included in the Hudson Subsea Facilities Decommissioning Programme (TAQA, 2024c) and this EA.

Table 3-11 Hudson Field Subsea Installations

Item	Number	Size (m) [LxWxH]	Weight (Te)	Location		Comments / Status
Hudson Manifold	1	25 x 13.5 x 7.8	333.9	WGS84 Decimal	61.2523 N 00.7337 E	The Manifold structure is piled. Weight includes piping and piles.
				WGS84 Decimal Minute	61° 15' 08.28 " N 00° 44' 01.59 " E	
Crossover Skid	1	4 x 3.4 x 4.6	37.5	WGS84 Decimal	61.2530 N 00.7352 E	Piled. Weight includes piles.
				WGS84 Decimal Minute	61° 15' 10.75 " N 00° 44' 06.67 " E	
FSM Protection Structure	1	8 x 3.8 x 0.3	5	WGS84 Decimal	61.2560 N 00.7447 E	Gravity based
				WGS84 Decimal Minute	61°15'21.74"N 0°44'40.97"E	
Xmas Trees & Wellheads Note 1	9	3.6 x 3.2 x 3.1	43.68	WGS84 Decimal	61.2603 N 00.7075 E	L1 Weight includes Xmas Tree, flowbase & wellhead.
				WGS84 Decimal Minute	61° 15' 37.15 " N 00° 42' 26.83 " E	
		3.6 x 3.2 x 3.1	43.68	WGS84 Decimal	61.2602 N 00.7075 E	L2 Weight includes Xmas Tree, flowbase & wellhead.
				WGS84 Decimal Minute	61° 15' 36.73 " N 00° 42' 26.38 " E	
		3.7 x 3.7 x 3.1	39.98	WGS84 Decimal	61.2526 N 00.7342 E	L3 Weight includes Xmas Tree, flowbase & wellhead.
				WGS84 Decimal Minute	61° 15' 09.23 " N 00° 44' 03.03 " E	

Item	Number	Size (m) [LxWxH]	Weight (Te)	Location		Comments / Status
		3.7 x 3.7 x 3.1	39.98	WGS84 Decimal	61.2523 N 00.7344 E	L4 Weight includes Xmas Tree, flowbase & wellhead.
				WGS84 Decimal Minute	61° 15' 08.44 " N 00° 44' 03.72 " E	
		3.7 x 3.7 x 3.1	39.98	WGS84 Decimal	61.2531 N 00.7342 E	U1 Weight includes Xmas Tree, flowbase & wellhead.
				WGS84 Decimal Minute	61° 15' 11.09 " N 00° 44' 03.24 " E	
		3.7 x 3.7 x 3.1	39.98	WGS84 Decimal	61.2524 N 00.7332 E	U2 Weight includes Xmas Tree, flowbase & wellhead.
				WGS84 Decimal Minute	61° 15' 08.51 " N 00° 43' 59.20 " E	
		3.7 x 3.7 x 3.1	39.98	WGS84 Decimal	61.2531 N 00.7349 E	U3 Weight includes Xmas Tree, flowbase & wellhead.
				WGS84 Decimal Minute	61° 15' 11.08 " N 00° 44' 05.51 " E	
		3.7 x 3.7 x 3.1	39.98	WGS84 Decimal	61.2533 N 00.7358 E	W1 Weight includes Xmas Tree, flowbase & wellhead.
				WGS84 Decimal Minute	61° 15' 12.00 " N 00° 44' 09.00 " E	
		3.7 x 3.7 x 3.1	39.98	WGS84 Decimal	61.2526 N 00.7339 E	W2 Weight includes Xmas Tree, flowbase & wellhead.
				WGS84 Decimal Minute	61° 15' 09.32 " N 00° 44' 02.07 " E	

Table 3-12 Hudson Field Pipelines and Umbilicals

Description	Pipeline No	Diameter	Length (km)	Component Parts	Product Conveyed	From – To	Burial Status	Pipeline Status	Current Content
Oil Production Flowline	PL1018	10”	10.141	Steel	HCs	Adjacent to Hudson Manifold – Adjacent to Tern Platform	Trenched and buried	Interim Pipeline Regime (IPR)	Seawater
Oil Production Flowline	PL1019	10”	10.142	Steel	HCs	Adjacent to Hudson Manifold – Adjacent to Tern Platform	Trenched and buried	IPR	Seawater
Oil Production/ Test Flowline	PL1020	8”	10.15	Steel	HCs	Adjacent to Hudson Manifold – Adjacent to Tern Platform	Trenched and buried	IPR	Seawater
Water Injection Flowline	PL1021	8”	10.65	Steel	HCs	Tern Platform – Hudson Manifold	Trenched and buried	IPR	Seawater
Water Injection Spool	PL1021.1	6.6”	0.043	Steel	Injection Water	Hudson Manifold – W1 Well	Surface laid	IPR	Seawater
Water Injection Jumper Line	PL1021.2	6.6”	0.029	Steel	Injection Seawater	Hudson Manifold – W2 Well	Surface laid	IPR	Seawater
Water Injection Header bypass	PL1021AJM	11.3”	0.045	Flexible	Injection Water	Hudson Manifold – Hudson Manifold	Surface laid	IPR	Seawater
Gas Lift flowline	PL1022	6”	10.571	Steel	HCs	Tern Platform – Hudson Manifold	Trenched and buried	Out of Use	Seawater
Gas Lift Flowline	PL1022.1	6”	1.764	Steel	HCs	Hudson Manifold – L1 Well	Trenched and buried	Out of Use	Seawater
Gas Lift Flowline	PL1022.2	2.37”	1.762	Steel	HCs	Hudson Manifold – L2 Well	Trenched and buried	Out of Use	Seawater
Gas Lift Jumper Line	PL1022.3	2.37”	0.035	Steel	HCs	Hudson Manifold – L3 Well	Surface laid	Out of Use	Seawater

Description	Pipeline No	Diameter	Length (km)	Component Parts	Product Conveyed	From – To	Burial Status	Pipeline Status	Current Content
Gas Lift Jumper Line	PL1022.4	2.37”	0.025	Steel	HCs	Hudson Manifold – L4 Well	Surface laid	Out of Use	Seawater
Gas Lift Jumper Line	PL1022.5	2.37”	0.035	Steel	HCs	Hudson Manifold – U1 Well	Surface laid	Out of Use	Seawater
Gas Lift Jumper Line	PL1022.6	2.37”	0.025	Steel	HCs	Hudson Manifold – U2 Well	Surface laid	Out of Use	Seawater
Chemical Injection Line	PLU6451 (Previously PL1023.1)	5.8”	12.664	Umbilical	Chemicals	Tern Platform – Well L1	Trenched and buried	Out of Use	Seawater
Chemical Injection Line	PLU6452 (Previously PL1023.2)	5.8”	15.589	Umbilical	Chemicals	Tern Platform – Well L2	Trenched and buried	Out of Use	Seawater
Chemical Injection Line	PLU6453 (Previously PL1023.3)	5.8”	10.807	Umbilical	Chemicals	Tern Platform – Well L3	Trenched and buried	Out of Use	Seawater
Chemical Injection Line	PLU6449 (Previously PL1023.4)	5.8”	10.802	Umbilical	Chemicals	Tern Platform – Well L4	Trenched and buried	Out of Use	Seawater
Chemical Injection Line	PLU6448 (Previously PL1023.5)	5.8”	10.802	Umbilical	Chemicals	Tern Platform – Well U1	Trenched and buried	Out of Use	Seawater
Chemical Injection Line	PLU6447 (Previously PL1023.6)	5.8”	10.802	Umbilical	Chemicals	Tern Platform – Well U2	Trenched and buried	Out of Use	Seawater
Chemical Injection Line	PLU6451 (Previously PL1023.7)	5.8”	12.664	Umbilical	Chemicals	Tern Platform – Well L1	Trenched and buried	Out of Use	Seawater
Chemical Injection Line	PLU6452 (Previously PL1023.8)	5.8”	12.589	Umbilical	Chemicals	Tern Platform – Well L2	Trenched and buried	Out of Use	Seawater
Chemical Injection Line	PLU6453 (Previously PL1023.9)	5.8”	10.807	Umbilical	Chemicals	Tern Platform – Well L3	Trenched and buried	Out of Use	Seawater

Description	Pipeline No	Diameter	Length (km)	Component Parts	Product Conveyed	From – To	Burial Status	Pipeline Status	Current Content
Chemical Injection Line	PLU6449 (Previously PL1023.10)	5.8”	10.802	Umbilical	Chemicals	Tern Platform – Well L4	Trenched and buried	Out of Use	Seawater
Chemical Injection Line	PLU6448 (Previously PL1023.11)	5.8”	10.802	Umbilical	Chemicals	Tern Platform – Well U1	Trenched and buried	Out of Use	Seawater
Chemical Injection Line	PLU6447 (Previously PL1023.12)	5.8”	10.802	Umbilical	Chemicals	Tern Platform – Well U2	Trenched and buried	Out of Use	Seawater
Chemical Injection Line	PLU6451 (Previously PL1023.13)	5.8”	12.664	Umbilical	Chemicals	Tern Platform – Well L1	Trenched and buried	Out of Use	Seawater
Chemical Injection Line	PLU6452 (Previously PL1023.14)	5.8”	12.589	Umbilical	Chemicals	Tern Platform – Well L2	Trenched and buried	Out of Use	Seawater
Chemical Injection Line	PLU6450 (Previously PL1023.15)	5.8”	10.73	Umbilical	Chemicals	Tern Platform – Hudson Manifold	Trenched and buried	Out of Use	Seawater
Chemical Injection Line	PLU6450 (Previously PL1023.16)	5.8”	10.73	Umbilical	Chemicals	Tern Platform – Hudson Manifold	Trenched and buried	Out of Use	Seawater
Chemical Injection Line	PLU6450 (Previously PL1023.17)	5.8”	10.73	Umbilical	Chemicals	Tern Platform – Hudson Manifold	Trenched and buried	Out of Use	Seawater
Chemical Injection Line	PLU6451 (Previously PL1023.18)	5.8”	12.664	Umbilical	Chemicals	Tern Platform – Well L1	Trenched and buried	Out of Use	Seawater
Chemical Injection Line	PLU6452 (Previously PL1023.19)	5.8”	12.589	Umbilical	Chemicals	Tern Platform – Well L2	Trenched and buried	Out of Use	Seawater
Chemical Injection Line	PLU6450 (Previously PL1023.20)	5.8”	10.73	Umbilical	Chemicals	Tern Platform – Hudson Manifold	Trenched and buried	Out of Use	Seawater

Description	Pipeline No	Diameter	Length (km)	Component Parts	Product Conveyed	From – To	Burial Status	Pipeline Status	Current Content
Chemical Injection Line	PLU6450 (Previously PL1023.21)	5.8”	10.73	Umbilical	Chemicals	Tern Platform – Hudson Manifold	Trenched and buried	Out of Use	Seawater
Chemical Injection Line	PLU6450 (Previously PL1023.22)	5.8”	10.73	Umbilical	Chemicals	Tern Platform – Hudson Manifold	Trenched and buried	Out of Use	Seawater
Chemical Injection Line	PLU6450 (Previously PL1023.23)	5.8”	10.724	Umbilical	Chemicals	Tern Platform – Hudson Manifold	Trenched and buried	Out of Use	Seawater
Chemical Injection Line	PLU6450 (Previously PL1023.24)	5.8”	10.724	Umbilical	Chemicals	Tern Platform – Hudson Manifold	Trenched and buried	Out of Use	Seawater
Chemical Injection Line	PLU6450 (Previously PL1023.25)	5.8”	0.001	Umbilical	Chemicals	SUT inlet Hudson Manifold – SUT outlet Hudson Manifold	Surface laid	Out of Use	Seawater
Chemical Injection Line	PLU6451 (Previously PL1023.26)	4.1”	1.941	Umbilical	Chemicals	Hudson Manifold – Well L1	Trenched and buried	Out of Use	Seawater
Chemical Injection Line	PLU6451 (Previously PL1023.26.1)	5.8”	0.006	Umbilical	Chemicals	Hudson Manifold – Hudson Manifold	Surface laid	Out of Use	Seawater
Chemical Injection Line	PLU6451 (Previously PL1023.26.2)	4.1”	0.002	Umbilical	Chemicals	Well L1 – W O Rig connection	Surface laid	Out of Use	Seawater
Chemical Injection Line	PLU6452 (Previously PL1023.27)	4.1”	1.866	Umbilical	Chemicals	Hudson Manifold – L2 Well	Trenched and buried	Out of Use	Seawater
Chemical Injection Line	PLU6452 (Previously PL1023.27.1)	5.8”	0.006	Umbilical	Chemicals	Hudson Manifold – Hudson Manifold	Surface laid	Out of Use	Seawater
Chemical Injection Line	PLU6452 (Previously PL1023.27.2)	4.1”	0.006	Umbilical	Chemicals	Well L2 – W O Rig connection	Surface laid	Out of Use	Seawater

Description	Pipeline No	Diameter	Length (km)	Component Parts	Product Conveyed	From – To	Burial Status	Pipeline Status	Current Content
Chemical Injection Line	PLU6453 (Previously PL1023.28)	3.9”	0.065	Umbilical	Chemicals	Hudson Manifold – L3 Well	Surface laid	Out of Use	Seawater
Chemical Injection Line	PLU6453 (Previously PL1023.28.1)	4.1”	0.002	Umbilical	Chemicals	Well L3 – W O Rig connection	Surface laid	Out of Use	Seawater
Chemical Injection Line	PLU6449 (Previously PL1023.29)	3.9”	0.06	Umbilical	Chemicals	Hudson Manifold – L4 Well	Surface laid	Out of Use	Seawater
Chemical Injection Line	PLU6449 (Previously PL1023.29.1)	4.1”	0.002	Umbilical	Chemicals	Well L4 – W O Rig connection	Surface laid	Out of Use	Seawater
Chemical Injection Line	PLU6448 (Previously PL1023.30)	3.9”	0.08	Umbilical	Chemicals	Hudson Manifold – U1 Well	Surface laid	Out of Use	Seawater
Chemical Injection Line	PLU6448 (Previously PL1023.30.1)	4.1”	0.002	Umbilical	Chemicals	Well U1 – W O Rig connection	Surface laid	Out of Use	Seawater
Chemical Injection Line	PLU6447 (Previously PL1023.31)	3.9”	0.06	Umbilical	Chemicals	Hudson Manifold – U2 Well	Surface laid	Out of Use	Seawater
Chemical Injection Line	PLU6447 (Previously PL1023.31.1)	4.1”	0.002	Umbilical	Chemicals	Well U2 – W O Rig connection	Surface laid	Out of Use	Seawater
Production/ Test Flowline	PL1024	8”	1.640	Steel	HCs	L1 Well – Hudson Manifold	Trenched and buried	IPR	Seawater
Production/ Test Flowline	PL1025	8”	1.639	Steel	HCs	L2 Well – Hudson Manifold	Trenched and buried	IPR	Seawater
Production Jumper	PL1026	6.6”	0.031	Steel	HCs	L3 Well – Hudson Manifold	Surface laid	IPR	Seawater
Production Jumper Line	PL1027	6.6”	0.025	Steel	HCs	L4 Well – Hudson Manifold	Surface laid	Out of Use	Seawater
Production Jumper Line	PL1028	6”	0.035	Steel	HCs	U1 Well – Hudson Manifold	Surface laid	Out of Use	Seawater

Description	Pipeline No	Diameter	Length (km)	Component Parts	Product Conveyed	From – To	Burial Status	Pipeline Status	Current Content
Production Jumper Line	PL1029	6”	0.025	Steel	HCs	U2 Well – Hudson Manifold	Surface laid	Out of Use	Seawater
Production Flowline	PL1018A	10”	10.973	Steel	HCs	Hudson Manifold – Tern Platform Pig Launcher/ Receiver	Trenched and buried	Out of Use	Flushed
Production Flowline	PL1019A	10”	10.656	Steel	HCs	Hudson Manifold – Tern Platform Pig Launcher/ Receiver	Trenched and buried	Out of Use	Flushed
Production Flowline	PL1020A	10”	10.472	Steel	HCs	Hudson Manifold – Tern Platform Pig Launcher/ Receiver	Trenched and buried	Out of Use	Flushed
Water Injection Pipeline	PL1021A	8.63”	10.211	Steel	Produced Water	Tern Platform – Hudson Manifold	Trenched and buried	IPR	Seawater
L1 Jumper	PL1024A	6.63”	1.624	Steel	HCs	L1 Well – Hudson Manifold	Trenched and buried	Out of Use	Inhibited Seawater
L2 Jumper	PL1025A	6.63”	1.787	Steel	HCs	L2 Well – Hudson Manifold	Trenched and buried	Out of Use	Seawater
Production Pipeline	PL1783	6.63”	0.03	Steel	HCs	U3 well – Crossover Skid	Surface laid	Out of Use	Seawater
Gas Lift Pipeline	PL1784	2.37”	0.028	Steel	HCs	Crossover Skid – U3 Well	Surface laid	Out of Use	Seawater
Production Pipeline	PL1785	8.63”	0.03	Steel	HCs	Crossover Skid – Hudson Manifold	Surface laid	Out of Use	Seawater
Production/ Test Pipeline	PL1786	8.63”	0.03	Steel	HCs	Crossover Skid – Hudson Manifold	Surface laid	Out of Use	Seawater
Gas Lift Pipeline	PL1787	6.63”	0.03	Steel	HCs	Hudson Manifold - Crossover Skid	Surface laid	Out of Use	Seawater
Chemical Injection Line	PL1788	0.37”	0.1	Umbilical	Chemicals	Hudson Manifold – U3 Well	Surface laid	Out of Use	Seawater
Chemical Injection Line	PL1789	0.37”	0.1	Umbilical	Chemicals	Hudson Manifold – U3 Well	Surface laid	Out of Use	Seawater

Description	Pipeline No	Diameter	Length (km)	Component Parts	Product Conveyed	From – To	Burial Status	Pipeline Status	Current Content
Chemical Injection Line	PL1790	0.37”	0.1	Umbilical	Chemicals	Hudson Manifold – U3 Well	Surface laid	Out of Use	Seawater
Chemical Injection Line	PL1791	0.37”	0.1	Umbilical	Chemicals	Hudson Manifold – U3 Well	Surface laid	Out of Use	Seawater
Sensor Jumper	PL3090	n/a	0.065	Electrical Cable	Signal	Hudson Manifold – U1 Well	Surface laid	Out of Use	Disconnected - Signal
Sensor Jumper	PL3091	n/a	0.065	Electrical Cable	Signal	Hudson Manifold – U2 Well	Surface laid	Out of Use	Disconnected - Signal
Sensor Jumper	PL3092	n/a	0.065	Electrical Cable	Signal	Hudson Manifold – U3 Well	Surface laid	Out of Use	Disconnected - Signal
Sensor Jumper	PL3093	n/a	0.065	Electrical Cable	Signal	Hudson Manifold – U3 Well	Surface laid	Out of Use	Disconnected - Signal
Production Jumper	PL4339	6.63”	0.041	Steel	HCs	L3 Well – Hudson Manifold	Surface laid	Out of Use	Seawater
Hydraulic Jumper	PL4340	0.6”	0.039	Umbilical	Hydraulic fluid	Hudson Manifold - Crossover Skid	Surface laid	Out of Use	Seawater
Services Umbilical	PLU6238	3.9”	0.07	Umbilical	Chemicals, Water, Power	Hudson Manifold – Well W1	Surface laid	Out of Use	Seawater
Services Umbilical	PLU6239	3.9”	0.07	Umbilical	Chemicals, Water, Power	Hudson Manifold – Well W2	Surface laid	Out of Use	Seawater
MeOH Jumper	PL6240	1.2”	0.02	Umbilical	MeOH	Well L1 to Well L2	Surface laid	Out of Use	Methanol
FSM Cable	PL6246	0.77”	0.506	FSM Cable	Signal	Disconnected adjacent to Tern Platform - PL1018A Insulation Flange	Surface laid	IPR	Disconnected - Signal

Table 3-13 Hudson Field Concrete Mattresses

Location	Number	Total Weight (Te)*	Exposed/Buried/Condition
Hudson Manifold Area	170	651.5	Exposed on seabed
Tern Alpha Area	59	212.4	
L1/L2 Drill Centre	125	366.7	
Total	**354**	**1,230.6**	

*Each mattress weighs approximately 4.7 Te. Approximate mattresses dimensions are 6 m (L) x 3 m (W) x 0.15 m (H)

Table 3-14 Hudson Field Stabilisation

Location	Type	Number	Weight (Te)**	Exposed/Buried/Condition
Hudson Manifold Area	Grout Bags	11,305	282.6	Exposed on seabed
Tern Alpha Area and FSM Cable	Grout Bags	10,734	268.4	
L1/L2 Drill Centre	Grout Bags	2,000	50	
Hudson risers	Grouted supports	6	56.3	
	Total	**24,045**	**657.3**	

**Each grout bag weighs 25kg. Grout Bags: Total number = 24,039. Total weight = 601 Te, Grouted supports: Total number = 6. Total weight = 56.3 Te

Table 3-15 Hudson Field Rock Placement (As-Laid)

Location	Weight (Te)	Exposed/Buried/Condition
PL1018 and PL1019	3,600	Partially covered in sediment
PL1018/A, PL1019/A, PL1020/A, PL1024/A and PL1025/A	12,000	
PL1018 Spot rock dump at 15 locations along whole length of line between manifold and Tern platform	12,822	
PL1019 Spot rock dump at 2 locations relatively close to Hudson Manifold	2,840	
PL1020 Spot rock dump at 9 locations between manifold and Tern platform, all within 60 m of the platform	16,600	
PL1024 Spot rock dump at 6 locations between manifold and well, all within 60 m of the platform	5,366	
Total	**53,228**	

3.4 Comparative Assessment

Under the Petroleum Act 1998 and as described in the Guidance Notes: Decommissioning of Offshore Oil and Gas Installations and Pipelines, (BEIS, 2018), a detailed CA is required to identify the recommended option for decommissioning the Tern Area pipelines which may be decommissioned *in situ*.

3.4.1 CA Overview

The Tern Area infrastructure was assessed as part of the NNS subsea infrastructure CA (Xodus, 2024a). The overall methodology for the CA was as follows:

- Review the inventory of subsea facilities to identify characteristic equipment types (groups) into which the facilities may be classified.
- Carry out CA scoping and evaluation for each group to determine the preferred decommissioning option for that group.
- Finalise selection of options.
- Perform formal write-up detailing the process and outcomes obtained.

The pipeline groups identified during the CA specific to the Tern Area are listed in Table 3-16.

Table 3-16 Tern Area Pipeline Groups Considered

Field(s)/DP	Group Number	Group Description
Cladhan	Group 3	Flexible pipelines and umbilicals (trenched and buried)
	Group 9	Rigid pipelines (trenched and buried)
Kestrel and Falcon	Group 3	Flexible pipelines and umbilicals (trenched and buried)
	Group 4	Flexible pipelines and umbilicals (trenched and rock buried)
Hudson	Group 3	Flexible pipelines and umbilicals (trenched and buried)
	Group 9	Rigid pipelines (trenched and buried)
	Group 16	Blocked Rigid Pipeline (Trenched and Buried)
	Group 17	In-Use Rigid Pipelines (Trenched and Partially Buried)
	Group 18	Low Integrity and Concrete Coated Pipelines (Trenched and Buried)

The NNS subsea infrastructure CA process follows a combined quantitative and qualitative approach where group decommissioning options were scored using a pairwise process with 'Neutral, Stronger, Much Stronger, Very Much Stronger, Weaker, Much Weaker and Very Much Weaker' scores. For each group, the options were classified from most preferred to least preferred irrespective of the number of options for that group. The classification was performed as a balanced consideration of the five CA criteria derived from OPRED (2018) and Offshore Energies UK (OEUK) (2015) Guidance. The criteria and associated sub-criteria are listed in Table 3-17.

Table 3-17 Primary and Sub-Criteria for The CA Process

Primary Criteria (Weighting)	Sub-Criteria
1 – Safety	Operations personnel
	Other users
	High consequence events
	Legacy risk
2 – Environment	Operational marine impact
	Atmospheric emissions & fuel consumption
	Other consumptions
	Seabed disturbance
	Legacy marine impacts
3 – Technical	Technical risk
4 – Societal	Fishing
	Other aspects
5 – Economic	Short-term costs
	Long-term costs

3.4.2 Pipeline Preferred Decommissioning Options

A CA workshop was undertaken to explain the CA process and obtain feedback from stakeholders as part of the overall NNS subsea decommissioning campaign. The acceptability of decommissioning options was discussed and recorded and the most preferred decommissioning option for each segment was identified. An overview of the current burial status for each pipeline and umbilical for the Tern Area are included in Table 3-18, Table 3-19 and Table 3-20 respectively. Depth of burial profiles for each of the pipelines where the preferred option is to decommission *in situ* are provided in Appendix A. An exposure and free span summary is also provided in Appendix B.

Following completion of the CA, further work was undertaken that identified additional remediation may be required on some of the Tern Area pipelines. As such, TAQA propose the following approach to assess the worst-case environmental impact for these pipelines: rock placement to remediate spans, exposures and shallow burial < 20 m long and removal of spans, exposures and shallow burial > 20 m long by cut and lift. See Section 3.5.5 for further explanation.

Table 3-18 Preferred Decommissioning Methods for The Cladhan Pipelines and Umbilicals

<table>
<tr><th>Equipment</th><th>Description</th><th>Decommissioning Options</th></tr>
<tr><td>PL3572 Production Pipeline[1]</td><td>The rigid pipeline runs from the Cladhan manifold to the Tern platform via the Cladhan SSIV. Short lengths adjacent to the Tern platform and the Cladhan manifold are on the surface with the majority of the 10”, 16.859 km production line being trenched and buried with spot rock dump along this line.</td><td rowspan="3">4C: Remove areas of spans/exposure/shallow burial
Pipelines will be disconnected. Removal and recovery of surface laid sections out with existing trench (including transitions). Rock placement to remediate snag risk from cut ends. Removal of areas of span, exposure and shallow burial using cut and lift techniques. Any areas of pipeline which are suitably buried will be decommissioned in situ.[2]</td></tr>
<tr><td>PL3573 Gas Lift Pipeline[1]</td><td>The rigid pipeline runs from the Tern platform to the Cladhan manifold via the Cladhan SSIV. Short lengths adjacent to the Tern platform and the Cladhan manifold are on the surface.
A 4” pipeline is piggybacked to PL3572, 16.866 km long. The pipeline is trenched and backfilled with spot rock cover.</td></tr>
<tr><td>PL3574 Water Injection Pipeline[1]</td><td>The rigid pipeline runs from the Tern platform to the Cladhan manifold. The 10”, 16.648 km pipeline is trenched and back filled with spot rock cover.</td></tr>
<tr><td>PLU3575 Control Umbilical[1]</td><td>The umbilical runs from the Tern platform to the Cladhan manifold and is 16.844 km long. The umbilical is trenched and back-filled with spot rock cover.</td><td>5: Remove ends & remediate snag risk
Pipeline/Umbilicals will be disconnected. Removal by cut and lift of surface laid sections out with existing trench (including transitions). Rock placement to remediate snag risk from cut ends[1].</td></tr>
</table>

Note:

1. TAQA will conduct a pipeline survey along the Cladhan line prior to decommissioning to inform the remediation activities.
2. Limited sections of surface laid pipelines and umbilicals in close proximity to the Tern platform jacket/sub-structure footings may be decommissioned in place, subject to derogation to decommission the footings in place and agreement with OPRED. “Close proximity” is considered within approximately 75 m of the platform footings. Logical break points between portions decommissioned *in situ* and portions removed will be selected, e.g., pipeline crossings, etc. This option represents a reasonable balance between the level of risk associated with removing the facilities, the degree of disturbance of the seabed, the use of resources during decommissioning and following decommissioning, the loss of amenity for other sea users. If derogation to decommission the jacket/sub-structure footings in place is not granted, all surface laid pipelines and umbilicals will be recovered and taken to shore for appropriate re-use, recycling, or disposal.
3. Explanation of codes associated with the decommissioning options are provided in the CA report (Xodus, 2024a).

Table 3-19 Preferred Decommissioning Methods for The Kestrel and Falcon Pipelines and Umbilicals

Equipment	Description	Decommissioning Options
PL1851 Production Flowline	The flexible pipeline runs from the Kestrel P1 well to the Kestrel SSIV. There are short sections of each end of the 8.5" flexible flowline which are on the surface. The remaining pipeline is trenched and buried with areas of exposure and spans.	**5: Remove ends & remediate snag risk** Pipeline/Umbilical will be disconnected. Removal by cut and lift of surface laid sections out with existing trench (including transitions). Rock placement to remediate snag risk from cut ends[1].
PL1852 Gas Lift Pipeline	The flexible pipeline runs from the Kestrel SSIV to the Kestrel P1 well. There are short sections of each end of the 4" flexible flowline which are on the surface. The remaining pipeline is trenched and buried with areas of exposure.	
PLU1854 Umbilical	The umbilical runs from the Tern platform to the Kestrel P1 well. There are short sections at each end of the 8.5" umbilical which are on the surface. The remaining umbilical is trenched and buried with exposures.	
PL2765 Production Flowline	The 6" flexible flowline is trenched and covered with rock and runs from Falcon to the Kestrel P2 well.	
PL2766 Gas Lift Pipeline	The 4" flexible flowline is trenched and covered with rock and runs from the Kestrel well P2 to Falcon.	
PL2767 Umbilical	The umbilical is trenched and covered with rock and runs form the Kestrel well P2 to Falcon	
PL1851 Production Jumper	The 8.5", 58 m flexible production jumper is surface laid and runs from the Kestrel well P2 to the Kestrel well P1.	**Full Removal**
PL1852 Gas Lift Jumper	The 4", 50m flexible jumper is surface laid and runs from the Kestrel well P1 to the Kestrel well P2.	
PLU1854 Umbilical Jumper	The 62 m umbilical is surface laid and runs from the Kestrel well P1 to the Kestrel well P2.	
PL1317JKEU/W1 Water Injection Jumper	The 6", 495 m jumper is surface laid and runs from the mid-line tee to the Kestrel Well W1.	
PLU6295 Umbilical Jumper	The 52 m umbilical is surface laid and runs from the Kestrel well P2 to the Kestrel well P1.	
PLU1854(J) P1 Chemical Injection Jumper	The 15 m jumper is surface laid and runs from the SUT to the Kestrel well P1.	

Equipment	Description	Decommissioning Options
PLU1854(J)P2 Chemical Injection Jumper	The 15 m jumper is surface laid and runs from the SUT to the Kestrel well P2.	

Note:

1. Limited sections of surface laid pipelines and umbilicals in close proximity to the Tern platform jacket/sub-structure footings may be decommissioned in place, subject to derogation to decommission the footings in place and agreement with OPRED. “Close proximity” is considered within approximately 75 m of the platform footings. Logical break points between portions decommissioned *in situ* and portions removed will be selected, e.g., pipeline crossings, etc. This option represents a reasonable balance between the level of risk associated with removing the facilities, the degree of disturbance of the seabed, the use of resources during decommissioning and following decommissioning, the loss of amenity for other sea users. If derogation to decommission the jacket/sub-structure footings in place is not granted, all surface laid pipelines and umbilicals will be recovered and taken to shore for appropriate re-use, recycling, or disposal.
2. Explanation of codes associated with the decommissioning options are provided in the CA report (Xodus, 2024a).

Table 3-20 Preferred Decommissioning Methods for The Hudson Pipelines and Umbilicals

<table>
<tr><th>Equipment</th><th>Description</th><th>Decommissioning Options</th></tr>
<tr><td>PL1018/A Production Pipeline</td><td>The rigid pipeline runs from the Hudson Manifold to the Tern platform.
Short lengths ranging from 214 m to 238 m adjacent to the Tern platform, the Hudson Manifold are on the surface with the majority of the 10” production line being trenched and buried.
The greatest depth of burial has been recorded at 2.9 m and the average depth of burial is calculated to be 1.49 m (Appendix A).</td><td rowspan="2">4C: Remove areas of spans / exposures / shallow burial.
Pipelines will be disconnected. Removal by cut and lift of surface laid sections out with existing trench (including transitions). Any areas of pipeline which are suitably buried will be decommissioned in situ.[1]</td></tr>
<tr><td>PL1019/A Production Pipeline</td><td>The rigid pipeline runs from the Tern platform to the Hudson Manifold.
Short lengths measuring 203 m and 223 m adjacent to the Tern platform and the Hudson Manifold are on the surface with the majority of the 10” production line being trenched and buried.
This pipeline remains trenched and buried over 0.6 m beneath the seabed surface (Appendix A)</td></tr>
</table>

Equipment	Description	Decommissioning Options
PL1020/A Production/Test Pipeline	The rigid pipeline runs from the Tern Platform to the Hudson Manifold. The 8”, 10.13 km pipeline is trenched and buried. Short lengths of 208 m and 207 m adjacent to the Tern platform and the Hudson Manifold are on the surface with the majority of the production/test line being trenched and buried. The greatest depth of burial has been recorded at 2.05 m and the average depth of burial is calculated to be 1.23 m (Appendix A).	
PL1025/A Production/Test Pipeline	The rigid pipeline runs from Well L2 to the Hudson Manifold. The 6”, 1.61 km pipeline is trenched and buried with short lengths at either end on the surface. The greatest depth of burial has been recorded at 2.05 m and the average depth of burial is calculated to be 1.23 m (Appendix A).	
PL1024/A Production/Test Pipeline	The rigid pipeline runs from Well L1 to the Hudson Manifold. The 6”, 1.624 km pipeline is trenched and buried with short lengths at either end on the surface. The greatest depth of burial has been recorded at 2.05 m and the average depth of burial is calculated to be 1.23 m (Appendix A).	**5: Remove ends & remediate snag risk** The 6”, 1.624 km pipeline has been flushed and is open-ended, trenched and buried with short sections at either end on the surface. The pipeline will be removed by cut and lift of surface laid sections out with existing trench (including transitions). Rock placement will remediate snag risk from cut ends.
PL1022 Gas Lift Pipeline	The rigid pipeline runs from the Tern platform to the Hudson Manifold. The 6”, 10.16 km pipeline is trenched and partially buried with multiple spans and exposures along the line. The greatest depth of burial has been recorded at 2.05 m and the average depth of burial is calculated to be 1.23 m (Appendix A).	**3B: Retrench and bury entire line** Pipelines will be disconnected. Re-trench and backfill full length of pipeline to remove areas of spans, exposures and shallow burial depth. No recovery of pipelines, no introduction of new material. [1]
PL1021/A Water Injection Pipeline	The rigid disused pipeline runs from the Tern platform to the Hudson Manifold. The 8”, 10.185 km pipeline trenched and partially buried with spans and exposures along the line. The greatest depth of burial is recorded at 2.43 m (Appendix A).	
PL1022.1 Gas Lift Pipeline	This rigid pipeline runs from the Hudson Manifold to the Well L1. The 2”, 1.64 km pipeline is trenched and buried with short sections at either end on the surface. There are areas of spans, exposure, and shallow burial along the line. The greatest depth of burial is recorded at 2.38 m (Appendix A).	**5: Remove ends & remediate snag risk** Pipeline will be disconnected. Removal by cut and lift of surface laid sections out

Equipment	Description	Decommissioning Options
PL1022.2 Gas Lift Pipeline	The rigid pipeline runs from the Hudson Manifold to the Tern platform. The 2", 1.64 km pipeline is trenched and buried with short sections at either end on the surface. There are areas of exposure and shallow burial along the line. The greatest depth of burial is recorded at 3.38 m (Appendix A).	with existing trench (including transitions). Rock placement to remediate snag risk from cut ends. [1]
PL1018 Production Pipeline (Disused)	The disused rigid pipeline runs from the Hudson Manifold to Tern platform. The 10", 10.41 km pipeline is trenched and buried with short sections at either end on the surface. There are areas of exposure and shallow burial along the line. The greatest depth of burial is recorded at 2.06 m (Appendix A).	
PL1019 Production Pipeline (Disused)	The disused rigid pipeline runs from the Hudson Manifold to the Tern platform. The 10", 10.41 km pipeline is trenched and buried with short sections at either end on the surface. There are areas of exposure and shallow burial along the line. The greatest depth of burial is recorded at 3.17 m (Appendix A).	
PL1020 Production/Test Pipeline (Disused)	The disused rigid pipeline runs from the Hudson Manifold to the Tern platform. The 8", 10.41 km pipeline is trenched and buried with short sections at either end on the surface. There are areas of spans, exposure, and shallow burial along the line. The greatest depth of burial is recorded at 2.23 m (Appendix A).	
PL1021 Water Injection Pipeline (Disused)	The disused rigid pipeline runs from the Tern platform to the Hudson Manifold. The 8", 10.41 km pipeline is trenched and buried with short sections at either end on the surface. There are areas of spans, exposure and shallow burial along the line. The greatest depth of burial is recorded at 1.68 m (Appendix A).	
PL1024 Production/Test Pipeline (Disused)	The disused rigid pipeline runs from Well L1 to the Hudson Manifold. The 8", 1.76 km pipeline is trenched and buried with short sections at either end on the surface. There are areas of spans, exposure and shallow burial along the line. The greatest depth of burial is recorded at 2.20 m (Appendix A).	
PL1025 Production/Test Pipeline (Disused)	The disused rigid pipeline runs from Well L2 to the Hudson Manifold. The 8", 1.76 km pipeline is trenched and buried with short sections at either end on the surface. There are areas of spans, exposure and shallow burial along the line. The greatest depth of burial is recorded at 1.72 m (Appendix A).	

Equipment	Description	Decommissioning Options
PL1023 umbilical is composed of cores PL1023.1 through to PL1023.31, (including sub-cores PL1023.26.1, PL1023.26.2, PL1023.27.1, PL1023.27.2 PL1023.28.1, PL1023.29.1, PL1023.30.1 and PL1023.31.1)	The umbilical runs between Tern platform to the Hudson Manifold, and supports Wells L1, L2, L3, L4, U1, U2 and U3. The line is trenched and buried with short sections at each end on the surface. The greatest depth of burial is recorded at 1.74 m (Appendix A).	**5: Remove ends & remediate snag risk** Pipeline/Umbilicals will be disconnected. Removal by cut and lift of surface laid sections out with existing trench (including transitions). Rock placement to remediate snag risk from cut ends. [1]

Note:

1. Limited sections of surface laid pipelines and umbilicals in close proximity to the Tern platform jacket/sub-structure footings may be decommissioned in place, subject to derogation to decommission the footings in place, and agreement with OPRED. "Close proximity" is considered within approximately 75 m of the platform footings. Logical break points between portions decommissioned *in situ* and portions removed will be selected, e.g., pipeline crossings, etc. This option represents a reasonable balance between the level of risk associated with removing the facilities, the degree of disturbance of the seabed, the use of resources during decommissioning, and, following decommissioning, the loss of amenity for other sea users. If derogation to decommission the jacket/sub-structure footings in place is not granted, all surface laid pipelines and umbilicals will be recovered and taken to shore for appropriate re-use, recycling, or disposal.
2. Explanation of codes associated with the decommissioning options are provided in the CA report (Xodus, 2024a).

3.4.3 Subsea Installations Selected Decommissioning Options

Guidance (BEIS, 2018) states that subsea installations must, where practicable, be completely removed for reuse or recycling or final disposal on land. The guidance requires that any piles used to secure such installations be cut 3 m below natural seabed level. Table 3-21 outlines the selected decommissioning options for the Tern Area subsea installations.

Table 3-21 Decommissioning Options for The Tern Area Subsea Installations

Field(s)/ DP	Equipment	Description	Selected Decommissioning Option
Cladhan	Production Well 210/29a-8 (P1)	Each well includes a wellhead and horizontal Xmas tree.	Phase 3 abandonment with reference to OEUK guidance. Remove Xmas trees, wellheads and top 3 m of each well conductor to shore for reuse, recycling, or appropriate disposal.
	Production Well 210/29a-7z (P2)		
	Water Injection Well 210/29a-6z (W1)		
	Cladhan Manifold	Structure includes various equipment, e.g., piping, valves, distribution unit and control jumpers. The manifold comingles production from the production wells P1 and P2 into the production pipeline PL3572, routes lift gas from gas lift pipeline PL3573 to each of the production wells, routes water injection from the water injection pipeline PL3574 to the water injection well W1 and distributes control, chemicals and power to all three wells. The structure is secured to the seabed by four steel piles.	Remove to shore for reuse, recycling, or appropriate disposal. Cut piles at -3 m below seabed, remove to shore for reuse, recycling, or appropriate disposal.
	Cladhan SSIV	Includes valves with direct control from Tern platform via a control umbilical. The structure is gravity based.	Remove to shore for reuse, recycling, or appropriate disposal.
Kestrel and Falcon	Falcon Production Well 210/25a-10z	Each well includes a wellhead and horizontal Xmas tree.	Phase 3 abandonment in accordance with OEUK guidance. Remove Xmas trees, wellheads and top 3 m of each well conductor to shore for reuse, recycling, or appropriate disposal.
	Kestrel Production Well P1 (211/21a-17z)		
	Kestrel Production Well P2 (211/21a-19)		
	Kestrel Water Injection Well W1 (211/21a-20)		
	Kestrel SSIV	Subsea isolation valve which isolates the production, gas lift and umbilical requirements from the Tern platform to the Kestrel/Falcon fields	Cut piles at -3 m and remove equipment to shore for reuse, recycling, or appropriate disposal.
	Kestrel SDU	Subsea Distribution Unit distributes controls services to each well from the main control umbilical.	

Field(s)/ DP	Equipment	Description	Selected Decommissioning Option
	Nine (9) off sentry piles surrounding the Kestrel Drill Centre	Profiled concrete blocks, secured to the seabed via steel piles, to protect the drill centre from contact from towed fishing gear.	
	Kestrel SkoFlo Skid	SkoFlo Skid at Well P1	Full recovery, Return to shore for reuse or recycling or disposal as appropriate.
	Kestrel SkoFlo Skid	SkoFlo Skid at Well P2	
Hudson	Production Well 210/24a-A1 (L1)	Each well includes a wellhead and horizontal Xmas tree.	Phase 3 abandonment in accordance with OEUK guidance. Remove Xmas trees, wellheads and top 3 m of each well conductor to shore for reuse, recycling, or appropriate disposal.
	Production Well 210/24a-A2 (L2)		
	Production Well 210/24a-B1 (L3)		
	Production Well 210/24a-B2 (L4)		
	Production Well 210/24a-B6Z (U1)		
	Production Well 210/24a-B5Z (U2)		
	Production Well 210/24a-B7Z (U3)		
	Water Injection Well 210/24a-B4 (W1)		
	Water Injection Well 210/24a-B3 (W2)		
	Hudson Manifold	Manifold structure, which includes various equipment, e.g., piping, valves, subsea control module, distribution unit and control jumpers. The manifold comingles production from the production wells L1, L2, L3, L4, U1, U2 and U3 into the production pipelines PL1018/A, PL1019/A and PL1020/A, routes lift gas from gas lift pipeline PL1022 to each of the production wells, routes water injection from the water injection pipeline PL1021/A to the water injection wells W1 and W2 and distributes control, chemicals, and power to the production wells. The structure is secured to the seabed by four steel piles.	Remove to shore for reuse, recycling, or appropriate disposal. Cut piles at -3 m below seabed, remove to shore for reuse, recycling, or appropriate disposal.
	Crossover Skid	Valve skid secured to the seabed via a single steel pile.	
	Hudson FSM structure	Protection structure for FSM.	Return to shore for reuse or recycling or disposal as appropriate.

3.5 Decommissioning Activities

3.5.1 Vessels

The vessel requirements for the decommissioning activities are not yet confirmed and will be subject to market availability, contractual agreements, and alignment with other decommissioning projects. It is anticipated that individual vessel types will be shared across fields for efficiency. Activities include flowline removal, rock placement and post-decommissioning monitoring among others and different vessel types are required for the different activities. The main decommissioning vessels are likely to be Dive Support Vessel (DSV), Construction Support Vessel (CSV), incorporating a back deck reel drive spread as required and Remotely Operated Vehicle Support Vessel (ROVSV). Well decommissioning will take place from a CSV. For the purposes of covering all scenarios, time has also been accounted for a fall-pipe rock placement vessel, where rock remediation is required and survey vessels to support any non-intrusive post-decommissioning survey activities. Currently it is envisaged that all vessels undertaking the decommissioning and removal works will be dynamically positioned vessels and there will be no requirement for anchoring activities.

3.5.2 Subsea Infrastructure Decommissioning

Subsea infrastructure decommissioning will include dredging and cutting activities to remove the items listed in Section 3.1 (Cladhan), Section 3.2 (Kestrel and Falcon) and Section 3.3 (Hudson). Where possible, to facilitate removal of the piled structures, it is the intent to cut each of the foundation piles 3 m below the seabed using an internal cutter to avoid having to carry out substantial seabed excavation at the pile locations. The preference is to make the cuts using abrasive water jet technology and an inert garnet cutting medium. Such jet cutters are routinely used subsea for cutting piles and provide an efficient method with little localised and very short-term noise impacts for the surrounding environment.

At each foundation pile location, the cutting operation will comprise the following steps;

- Removal of the locking pin securing the structure to that pile, to give access to the inside of the pile. This operation is expected to require the use of divers;
- Running an internal clean out tool to remove any soil infill, etc. from within the pile, and then removing the tool;
- Running a jet cutter into the pile to the required cutting depth; and
- Making the pile cut and withdrawing the cutting tool.

Following removal of the subsea structure, the cut off portions of the piles will then be recovered. Deployment of the cleaning and jet cutting tools and recovery of the structure and pile cut-offs will be by means of Remotely Operated Vehicle (ROV) and vessel cranes. It may be necessary to import additional rock cover to mitigate the remaining depressions.

3.5.3 Decommissioning of Pipelines and Umbilicals

There are a couple of options for the removal of the surface laid portions of the rigid and flexible pipelines, umbilicals, spools and jumpers from the seabed including:

- Cut surface laid sections into discrete lengths and recover each section using subsea grab or similar, and
- Cut surface laid sections into discrete lengths and recover multiple sections using subsea basket to vessel.

Surface laid umbilicals will be fully removed by reverse installation, either onto a back deck mounted reel, or carousel, or cut on deck into short sections for storage before return to shore.

The cutting equipment used to cut the rigid pipeline and spools will typically be either a diamond wire saw or hydraulic shears. In terms of environmental impact and the time taken to complete the cutting operation(s), there is little difference between the two methods, especially given the relatively small diameters of the pipelines.

The majority of surface laid umbilicals, flexible spools and jumpers will be fully removed, in line with the OPRED (2018) Guidance and the CA outcomes.

Limited sections of surface laid pipelines and umbilicals in close proximity to the Tern platform jacket/sub-structure footings may be decommissioned in place, subject to derogation and agreement with OPRED. “Close proximity” is considered within approximately 75 m of the platform footings. Logical break points between portions decommissioned *in situ* and portions removed will be selected, e.g., pipeline crossings, etc. This option represents a reasonable balance between the level of risk associated with removing the facilities, the degree of disturbance of the seabed, the use of resources during decommissioning, and following decommissioning, the loss of amenity for other sea users. If derogation to decommission the jacket/sub-structure footings in place is not granted, all surface laid pipelines and umbilicals will be recovered and taken to shore for appropriate re-use, recycling, or disposal.

3.5.4 Removal of Protection Material

Concrete mattresses, grout bags and grouted supports will be removed from the seabed to the vessel unless it is not feasible to do so. If recovery of the stabilisation materials is not possible, TAQA will inform OPRED and agree an alternative approach to decommissioning these items. If protection material is located within the vicinity of the Tern jacket footings, the approach to decommissioning will also be addressed in discussion with OPRED and in line with wider derogation discussions.

The protection material in close proximity to the Tern platform jacket/sub-structure footings may be decommissioned in place, subject to derogation and agreement with OPRED. “Close proximity” is considered within approximately 75 m of the platform footings. Logical break points between portions decommissioned *in situ* and portions removed will be selected, e.g., pipeline crossings, etc. This option represents a reasonable balance between the level of risk associated with removing the facilities, the degree of disturbance of the seabed, the use of resources during decommissioning, and following decommissioning, the loss of amenity for other sea users.

3.5.5 Remediation

Where exposures and free spans have been identified along the length of the pipelines these shall be remediated. Exposures and spans that are less than 20 m will be rock covered. Exposures and spans longer than 20 m long will be cut out, and the cut ends will be rock covered. The 20 m span/exposure breakpoint was determined to balance the degree of disturbance to the seabed, GHG emissions from cutting and lifting spans, and the use of material. For spans less than 20 m, it is more efficient to cover the whole span with rock. Where exposures are less than 20 m long, the full length of the exposure will be covered with rock. The remaining buried sections of the pipelines shall be decommissioned *in situ*. Flexible pipelines/umbilicals will be disconnected and surface laid sections out with existing trench (including transitions) will be removed by cut and lift. There will be rock placement to remediate snag risk from cut ends. There are limited areas of spans/exposures or shallow burial on any of these pipelines. These areas will be the subject of a future surveys and monitoring program.

The approach to remediation will be assessed on a case-by-case basis and rock cover represents a worst-case scenario. Subject to future surveys, additional rock cover required for remediation activities will be covered by relevant environmental permits. Permits will also address associated seabed and emissions impacts (if required).

The factors that will be considered for remediation approach include:

- The length of time required to cut a span/spans and the associated Greenhouse Gases (GHGs);
- The GHGs associated with quarrying, transporting, and placing rock; and
- The amount of rock required to safely remediate a cut end, versus required to remediate a span.
- The GHGs generated by manufacturing new steel to replace steel that might have been recycled had it been recovered in the form of a spool cut out and transported to shore.

Remediation requirements will be confirmed following pre-decommissioning survey.

3.5.5.1 Cladhan Remediation

The Cladhan pipelines will be decommissioned *in situ* in accordance with the CA outcome.

TAQA will conduct pre-decommissioning surveys within the Cladhan Area prior to the commencement of decommissioning programme scope and the latest environmental information will be incorporated in relevant permits. Should any exposures or free spans be identified during pre-decommissioning surveys, these will be appropriately remediated via rock placed by fall pipe vessel or using rock bags. An indicative and highly conservative estimate has been made for the rock cover required to remediate potential mid-line spans and exposures by the time the pre-decommissioning survey is undertaken. This estimate is based on the assumptions and approach detailed in Section 3.5.5 and a contingency for rock cover remediation of 2% of the total Cladhan pipelines length to account for worst-case environmental impacts. For estimating the tonnage and footprint of the remedial rock cover, it is assumed that the rock will be laid in a 5.1-meter-wide corridor and designed with a 1:3 slope to be overtrawlable. The estimated total contingency weight of rock that may be required for the remediation of spans and exposures on the Cladhan pipelines is 7,900 Te, with a total footprint of 5,110 m^2.

The exposed end sections will be fully removed, including the transitions to trench depth with remaining cut ends buried and remediated with rock if required. The total weight of rock required is estimated to be 200 Te. This is based upon a 10 m wide rock berm, 5 m long at each cut pipeline end giving approximately 10 Te/linear metre. Rock will be laid precisely using a fall pipe vessel or with rock bags, which will subsequently be removed to shore.

The removal of the foundation piles associated with subsea structures may leave depressions in the seabed. TAQA will monitor the seabed to assess any seabed depressions and ensure that they are overtrawlable. Rock may be used as localised remediation for depressions where backfill is not possible.

3.5.5.2 Kestrel and Falcon Remediation

The Kestrel and Falcon flowlines and umbilicals will be decommissioned *in situ* in accordance with the CA outcome.

TAQA will conduct pre-decommissioning surveys within the Kestrel and Falcon Area prior to the commencement of decommissioning programme scope and the latest environmental information will be incorporated in relevant permits. Should any exposures or free spans be identified during pre-decommissioning surveys, these will be appropriately remediated via rock placed by fall pipe vessel or using rock bags. An indicative and highly conservative estimate has been made for the rock cover required to remediate potential mid-line spans and exposures by the time the pre-decommissioning survey is undertaken.

Based on the assumptions and approach detailed in Section 3.5.5 and a contingency for rock cover remediation of 5% of the total length of the Kestrel and Falcon pipelines to account for worst-case environmental impacts. For estimating the tonnage and footprint of remedial rock cover, it is assumed that it will be laid in a 5.1 m-wide corridor and will be designed with a 1:3 slope to be overtrawlable. The estimated total contingency weight of rock that may be required for the remediation of potential spans and exposures on the Kestrel and Falcon pipelines is estimated to be 3,400 Te, with a total footprint of 2,017 m^2.

Where required, rock cover will also be used to remediate any cut pipeline ends, with a worst-case of 100 Te (100 m^2) of rock per umbilical and flowlines cut end. Rock berm profiles will be within a 10 m wide corridor and will be designed with a 1:3 slope to be overtrawlable. Rock will be laid precisely using a fall pipe vessel or with rock bags.

The approach to remediation will be assessed on a case-by-case basis and rock cover represents a worst-case scenario. Subject to future surveys, additional rock cover required for remediation activities will be covered by relevant environmental permits. Permits will also address associated seabed and emissions impacts (if required).

The removal of the sentry bollard piles associated with the Kestrel drill centre may leave depressions in the seabed. TAQA will monitor the seabed to assess any seabed depressions and ensure that they are overtrawlable. Rock may be used as localised remediation locally for depressions where backfill is not possible.

3.5.5.3 Hudson Remediation

There are 43 areas of free span and 41 exposures along the Hudson pipelines proposed to be decommissioned *in situ*, totalling 170 m. Where individual exposures exceed 20 m in length the sections will be cut and removed with rock placement to remediate cut ends in accordance with the CA outcomes. Where exposures are less than 20 m long the exposure will be rock covered as this equates to less rock placement than removal and remediation of cut ends. Rock cover will be laid within a 10 m wide corridor. The total weight of rock that will be used for remediation of spans and exposure is estimated to be 1,700 Te (i.e. 10 Te/linear metre).

Where required, rock cover will also be used to remediate any cut pipeline ends, with a worst-case of 100 Te (100 m^2) of rock per pipeline cut end. Rock berm profiles will be within a 10 m-wide corridor and will be designed with a 1:3 slope to be overtrawlable. Rock will be laid precisely using a fall pipe vessel or with rock bags, which will subsequently be removed to shore.

The seabed disturbance footprint associated with Hudson remediation activities is presented in Table 6-8. The area of seabed disturbed by recovery of the pipeline ends and associated remediation (concrete mattresses and grout bags) has been estimated in Geographical Information Systems (GIS) defining the outer extent of all the pipelines due for removal and a 5 m buffer width was added to ensure that all pipeline remediation had been incorporated in the disturbance footprint (see Figure 6-1 and Figure 6-2).

Where pipeline ends become exposed during removal activities (e.g. where spools are removed either side of existing rock placement) they will be covered by an overtrawlable rock berm which will be 10 m wide, 5 m long. This represents a permanent impact. Pipeline exposures and freespans surveys (see Appendix B) were utilised to perform GIS calculations.

The removal of the foundation piles associated with subsea structures may leave depressions in the seabed. TAQA will monitor the seabed to assess any seabed depressions and ensure that they are overtrawlable. Rock may be used as localised remediation for depressions where backfill is not possible.

3.5.6 Post-Decommissioning Surveys

Following the decommissioning of the subsea infrastructure, it will be necessary to identify any potential snagging hazards associated with any changes to the seabed and remediate these. A clear seabed will be verified by an independent survey of the installation sites and pipeline corridors. The aim of seabed verification is to ensure the seabed is left in a safe condition following decommissioning for future fishing effort in line with Guidance (BEIS, 2018).

The survey methods will be discussed and finalised with OPRED prior to survey commencement to ensure the survey meets the requirements for clear seabed verification. Non-intrusive verification techniques will be considered in the first instance. These may include techniques which do not make contact with the seabed such as Side Scan Sonar (SSS) and ROV surveys. Any oil field debris identified shall be recovered and recycled/disposed of accordingly.

3.5.7 Ongoing Inspections & Evaluation

With any materials decommissioned *in situ*, the Operator has a liability to monitor and mitigate any impacts from these materials. As the buried pipelines and associated remediation will likely be decommissioned *in situ*, they will be subject to on-going inspections when the Tern Area decommissioning activities are concluded. After the initial post-decommissioning site survey reports have been sent to OPRED and reviewed, a post-decommissioning inspection regime will be agreed with OPRED by TAQA, as Operator.

3.5.8 Proposed Schedule

The precise timing of the decommissioning activities is not yet confirmed and will be subject to market availability, contractual agreements, and alignment with other decommissioning projects. The most likely window for the decommissioning of the Tern Area subsea infrastructure is provisionally expected to be 2024 – 2034. The most-likely schedule for the whole Tern Area is shown in Figure 3-1, with individual field schedules shown in Figure 3-2 to Figure 3-5.

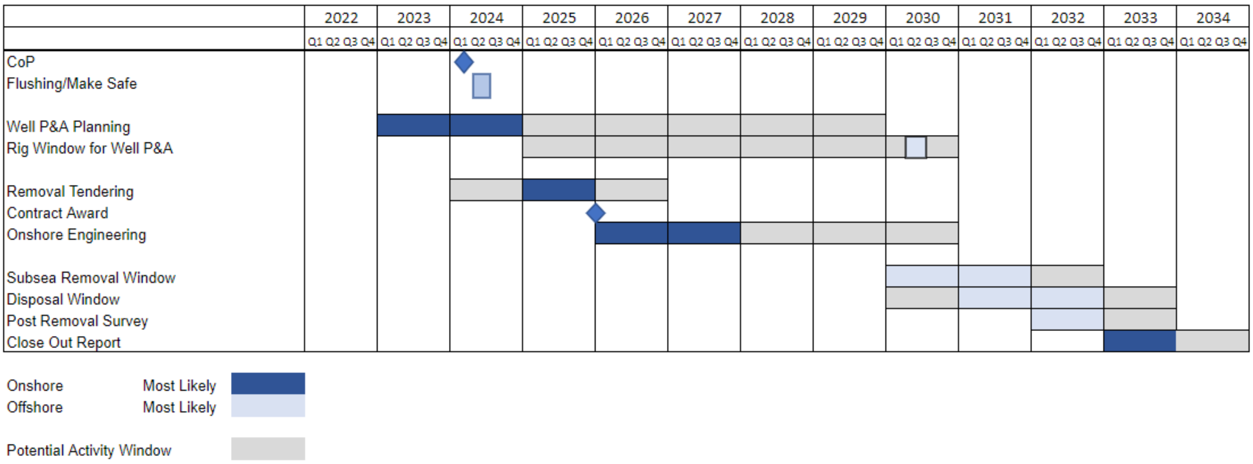
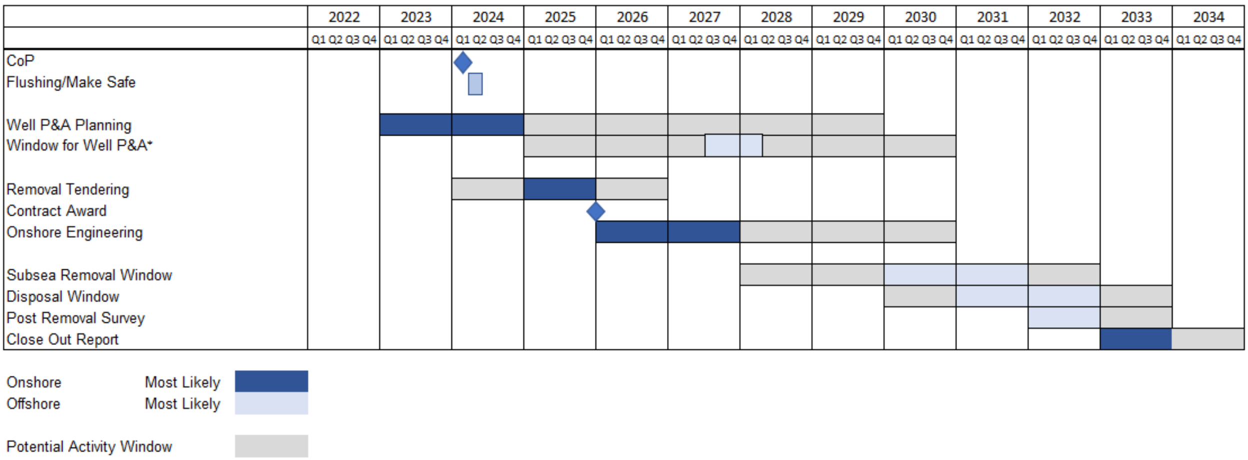
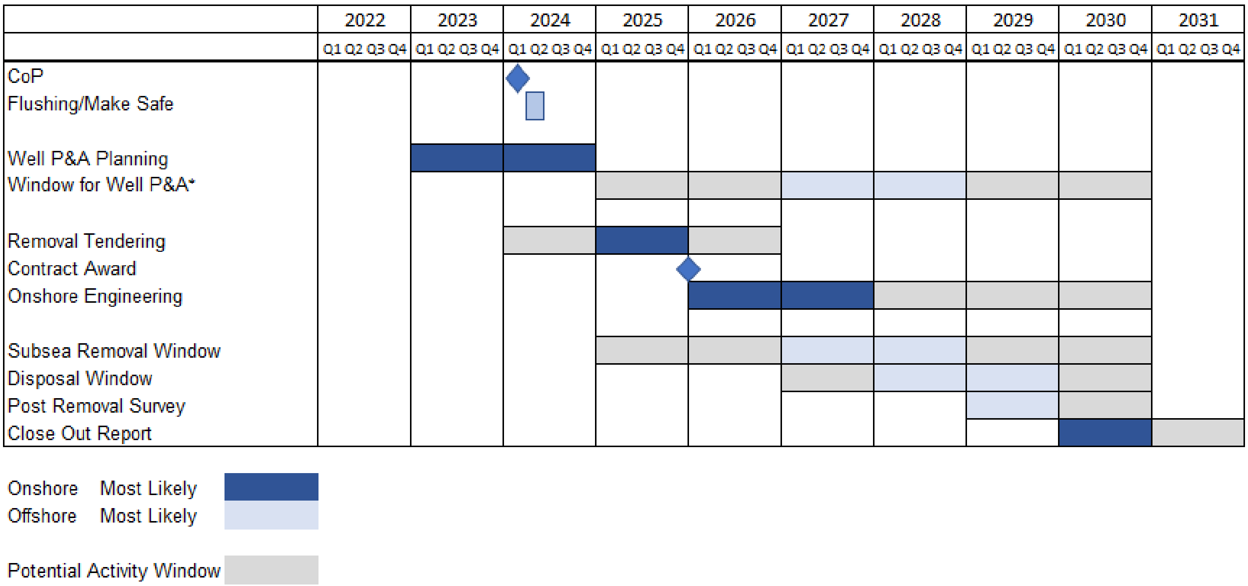


Figure 3-1 Tern Area Proposed Decommissioning Schedule



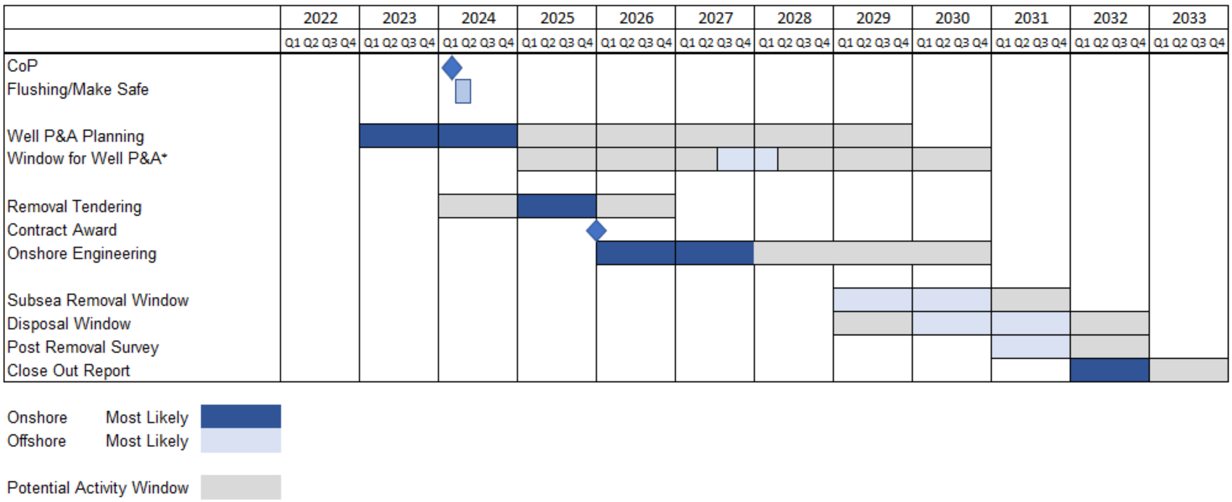
*The Well P&A offshore activity indicates WDP3 activity

Figure 3-2 Cladhan Proposed Decommissioning Schedule



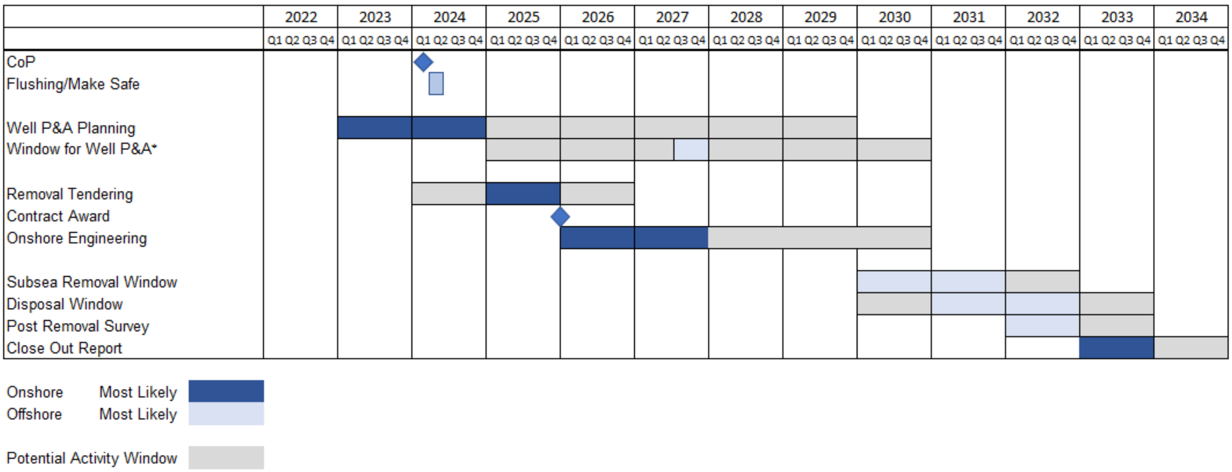
*The Well P&A offshore activity indicates WDP3 activity

Figure 3-3 Hudson Proposed Decommissioning Schedule



*The Well P&A offshore activity indicates WDP3 activity

Figure 3-4 Kestrel Proposed Decommissioning Schedule



*The Well P&A offshore activity indicates WDP3 activity

Figure 3-5 Falcon Proposed Decommissioning Schedule

3.6 Summary of Materials Inventory

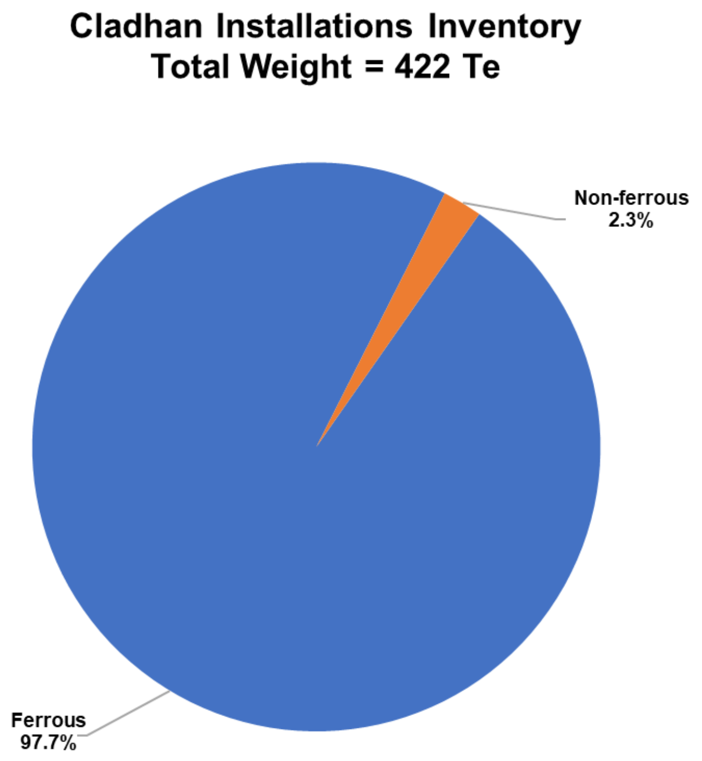
The approximate amounts of key materials that make-up the Tern Area subsea facilities have been evaluated. A focused review of the inventories of materials will be conducted during the detailed engineering phase of decommissioning. A summary of the bulk material inventory for the Tern Area is presented in Table 3-22 and Table 3-23 with a breakdown of the inventory for the installations and pipeline infrastructures for each field shown in Figure 3-6 to Figure 3-9.

Table 3-22 Tern Area Subsea Infrastructure Inventory

Material	Cladhan		Hudson		Kestrel		Falcon		Total
	Pipelines / Umbilicals / Stabilisation Material (Te)	Subsea Installations (Te)	Pipelines / Umbilicals Stabilisation Material (Te)	Subsea Installations (Te)	Pipelines / Umbilicals Stabilisation Material (Te)	Subsea Installations (Te)	Pipelines / Umbilicals Stabilisation Material (Te)	Subsea Installations (Te)	
Ferrous metals (all grades)	4,695.2	412.7	7,912.4	734.2	1,448.7	545.5	465.8	59.1	**16,273.6**
Non-ferrous metals (copper, aluminium alloys)	14.6	9.5	22.1	9.5	10.0	0.1	2.2		**68.0**
Plastics	1,108.7		1,880.6		384.4		119.0		**3,492.7**
Concrete mattresses	2,256.2		1,230.5		764.3	189.0	1,793.5		**6,233.5**
Grout (bags and grouted supports)	153.0		657.2		8.3				**818.5**
Other Non-hazardous (rock)	22,000.0		53,228.0				51,388.0		**126,616.0**
Other non-hazardous			23.3						**23.3**
Hazardous – NORM	6.4	Trace	25.4		2.8		1.0		**35.6**
Hazardous – Residual fluids	18.5	Trace	75.2		8.3		2.9		**105.0**
Total Inventory Tonnage (Te)	**30,252.5**	**422.2**	**65,054.7**	**743.7**	**2,626.8**	**734.6**	**53,772.4**	**59.1**	**153,665.9**
Planned Tonnage to Shore (Te)	2,862.1	399.5	3,625.7	707.5	1,038.8	516.7	1,827.6	59.1	11,037.0
Planned Tonnage decommissioned *in situ* (Te)	27,390.4	22.7	61,429.1	36.2	1,588.0	217.9	51,944.6	0.0	142,628.9

Table 3-23 Tern Area Inventory Disposition

Material	Cladhan		Hudson		Kestrel		Falcon		Total Tern Area	
	Planned Tonnage decommissioned *in Situ* (Te)	Planned Tonnage to Shore (Te)	Planned Tonnage decommissioned *in Situ* (Te)	Planned Tonnage to Shore (Te)	Planned Tonnage decommissioned *in Situ* (Te)	Planned Tonnage to Shore (Te)	Planned Tonnage decommissioned *in Situ* (Te)	Planned Tonnage to Shore (Te)	Planned Tonnage decommissioned *in Situ* (Te)	Planned Tonnage to Shore (Te)
Ferrous metals (all grades)	4,413.00	694.90	6,638.8	2,007.8	1,440.21	554.03	439.12	85.68	12,931.13	3,342.41
Non-ferrous metals (copper, aluminium alloys)	11.60	12.50	6.2	25.5	6.39	3.77	1.62	0.53	25.81	42.30
Plastics	963.60	145.10	1,511.4	369.2	348.61	35.80	112.25	6.72	2,935.86	556.82
Concrete mattresses		2,256.20		1,230.5		953.32		1,793.46	0.00	6,233.48
Grout (bags and grout support)		153.00		657.3		8.25			0.00	818.55
Other Non-hazardous (rock)	22,000.00		53,228.0				51,388.00		126,616.00	0.00
Other non-hazardous				23.3					0.00	23.30
Hazardous – NORM	6.40		20.4	5.0	2.71	0.10	0.91	0.05	30.42	5.15
Hazardous – Residual fluids	18.50		60.5	14.7	8.04	0.30	2.71	0.16	89.75	15.16
Inventory Tonnage (Te)	**27,413.1**	**3,261.7**	**61,465.3**	**4,333.3**	**1,806.0**	**1,555.6**	**51,944.6**	**1,886.6**	**142,628.9**	**11,037**



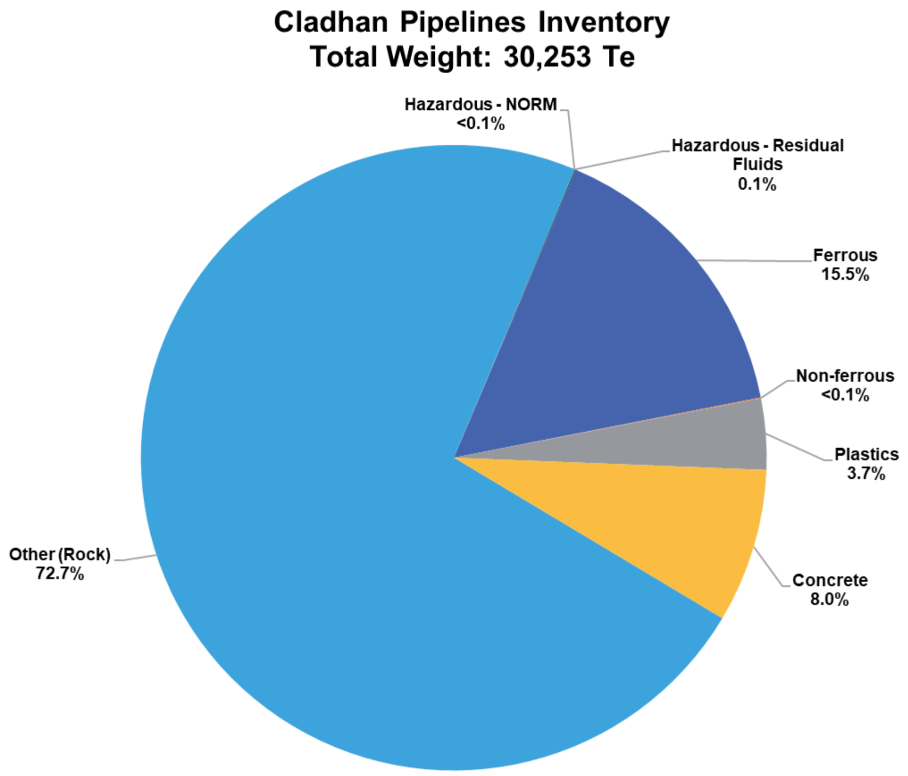
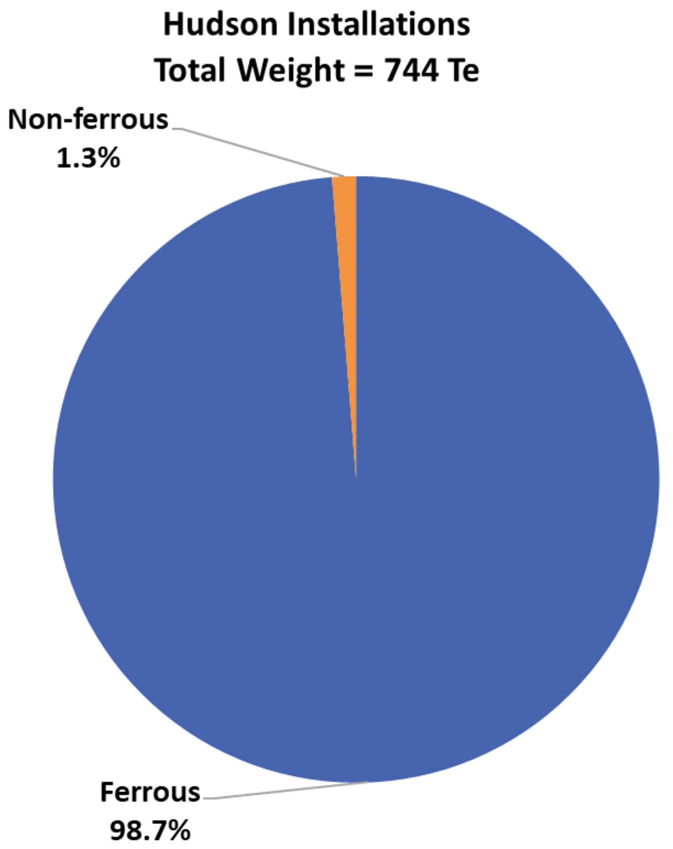


Figure 3-6 Cladhan Installations and Pipeline Inventories



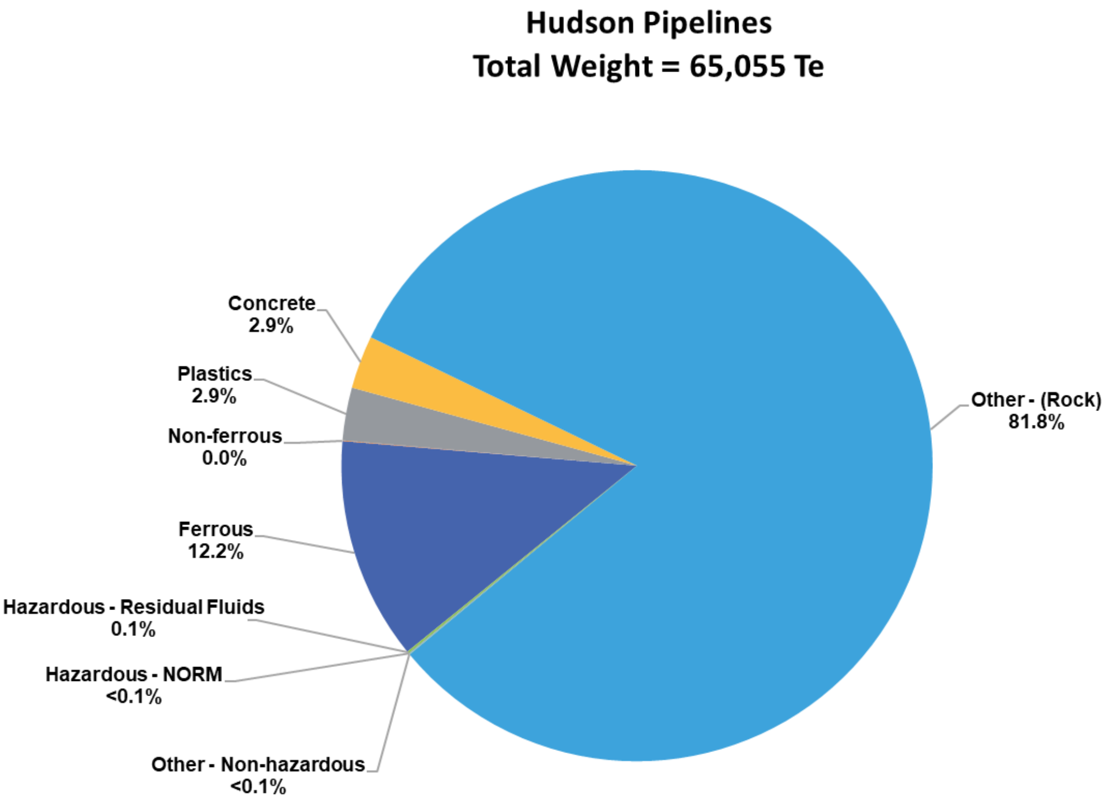
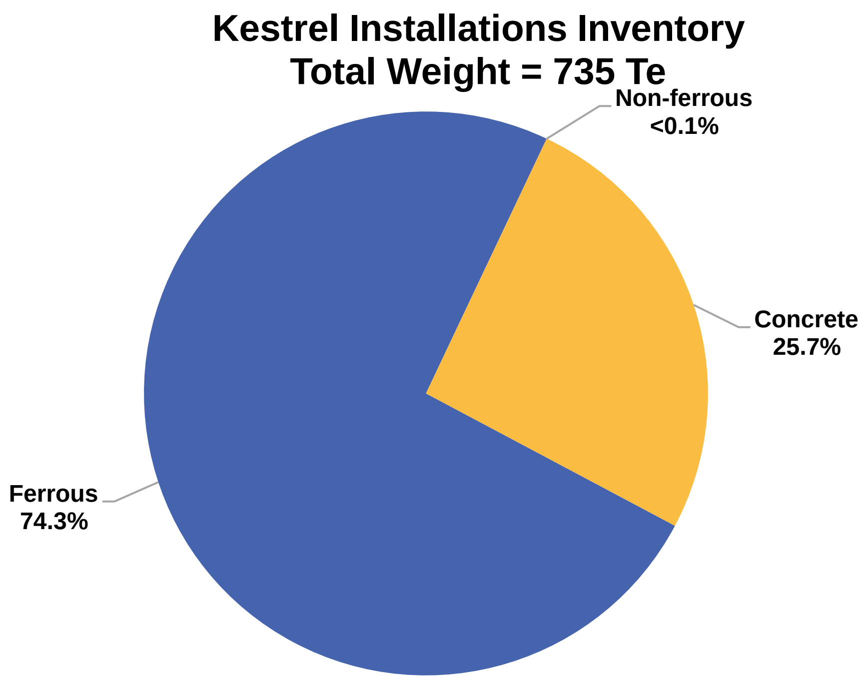


Figure 3-7 Hudson Installations and Pipeline Inventories



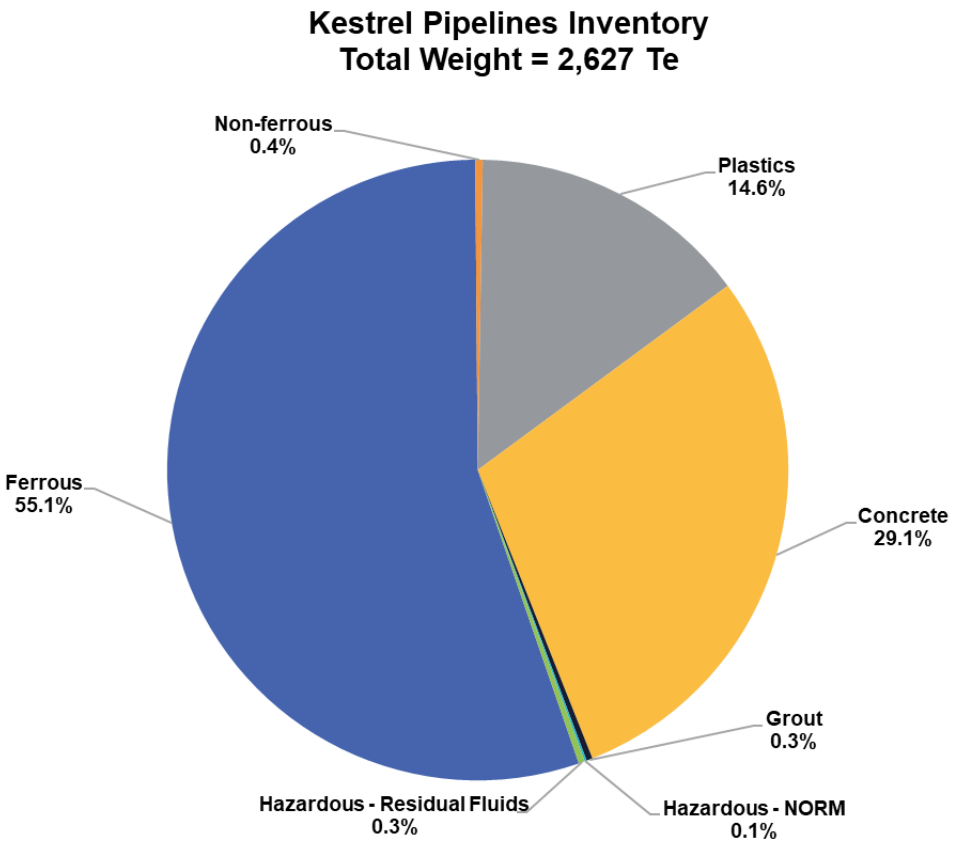


Figure 3-8 Kestrel Installations and Pipeline Inventories

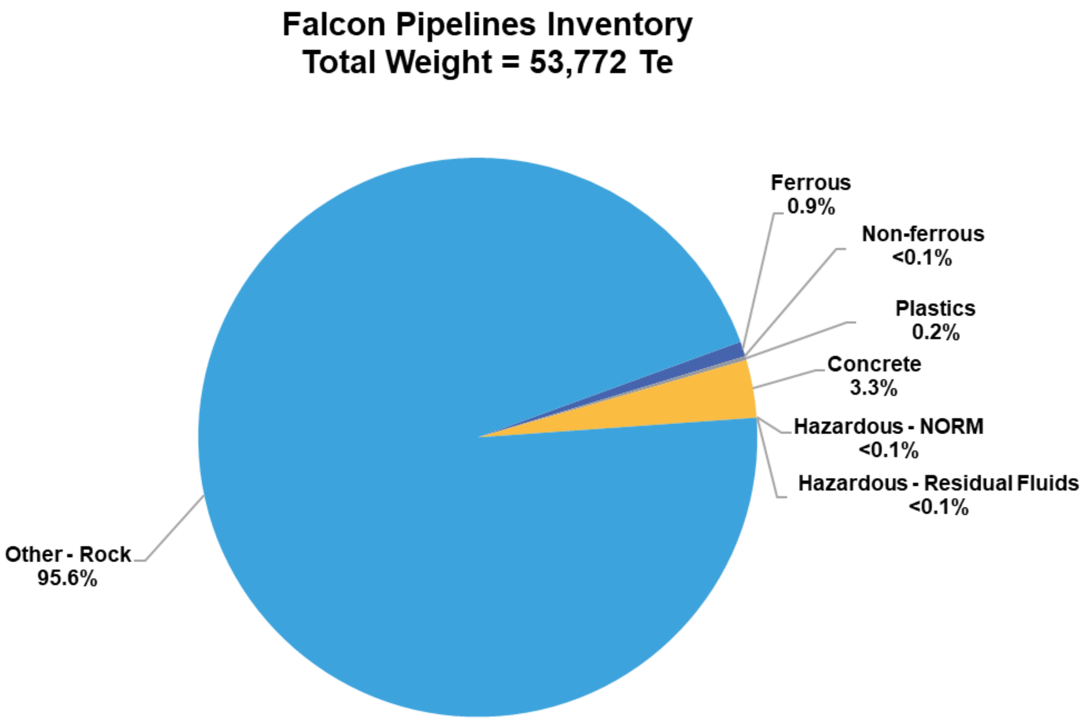


Figure 3-9 Falcon Pipeline Inventory

3.7 Waste Management

TAQA will comply with the Duty of Care requirements under the UK Waste Regulations and The Environmental Protection (Duty of Care) (Scotland) Regulations 2014. The hierarchy of waste management will also be followed at all stages of disposal (see Figure 3-10) and industry best practice will be applied (Decom North Sea, 2018 Managing Offshore Decommissioning Waste, November 2018).

All waste will be managed in compliance with relevant waste legislation by a licenced and/or permitted waste management contractor. The selected contractor will be assessed for competence through due diligence and duty of care audits.

Most of the material recovered during the Tern Area subsea decommissioning activities will be non-hazardous, including steel, non-ferrous metals, plastic and concrete as outlined in Section 2.4.

Preventing waste is ultimately the best option, achieved through reducing consumption and using resources more efficiently. However, this is followed by re-use and recycling of goods. If all re-use opportunities have been taken by TAQA, the next preferable option is for recycling of materials.

Figure 3-10 Waste Hierarchy Model

The Material Inventory has also classified each material according to the European Waste Catalogue Codes (EWC) as required for disposal of wastes within the EU and a further categorisation of hazardous/special or non-hazardous/non-special wastes. The EWC is a standardised way of describing waste and was established by the European Commission. The use of EWC codes to describe waste is a requirement of the Duty of Care for waste which requires the holder of waste to take all reasonable steps to ensure that waste is described in a way that permits its safe handling and management.

Until a waste management contractor has been selected and disposal routes identified, the final disposal options for waste materials are unknown. The project aspiration is that all ferrous and non-ferrous metals, concrete and plastics will be recycled where possible and TAQA will work closely with contractors to ensure this is the case. There may be instances where infrastructure returned to shore is contaminated (marine growth, hydrocarbons, paints etc), in this situation TAQA will make every effort to clean such infrastructure to enable it to be recycled. In cases where this is not possible, and the infrastructure cannot be recycled, material will be disposed of in landfill.

As part of TAQA's standard processes, all sites and waste carriers will have appropriate environmental and operating licences and/or permits to carry out this work and will be closely managed within TAQA's contractor assurance processes.

Should Naturally Occurring Radioactive Material (NORM) be encountered, TAQA will ensure the disposal site is suitably licenced to accept the waste arising from the decommissioning of the subsea infrastructure.

An AWMP including an inventory of hazardous waste will be compiled to aid the segregation and recycling of waste.

TAQA is committed to working towards the government policy of Net Zero in line with the North Sea Transition Authority (NSTA) Stewardship Expectation 11. This commitment includes decommissioning activities and is intended to drive increased energy efficiencies and minimise emissions. TAQA seeks to influence our joint venture partners and suppliers to ensure that everyone is striving to reduce and manage associated emissions.

3.8 Environmental Management Strategy

TAQA Bratani has an established and independently verified Environmental Management System (EMS) which is certified in accordance with the requirements of ISO14001:2015. The scope of the TAQA EMS is defined to include all activities, onshore and offshore, in relation to the exploration for, and production of, hydrocarbons in defined license areas of the UK sector of the North Sea. This scope encompasses the Tern Area pipelines and subsea infrastructure decommissioning. The EMS meets the requirements of OSPAR Recommendation 2003/5 which promotes the use and implementation of EMSs by the offshore industry.

TAQA is committed to managing all environmental impacts associated with its activities. Continuous improvement in environmental performance is sought through effective project planning and implementation, emissions reduction, waste minimisation and waste management. This mindset has fed into the development of the mitigation measures developed for the project. These measures include both industry-standard and project-specific mitigations. A copy of TAQA's Health, Safety, Security and Environment (HSSE) Policy is presented in Appendix A.

The project has limited activity associated with it beyond the main period of preparation for decommissioning of the Tern Area pipelines and subsea infrastructure. The focus of environmental performance management for the project is therefore to ensure that the activities that will take place during the limited period of decommissioning happen in a safe, compliant, and acceptable manner. The primary mechanism by which this will occur is through TAQA's accredited EMS and HSSE Policy.

To support this, a project Health, Safety and Environment (HSE) Plan will be developed which outlines how HSE issues will be managed and how the policies will be implemented effectively throughout the project. The plan will apply to all work carried out, whether onshore or offshore. Performance will be measured to satisfy both regulatory requirements including compliance with environmental consents, as well as to identify progress on fulfilment of project objectives and commitments.

TAQA also operates a Waste Management Strategy and will develop an AWMP for the project to identify and describe the types of materials identified as decommissioning waste and to outline the processes and procedures necessary to support the Decommissioning Programme for the Tern subsea infrastructure. The AWMP will detail the measures in place to ensure that the principles of the waste management hierarchy are followed during decommissioning.

TAQA has developed a draft Emissions Reduction Strategy which supports their commitment to Net Zero and the NSTA Stewardship Expectation 11. This strategy catalogues TAQA's asset portfolio and future decommissioning activities and is intended to drive increased energy efficiencies and reduced emissions. TAQA plans several initiatives under the Emissions Reduction

Strategy including working with the supply chain, collating emission/energy savings initiatives across the business and reviewing emissions sources.

The NMP has been adopted by the Scottish Government to help ensure sustainable development of the marine area. The NMP has been developed in line with UK, EU and OSPAR legislation, directives, and guidance. With regards to decommissioning, the Plan states that ‘where re-use of oil and gas infrastructure is not practicable, either as part of oil and gas activity or by other sectors such as Carbon Capture and Storage (CCS), decommissioning must take place in line with standard practice, and as allowed by international obligations. TAQA has given due consideration to the Scottish NMP during project planning and decision making.

4 ENVIRONMENTAL AND SOCIETAL BASELINE

As part of the EA process, it is important that the main physical, biological and societal sensitivities of the local environment are well understood. This environmental baseline describes the characteristics of the Tern Area and highlights the key environmental sensitivities. This section draws on several information sources including site-specific investigations, published papers, and relevant Strategic Environmental Assessments (SEAs). The surveys listed below have been carried out within the Tern Area and provide full coverage of project area, including the Cladhan, Hudson and Kestrel and Falcon fields, and have been used to inform this baseline section:

- North Tern Site and Environmental Survey (Falcon field) (Gardline, 2009);
- Cladhan Site Survey. Environmental Baseline Report (Gardline, 2010);
- Cladhan Development Pipeline Route Survey from Cladhan 210/30a-A4 to Tern (Gardline, 2011);
- Cladhan Development Cladhan Infield Site Survey. Environmental Baseline Survey (Gardline, 2012a);
- Cladhan Development Pipeline Route Survey Cladhan Infield Interconnecting Routes. Environmental Baseline Survey. Cladhan field (Gardline, 2012b);
- Environmental baseline survey Cladhan Site Survey 210/2. (Cale-survey, 2012);
- Kestrel Environmental Monitoring Survey UKCS Block 211/25a (Fugro, 2014);
- Tern - Combined Environmental Baseline and Habitat Assessment Survey Report. Northern North Sea (Benthic Solutions, 2019);
- Tern Cuttings Pile (Fugro, 2019); and
- Hudson Manifold – Pre-decommissioning Cuttings Pile, Environmental Baseline and Habitat Survey (Benthic Solutions, 2022).

A further environmental baseline / habitat assessment survey will be conducted prior to decommissioning, e.g. in the period prior to the subsea removal window.

A risk-based monitoring and inspection strategy will also be adopted for all pipelines. Time between pipeline surveys would not be expected to exceed 5 to 7 years

4.1 Seabed Environment

4.1.1 Bathymetry

Across the Tern Area the overall depth ranges from about 148-170 mLAT, with a trend of water depth increasing slightly to the north. The bathymetry within the Kestrel and Falcon fields ranges from 156-164 mLAT (Gardline, 2009; Fugro, 2014). The Cladhan field is located in water of a similar depth, 148-170 mLAT (Cale-survey, 2012). The water depth within the Hudson survey area ranges from 158.8 mLAT in the northwest to 160.7 mLAT in the southeast (Benthic Solutions, 2022).

The Tern Area is not located on any large-scale features of functional significance such as shelf deeps, shelf banks and mounds, seamounts, or continental slopes (NMPI, 2022).

4.1.2 Currents, Waves and Tides

The annual mean wave height in the NNS follows a gradient increasing from the southern point in the Fladen/Witch Ground to the northern area of the East Shetland Basin. In the south, the mean wave height ranges from 2.11-2.40 m whilst in the north it ranges from 2.41-3.30 m (NMPI, 2022). McBreen *et al*. (2011) shows wave energy at the seabed is ‘low’ (less than 0.21 N/m^2) within the Tern Area. The annual mean wave height at ranges from 2.73 m-2.76 m and the annual mean wave power ranges from 40.08-41.08 kW/m (NMPI, 2022).

The anti-clockwise movement of water through NNS originates from the influx of Atlantic water, via the Fair Isle Channel and around the north of Shetland and the main outflow northwards along the Norwegian coast (DECC, 2016). Against this background of tidal flow, the direction of residual water movement in the NNS is generally to the south or east (DTI, 2001; DECC, 2016). The peak flow for mean spring tide ranges between low velocities of 0.1 m/s in open (DECC, 2016). The mean residual current through the Tern Area is approximately 0.05 to 0.1 m/s (Wolf *et al*., 2016).

The NNS is seasonally stratified with the strength of the thermocline determined by solar energy, tidal and wave forces (DECC, 2016). Distinct density stratification occurs in the NNS region in summer at around 50 m depth and the thermocline becomes increasingly distinct towards deeper water in the north of the region (DECC, 2016). This stratification breaks down in September as the frequency and severity of storms increases causing mixing in the water column (DECC, 2009).

4.1.3 Meteorology

The prevailing winds in the NNS are from the southwest and north northeast. Wind strengths in winter are typically in the range of Beaufort scale force 4-6 (6-11 m/s) with higher winds of force 8-12 (17-32 m/s) being much less frequent. Winds of force 5 (8 m/s) and greater are recorded 60-65% of the time in winter and 22-27% of the time during the summer months. In April and July, winds in the open, central to NNS, are highly variable and there is a greater incidence of north westerly winds (DECC, 2016).

4.1.4 Wider Tern Area Seabed Environment

4.1.4.1 Physical Characteristics

In the NNS, seabed sediments generally comprise a veneer of unconsolidated terrigenous and biogenic deposits, generally much less than 1 m thick. The physical seabed characteristics recorded from survey work show a high degree of uniformity across the Tern Area. Sediments appear to be consistently dominated by very fine to medium sands and have comparable silt clay contents that would earn their description as muddy sands.

All available survey reports covering the Tern Area have been assessed and the full coverage of the field surveys conducted in the area, including sampling station locations, are shown in Figure 4-1. These surveys have all indicated similar species and sediment compositions which provide evidence of a relatively uniform nature of the seabed habitats and communities in the vicinity of the Tern Area and in the wider NNS setting.

Under the EUNIS habitat classification, the most widespread seabed type around the Tern Area is predicted to be A5.27 “deep circalittoral sand” which represents offshore (deep) circalittoral habitats with fine sands or non-cohesive muddy sands. This habitat type falls within the broad habitat Priority Marine Feature (PMF) “offshore sands and gravels” (Tyler-Walters *et al.,* 2016) (NMPI, 2022). In addition, at Hudson, the habitat A5.45 “Deep circalittoral mixed sediment” was predicted to occur (Benthic Solutions, 2022). The surveys taken across the fields which make up the Tern Area also identified the EUNIS habitat complex A5.37 “Offshore circalittoral mud” and A5.35 “Circalittoral sandy mud”. Generally, the sediment characteristics reported by more recent surveys are comparable to those identified from surveys carried out in the 1980s and early 2000s, indicating limited temporal variability (Xodus, 2018).

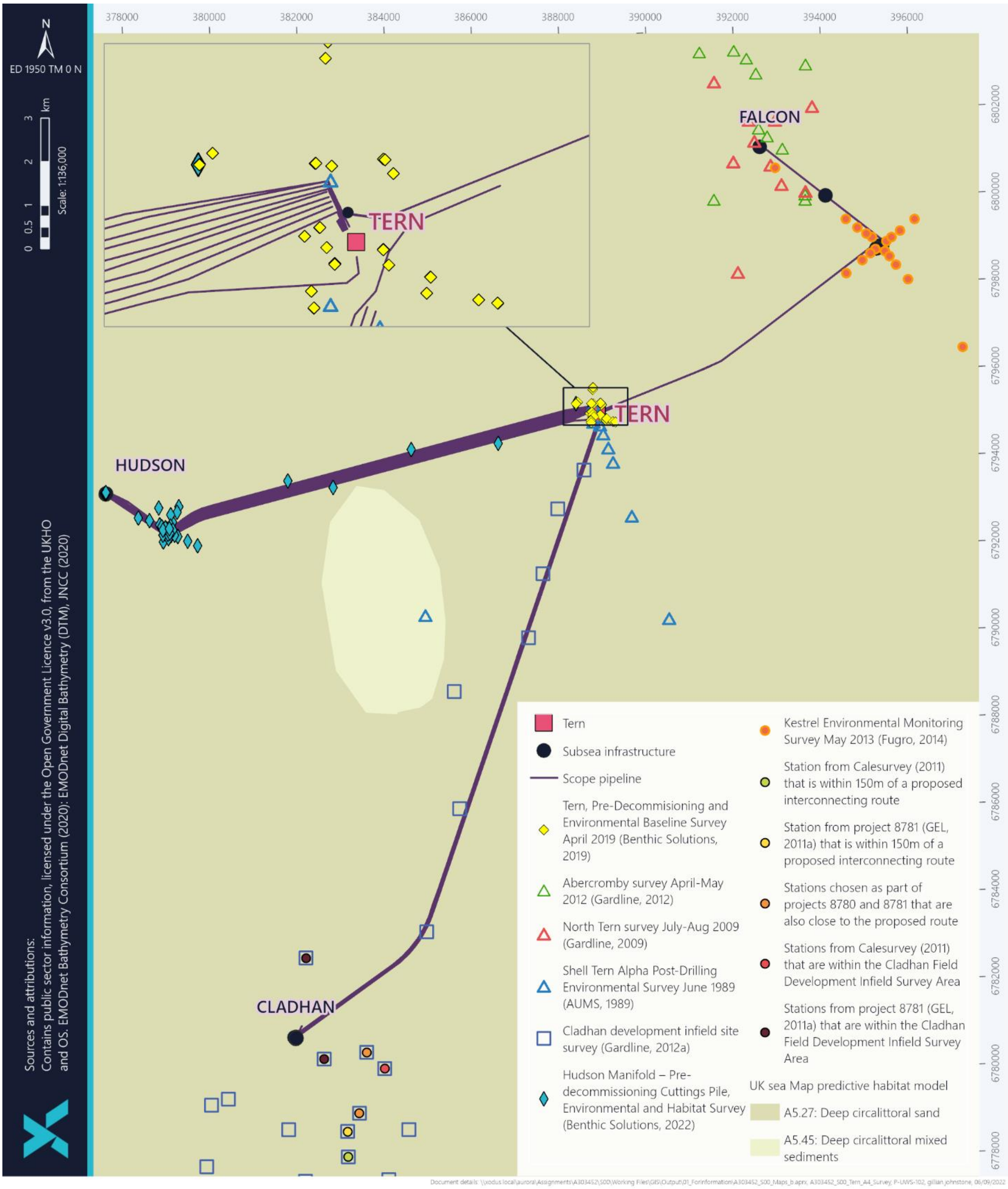
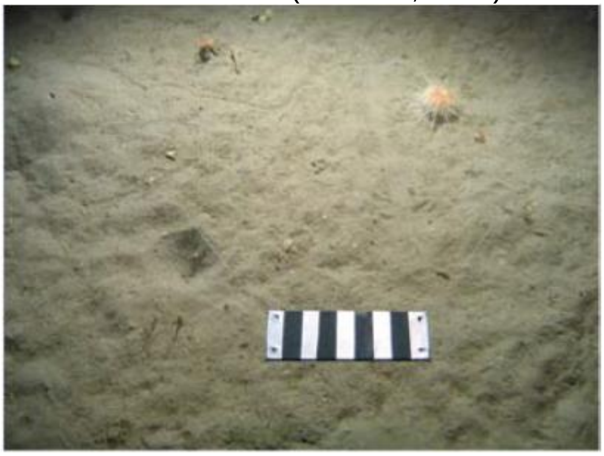


Figure 4-1 Coverage of Environmental Surveys in The Tern Area

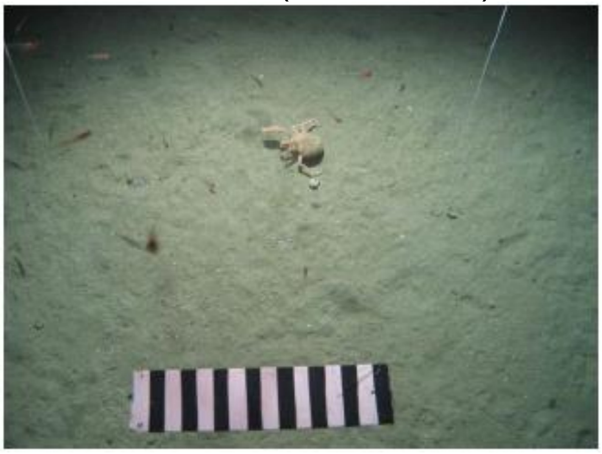
Cladhan Field (Gardline, 2010)



Cladhan Field (Gardline, 2012b)

Tern Field (Benthic Solutions, 2019)

Falcon Field (Gardline, 2009)



Hudson Field (Benthic Solutions, 2022)

Hudson Field (Benthic Solutions, 2022)

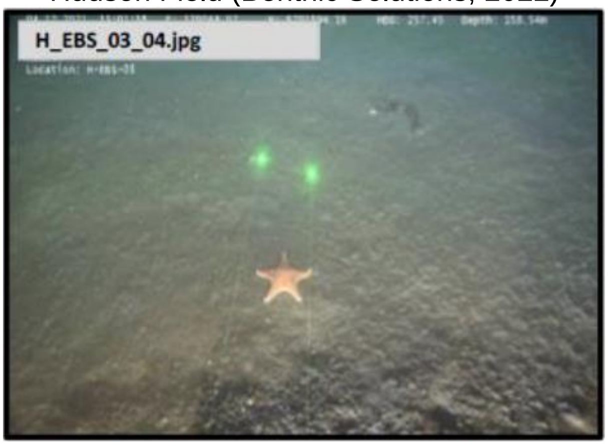


Figure 4-2 Seabed Imagery From The Wider Tern Area (Scale Bars With 1 cm Divisions Shown)

Sediments across the wider Tern Area are mostly sandy, with fine-silty sand reported at Cladhan, muddy sand at Hudson, fine sand at Kestrel and Falcon and very fine sand at the Tern platform. The range in silt/clay contribution varied in line with this classification; at Cladhan, fines made up 6.3-8.3% (Xodus, 2018). The proportion of fines in the Hudson field ranged from 9.8-21.5% and the sediment was mostly described as muddy sand (Benthic Solutions, 2022). At the Kestrel and Falcon fields the silt/clay component of the sediment ranged from 10.1-17.4% and 9.0-15.0%, respectively (Xodus, 2018).

Images of the seabed within the Cladhan, Hudson and Falcon fields and close to the Tern platform are shown in Figure 4-2.

4.1.4.2 Chemical Characteristics

Of relevance to the offshore oil and gas industry are metals associated with drilling-related discharges. Cuttings accumulate at drilling sites and comprise small amounts of drilling fluids which bind to drilling muds and rock fragments (cuttings) during the drilling activity, with larger particles settling rapidly to the seabed. Finer sediments comprising clay particles can be carried further away from platforms by water currents.

The discharge of oil-based muds (OBMs) was banned in the UK in 1984 (PARCOM, 1984), with their use also prohibited for exploratory drilling in 1987 and for all drilling in 1988. As a result, OBMs were gradually replaced by Low Toxicity OBMs (LTOBMs), synthetic based muds (SBMs) and water-based muds (WBMs) (OSPAR, 2009b). These fluids consist of water and non-water dispersible fluids and include weighting agents like barium sulphate and other additives for viscosity, scale, and corrosion control. The presence of barium is frequently used to detect the deposition of drilling fluids around offshore installations (Chow and Snyder, 1980; Gettleson and Laird, 1980; Muniz *et al*., 2004). Solid barites are often discharged during the drilling process and contain measurable concentrations of heavy metals as impurities, including cadmium, chromium, copper, lead, mercury, and zinc (NRC, 1983; McLeese *et al*., 1987).

The total barium concentrations in the sediments around the Tern platform were found to range from 322 mg/kg to 20,000 mg/kg with a mean of 3,940 mg/kg. Additionally, at several stations within 500 m of the Tern platform there was evidence of drilling related hydrocarbon contamination, namely LTOBMs (Benthic Solutions, 2019). Within the Hudson field, natural barium levels ranged from 30 mg/kg at a sample far from any wellhead (>3 km) to a maximum of 1,720 mg/kg out with the boundary of notable cuttings pile discharge (Benthic Solutions, 2022). The mean barium concentration at Cladhan was 234 mg/kg (Gardline, 2012a). In the Kestrel and Falcon fields, barium concentrations were lower, with a mean of 96 mg/kg (Fugro, 2014). Both of these results are consistent with previous surveys of the area and are also below background concentrations.

Overall, the chemical parameters found in sediments at stations within 120 m of the Tern platform displayed clear indications of drilling-related contamination. Further to the high levels of barium, sediment was also organically enriched, with high moisture content and high concentrations of hydrocarbons. At least seven stations adjacent to the Tern platform exceeded natural background levels for several metals including arsenic, cadmium, chromium, copper, and zinc. Metal levels in sediments around the Tern platform decreased with distance from the installation (Benthic Solutions, 2019). While concentrations of copper, lead and zinc exceeded the UKOOA (2001) 95th percentile at several stations in the Cladhan field, all metals were below those available concentrations considered representative of a pristine environment by OSPAR (2005) (Gardline, 2012a). The levels of all metals in sediments within the Kestrel and Falcon fields were also generally within the range of natural background concentrations and were of no obvious environmental concern (Fugro, 2014).

THC concentrations measured in the surface sediments from around the Tern platform ranged from 2.0 mg/kg to 38.8 mg/kg with a mean value of 11.2 mg/kg. Levels of THC were found to decrease with distance from the platform (Benthic Solutions, 2019). Total Organic Carbon (TOC) and THC content from stations sampled around the Hudson manifold indicates that the sediment is organically enriched by drilling related discharges. This was observed particularly at stations with high fines content. Peak THC was recorded at stations sampled north and northwest of the Hudson manifold, in line with the prevailing current direction. Analysis indicated the presence of LTOBMs (Benthic Solutions, 2022). Comparatively, THC measured in the surface sediments at Kestrel and Falcon ranged from 6.9 mg/kg to 17.1 mg/kg with a mean value of 9.0 mg/kg, showing a lower mean concentration and reduced maximum compared to the Tern field. THC concentrations were also mostly below, or similar to, the average background concentration of 10.8 mg/kg calculated from environmental survey data collected between 1975 and 1995 in the northern North Sea area (Fugro, 2014). The mean THC for the Cladhan field was lower again at 6.6 mg/kg (Gardline, 2012a).

4.1.5 Drill Cuttings Piles

The Cladhan, and Kestrel and Falcon wells were drilled using Water-Based Mud (WBM) and therefore do not have any associated cuttings contamination. Surveys were undertaken of the Tern (Fugro, 2019) and Hudson (Benthic Solutions, 2022) cuttings piles to characterise their physical, chemical, and biological composition. The survey strategies followed the Norsk Olje and Gass (NorOG) guidance document for characterization of offshore drill cuttings piles (NorOG, 2016) with regards to sampling design across the topography of each cuttings pile. Analysis was aligned as far as practicable with the OSPAR Guidelines for the Sampling and Analysis of Cuttings Piles (OSPAR, 2017) and Joint Article Management Promotion-consortium (JAMP) Guidelines for Monitoring Contaminants in Sediments (OSPAR, 2015). The results of these surveys are presented below.

4.1.5.1 Physical Characteristics

4.1.5.1.1 Tern

Bathymetry data (Fugro, 2019) indicates a single cuttings pile located adjacent to the north-east and north-west legs of the Tern jacket. The physical cuttings pile boundary in relation to the Tern platform jacket is displayed in Figure 4-3. The level of expected natural seabed was extrapolated from the surrounding background which illustrated an estimated maximum cuttings pile depth of 7.5 m. Following the investigation of the natural morphology of the seabed and the vertical profiles of the core samples retained from the survey, the approximate physical boundary and volume calculation of the cuttings pile was delineated. The Tern cuttings pile was estimated to cover an area of 10,211 m^2 with a pile volume of 13,470 m^3 which would be categorised as a “medium cuttings pile” (5,000-20,000 m^3; NorOG, 2016). The Tern platform cuttings pile is out with the scope of this EA and the DPs that it supports.

The Tern core sediments were classified as moderately to extremely poorly sorted fine silt to medium sand (average mean particle size 85 µm). In general, coarser material was noted in the top core sections compared to their respective middle and bottom core sections. The cuttings pile sediment is highly modified compared to the wider field with the cuttings pile containing both higher levels of gravel and fines (silt/clay). This indicates an input of drilling related gravel/rock chippings and mud has been observed across the cuttings pile.

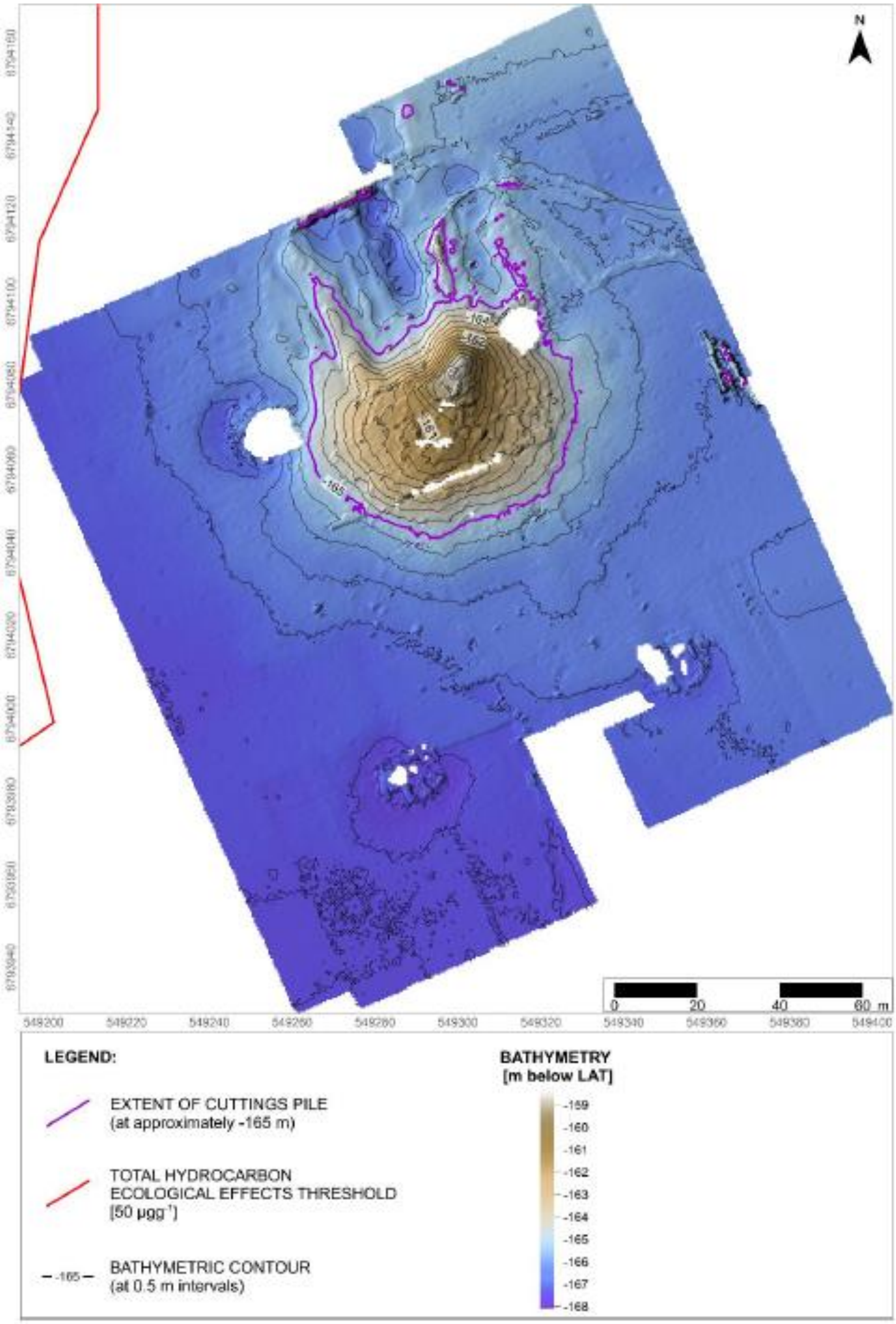


Figure 4-3 The Tern Platform Cuttings Pile

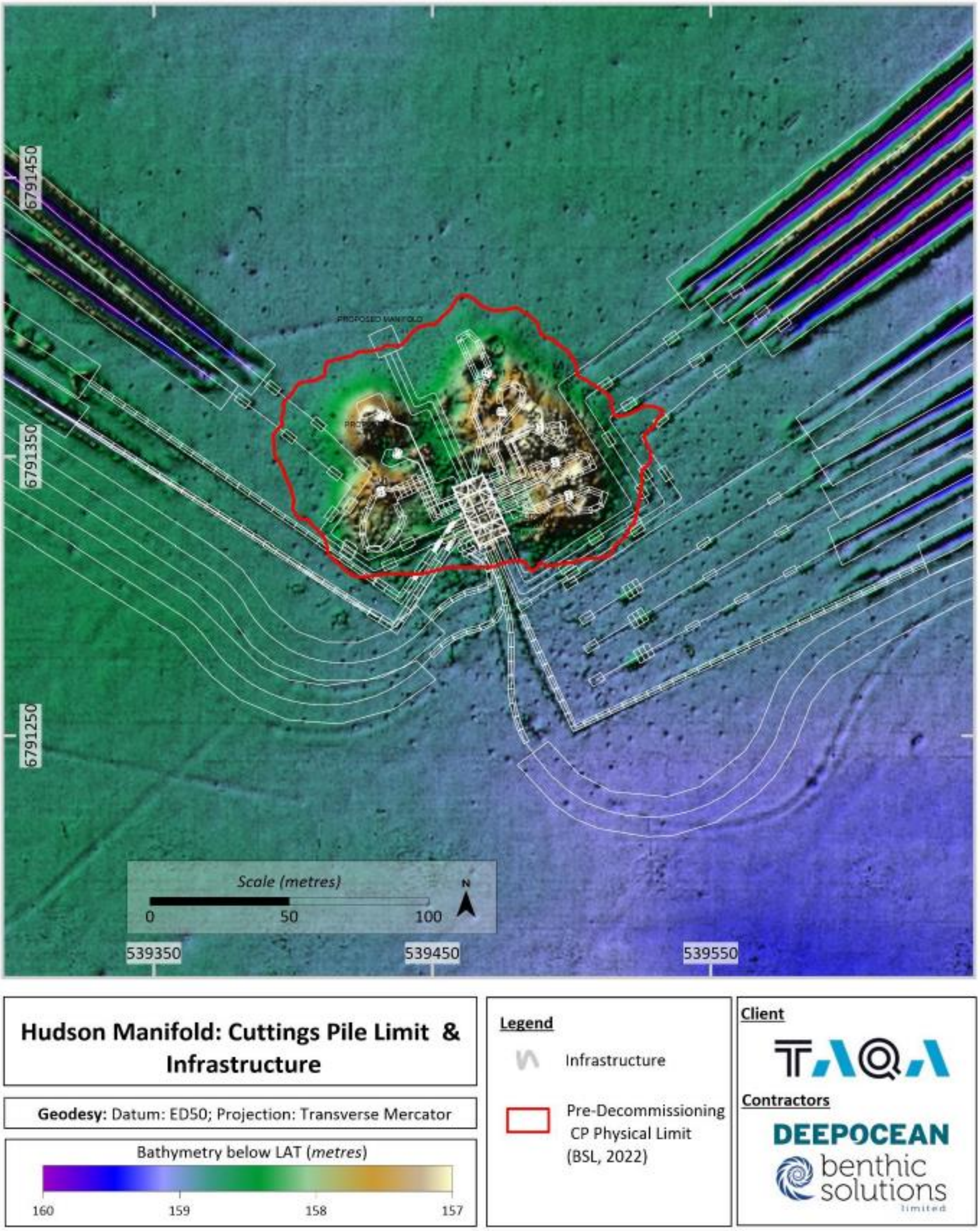


Figure 4-4 The Hudson Manifold Cuttings Pile(s)

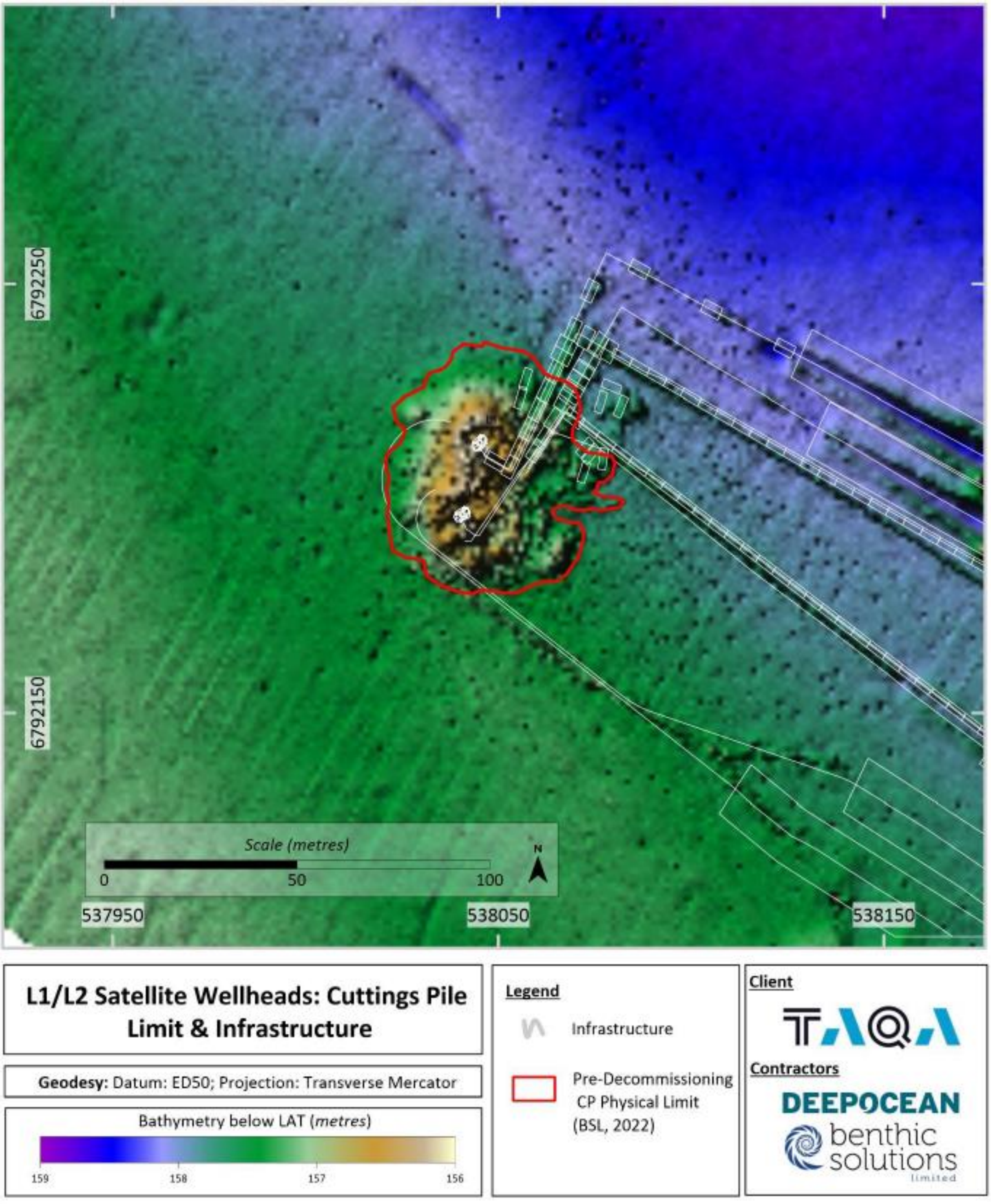


Figure 4-5 The Hudson Satellite Well Cuttings Pile

4.1.5.1.2 Hudson

The bathymetry data (Benthic Solutions, 2022) indicates a number of discrete cuttings piles surrounding a total of seven wellheads associated with the Hudson manifold (Figure 4-4). Due to the complexity of the site, the small piles have been analysed and interpreted as one large cuttings pile, encompassing the manifold and the wellheads. The level of expected natural seabed was extrapolated from the surrounding background which illustrated an estimated maximum drilling discharge deposition depth of 3.6 m.

At the Hudson L1 and L2 satellite wells (Figure 4-5), the bathymetry data showed the site consists of distinct cuttings piles at each well, with both piles merging in the centre to form an overall cuttings pile area of approximately 56 m in diameter with an estimated maximum drilling discharge deposition depth of 1.7 m at the L1 satellite well and 1.2 m at the L2 satellite well.

Following the investigation of the natural morphology of the seabed and the vertical profiles of the core samples retained from the survey, Benthic Solutions (2022) delineated the approximate physical boundary and volume of the cuttings piles. The Hudson manifold cuttings pile was estimated to cover an area of 8,957 m^2 with a pile volume of 6,819 m^3 which is categorised as a “medium cuttings pile” (5,000-20,000 m^3; NorOG, 2016). The physical cuttings pile limit boundary in relation to the Hudson manifold area is displayed in Figure 4-4. The extent of the cuttings pile was estimated to cover an area of 2,314 m^2 with a pile volume of 1,156 m^3 which would be categorised as a “small cuttings pile” (<5,000 m^3; NorOG, 2016). The physical cuttings pile limit boundary in relation to the Hudson satellite wells area is displayed in Figure 4-5.

At the Hudson manifold, core samples were dominated by ‘muddy sand’, ‘sand’ and ‘gravelly muddy sand’. A relationship between the core layer depth and the proportion of fines, sands and gravel was evident in the cuttings piles. Higher proportions of gravelly material were typically found within core sub-layers reflecting the natural seabed present comprised of silty sand with shell debris. The consistent occurrence of gravel in the form of black granules at the core surface and middle layers was assumed to be related to cuttings deposits during various stages of the drilling campaign. Fine sediment was present within all cores at similar proportions but generally peaked in the core surface layers. Within the L1/L2 cuttings pile, the proportions of fines increased with depth. The low but consistent occurrence of gravel in the form of black granules and shiny particles is also assumed to be related to cuttings deposition. The proportion of sands within the cuttings piles was fairly consistent across most stations but did peak within core middle layers at several Hudson manifold and L1/L2 stations. The sand component of these stations consisted primarily of medium to very fine sand which was ‘moderately sorted’ or ‘moderately well sorted’ and grey in appearance. The prevailing current direction (SE-NW) across the Hudson area has resulted in much of the finer drilling particulates to settle north and northwest of the manifold structure.

4.1.5.2 Chemical Characteristics

4.1.5.2.1 Tern

Gas chromatographic profiles obtained from the Tern cuttings pile sediments shared a common hydrocarbon distribution typical of an input of a synthetic paraffin-based drilling fluid which had undergone varying degrees of weathering. Additionally, several core sections also exhibited evidence of drilling fluids (Fugro, 2019).

Total Hydrocarbon content (THC) levels ranged from 2,600 mg/kg to 82,700 mg/kg with a mean of 28,800 mg/kg. The approximate ‘ecological effect’ threshold of 50 mg/kg dry weight for sediment total hydrocarbon concentrations was defined by OSPAR to estimate the environmental impacts of cuttings piles in the North Sea (OSPAR, 2017). THC levels exceeded the 50 mg/kg threshold in all core sections. The mean THC level was lower in the top core sections than in the middle and bottom core sections. A gradient of THC levels decreasing with distance from Tern was evident, suggesting a point source of hydrocarbons most likely related to drilling discharges.

At each station, there is a good correlation between THC and total Alkylphenol Ethoxylates (APEs), indicating that these compounds probably originated from the same source, discharged drill cuttings, although there has been some degradation of the APEs following discharge.

Within the Tern cuttings pile some metals, including cadmium, chromium, copper, mercury, lead, and zinc showed elevation above their respective OSPAR Effects Range Low (ERL) thresholds, above which a significant environmental impact might be expected (Fugro, 2019). Polychlorinated Biphenyls (PCB) and Tributyl Tin (TBT) concentrations recorded across the Tern cuttings pile are unlikely to have had a detrimental impact on the benthic community.

OSPAR Decision 2006/5 (OSPAR, 2006) requires operators to assess cuttings piles against:

- oil loss to the water column of 10 Te a year; and
- persistence of the area of seabed contamination of 500 $km^2 yr^{-1}$.

If either threshold is exceeded, the operator is required to characterise the cuttings pile and review the impacts. The sediment leachate analysis results indicated that both the oil loss to the water column and the persistence of the Tern cuttings pile fell below the relevant OSPAR threshold values.

Overall, the environmental data obtained from the pre-decommissioning survey at the Tern cuttings pile indicate that the cuttings pile sediments were heavily modified compared to the wider field but could generally be ascribed as typical for cuttings piles at North Sea installations (Fugro, 2019).

4.1.5.2.2 Hudson

Distinct layers were identified within all sample cores and sub-samples from all layers of the cores appeared to be hydrocarbon saturated, with odours of hydrocarbons recorded and cuttings material and showing a trend of increasing contamination below the surface layers. Gas chromatographic traces showed the presence of two predominant hydrocarbon contamination signatures, showing resemblance to LTOBM.

THC was elevated at stations in proximity to the Hudson manifold where several stations located within the boundary of notable cuttings discharge and exceeded the OSPAR (2006) 50 mg/kg threshold. Peak THC was recorded at stations sampled north and northwest of the manifold and in line with the prevailing current direction where levels reached a maximum of 2,173.7 mg/kg. Lower THC levels were noted at stations sampled near three wellheads at the Hudson manifold and the two satellite wells at the L1/L2 cuttings pile, due to the high sand content present (Benthic Solutions, 2022). While most core surface layers at the cuttings pile exceeded the OSPAR 50 mg/kg threshold, the concentrations are at the lower range of expected contamination when compared with historical North Sea studies.

Low to moderate levels of heavy metal contamination was evident at stations at the Hudson manifold and at stations closely associated with the L1/L2 cuttings piles, with the metals; arsenic, chromium, copper, lead, nickel, vanadium, zinc, mercury, and barium exceeding at a minimum their corresponding UKOOA 95th percentile reference values (Benthic Solutions, 2022).

OSPAR Decision 2006/5 (OSPAR, 2006) requires operators to assess cuttings piles against:

- oil loss to the water column of 10 Te a year; and
- persistence of the area of seabed contamination of 500 $km^2 yr^{-1}$.

If either threshold is exceeded, the operator is required to characterise the cuttings pile and review the impacts. The sediment leachate analysis results indicated that both the oil loss to the water column and the persistence of the Hudson cuttings pile fell below the relevant OSPAR threshold values.

Overall, the environmental data obtained from the Tern and Hudson cuttings piles indicated that the sediments are modified compared to the wider field but could be described as typical for cuttings piles at oil and gas installations, with the pile's characteristics falling within the OSPAR thresholds.

As a result, based solely on the criteria for environmental significance produced by UKOOA (2001) and OSPAR (2006), the potential environmental impact from the cuttings pile of the proposed decommissioning operations would be considered 'insignificant' with 'natural degradation' suggested as the best environmental strategy (Fugro, 2019; Benthic Solutions, 2022).

4.2 Biological Environment

4.2.1 Plankton

Planktonic assemblages exist in large water bodies and are transported with tides and currents as they flow around the North Sea. Plankton forms the basis of marine ecosystem food webs and therefore directly influences the movement and distribution of other marine species.

In both the northern and central areas of the North Sea, the phytoplankton community is dominated by dinoflagellates of the genus *Ceratium* and diatoms such as *Thalassiosira spp*. and *Chaetoceros spp*. In recent years the dinoflagellate *Alexandrium tamarense* and the diatom *Pseudo-nitzschia* (known to cause amnesic shellfish poisoning) has been observed in the area (DECC, 2016). Densities of phytoplankton fluctuate during the year, with sunlight intensity and nutrient availability driving its abundance and productivity together with water column stratification (Johns and Reid, 2001; DECC, 2016). In the 10-year period between 1997 and 2007, two main blooms are seen to occur in the NNS: one in May, and a second in August before levels decrease through the winter months when light and temperature are less abundant (SAHFOS, 2015).

Zooplankton species richness is greater in the northern and central areas of the North Sea, than in the south and displays greater seasonality. Zooplankton in this area is dominated by calanoid copepods, in particular *Calanus* and *Acartia spp*. and *Euphausiids* and decapod larvae are also important to the zooplankton community in this region (DECC, 2016).

Calanus finmarchicus has historically dominated the zooplankton of the North Sea and is used as an indicator of zooplankton abundance. Analysis of data provided by the Continuous Plankton Reader (CPR) surveys in the 10-year period between 1997 and 2007 shows a sharper spring increase in *C. finmarchicus* biomass in May in the NNS compared to more southerly areas. This peak in numbers is 70% greater than seen in the central North Sea and 88% greater than the southern North Sea over the same period (SAHFOS, 2015). The increase is likely a reflection of the increased availability of nutrients and food (including phytoplankton) in spring. Overall abundance of *C. finmarchicus* has declined dramatically over the last 60 years, which has been attributed to changes in seawater temperature and salinity (Beare *et al*., 2002; FRS, 2004). *C. finmarchicus* has largely been replaced by boreal and temperate Atlantic and neritic (coastal water) species and a relative increase in the populations of *C. helgolandicus* has occurred (DECC, 2009; Edwards *et al*., 2010; Baxter *et al*., 2011).

4.2.2 Benthos

The biota living near, on or in the seabed is collectively termed benthos. The diversity and biomass of the benthos is dependent on several factors including substrata (e.g. sediment, rock) type, water depth, salinity, the local hydrodynamics and degree of organic enrichment (DECC, 2016). The species composition and diversity of the benthos or macrofauna found within sediments is commonly used as a biological indicator of sediment disturbance or contamination.

In broad terms, the infauna present is characterised by the most abundant species present and appears very similar in all surveys around TAQA assets. Species consistently appearing in the lists of most abundant taxa centre around the polychaetes *Galathowenia oculata*, *Euchone incolor*, *Aonides paucibranchiata*, *Paradoneis lyra*, and the bivalve molluscs *Adontorhina similis* and *Axinulus croulinensis* (Xodus, 2018).

The epifauna present in all areas is generally noted as sparse (in direct contrast to the infauna) and typically features mobile species that have wide distributions throughout the North Sea. These include, for example, hermit crabs (usually *Pagurus spp.*), various starfish including *Asterias rubens*, *Porania pulvillus*, and *Luidia sarsi*, and sea urchins such as *Echinus acutus*.

Review of the faunal data obtained from the cuttings piles at Tern and Hudson indicated an impacted macrofaunal community was present when compared to the wider area. Bacterial mats were also observed at the Hudson manifold cuttings pile further evidencing organic enrichment in areas or relative contamination. Bacterial mats generally occur where significant organic enrichment has resulted in impoverished infaunal communities with a reasonable abundance of opportunist/scavenging species (JNCC, 2015b).

4.2.3 Potential Sensitive Habitats and Species

A review of data from the surveyed area within the wider Tern Area indicated the presence of several potentially sensitive habitats and species, including:

- ‘Submarine structures made by leaking gases’ - Annex I Habitat
- ‘Sea-pen and Burrowing megafauna communities – UK Biodiversity Action plan (BAP) habitat
- Ocean quahog (*Arctica islandica*) - OSPAR list of threatened and/or declining species and habitats (Region II - Greater North Sea)

These habitats are listed by one or more International Conventions, European Directives or UK Legislation (including devolved UK administrations).

‘Submarine structures made by leaking gases’ encompass hard substrates which support a unique community of organisms that are able to survive on the methane and hydrogen sulphide gasses associated with these ecosystems. There are two main types of submarine structures known to occur in the UK: bubbling reefs and submarine structures associated with pockmarks. Pockmarks are generally connected to the release of methane, which reacts with the surrounding seawater forming carbonate blocks.

Numerous depressions on the seabed were noted on the geophysical and photographic data across the surveyed areas. In particular, a large 1 m deep, 13 m wide depression was noted at station TERN_EBS_03. However, ground-truthing did not identify Methane Derived Authigenic Carbonates (MDAC) within the depressions.

Several seabed depressions that resembled pockmarks were also observed in the Hudson Area. However, none were thought to be associated with MDAC. A rock sample was recovered from the centre of a pockmark for subsequent analysis. This indicated it to be of metamorphic origin and is likely derived from a glacial deposit with no MDAC present. The lack of MDAC present in pockmarks identified across the Tern Area indicates that Annex I ‘Submarine structures caused by leaking gases’ are not present (Benthic Solutions, 2022).

A single ocean quahog individual was identified during the taxonomic analysis at station TERN_EBS_07 (Benthic Solutions, 2019). Low abundances of *A. islandica* (ocean quahog) were identified at Hudson during the most recent survey effort (Benthic Solutions, 2022). No evidence of distinct *A. islandica* siphons was seen on any of the video footage within the survey area. No *A. islandica* were observed in surveys of the Cladhan, Kestrel, and Falcon fields (Fugro 2014; Gardline, 2009, 2010, 2011, 2012a, 2012b; Cale-survey, 2012, Xodus, 2018). The ocean quahog sightings at Tern and Hudson do not constitute aggregations and surveys of Marine Protected Area (MPA) designated for the protection of *A. islandica* populations have shown only sparse populations (O'Connor, 2016; cited in Benthic Solutions, 2019). In summary, the presence of ocean quahog individuals over the whole area of interest must be assumed, however the presence of aggregations is unlikely.

Another feature of conservation concern potentially present in the area is the OSPAR (2008) listed habitat 'Seapen and burrowing megafauna communities'. According to JNCC (2015) guidance, the key determinant for classification of 'Seapen and burrowing megafauna communities' is the presence of burrowing species or burrows at a SACFOR (super-abundant, abundant, common, frequent, occasional, rare) density of at least 'frequent'. Benthic Solutions (2019) estimated the density of burrow openings at the seabed using representative video transects from sampling stations within the Tern field and found that the density of small and large burrows across the two transects were recorded as 'occasional' on the SACFOR scale and therefore not considered to be a high enough density to be classified as a Feature of Conservation Interest (FOCI) or as an OSPAR Habitat. The "Tern field" image in Figure 4-2 shows typical seabed imagery from the Benthic Solutions 2019 survey. A small patch of burrows was present 450 m northwest of the Hudson manifold. They were classified as 'rare' on the SACFOR scale and as such, the area would not be considered 'Seapen and burrowing megafauna communities' (Benthic Solutions, 2022). No surveys conducted within any of the other fields identified presence of this habitat (Xodus, 2018).

With regards to free-swimming species, ling (*Molva molva*) were observed within the Falcon field (Gardline, 2009) and during the recent surveys of the Hudson field (Benthic Solutions, 2022). Ling are a Scottish PMF species. Amongst other species observed during the Hudson survey were members of the order Gadiformes, cod (*Gadus morhua*) and saithe (*Pollachius virens*). Cod and saithe are both PMF species. Additionally, cod is an OSPAR listed threatened and/or declining species. Other species were present but were less frequently observed such as anglerfish (*Lophius piscatorius*) which are also a PMF (Benthic Solutions, 2022).

No other benthic habitat or species features of conservation interest have been noted within the Tern Area, including those listed on the Annex I of the European Commissions (EC) Habitats Directive, the International Union for Conservation of Nature (IUCN) Red List of Threatened Species, the OSPAR list of threatened and/or declining species, or the Scottish PMF list (NMPI, 2022).

4.2.4 Blue Carbon

Marine sediments are the primary store of biologically derived carbon (mostly inorganic carbon). Marine ecosystems that contribute to climate change mitigation by sequestering excess carbon from the atmosphere are known as Blue Carbon ecosystems. The Intergovernmental Panel on Climate Change (IPCC) defines Blue Carbon as "All biologically-driven carbon fluxes and storage in marine systems that are amenable to management" (IPCC, 2019). Many natural processes and ecosystem components contribute to carbon sequestration and burial; when these are disrupted additional carbon previously stored can be released into the ocean or atmosphere.

As Blue Carbon increasingly becomes a focus for research and policymakers so does our ability to measure the rates and permanence of carbon sequestration (Macreadie *et al*., 2017). To date, focus has been placed on biogenic marine habitats (e.g., saltmarshes and seagrasses), which are highly productive places. Scotland's biogenic marine habitats have a very high rate of assimilation of carbon into plant material (662 gC/m^2/yr), mostly in coastal areas (Burrows *et al*., 2014; 2017). However, their overall contribution to the carbon budget is relatively small compared to offshore sediments (Himli *et al.,* 2021).

Carbon may be sequestrated in marine sediments as precipitated carbonates (PCO) or as particulate organic carbon (POC). While it is known that sediment accumulation rates tend to be faster nearer to land (e.g. in sea lochs), it is unclear what processes maintain the accumulation basins on the shelf, or whether any of the rich supply of organic material from phytoplankton in productive shelf waters becomes refractory and remains there (Burrows *et al*., 2014). The principal threat to long term carbon burial in sediments is any process that stirs up the sediment, particularly the top few millimetres of sediment. Resuspension of sediment allows rapid consumption of buried carbon by organisms and its subsequent release as carbon dioxide. This effectively reduces the carbon burial rate significantly and reduces the blue carbon inventory.

Total standing stock of organic carbon in Scotland's marine sediments is estimated as 18.1 million tonnes Carbon (MtC), and total sequestration capacity of Scottish seas as 7.2 MtC/yr. Patterns of standing stocks and sequestration capacity of organic carbon follow the distribution of mud and mud-sand-gravel combinations. Most organic carbon and the largest capacity for sequestration of organic carbon appears to be in deep mud off the continental shelf (Burrows *et al*., 2014).

The percentage carbonate in the top 10 cm of superficial sediments in UKCS Blocks 210/24, 210/25, 210/29, 210/30 and 211/21 ranges from 10 to 40% (BGS, 2022) which is above average compared the UKCS more generally (UKCS average value is 10.1%; Burrows *et al*., 2014; NMPi, 2022). The variation in carbonate sequestration can be attributed to the sediment composition across the fields, with sandy and muddy (fine) sediment generally exhibiting a higher percentage uptake of carbonate (Burrows *et al*., 2014).

4.2.5 Fish and Shellfish

A number of commercially important fish and shellfish species occur in the vicinity of the proposed decommissioning operations. Fish and shellfish populations may be vulnerable to impacts from offshore installations such as hydrocarbon pollution and exposure to aqueous effluents, especially during the egg and juvenile stages of their lifecycles (Bakke *et al*., 2013).

The Tern Area infrastructure is located in International Council for the Exploration of the Sea (ICES) rectangles 51F0 and 51F1, in an area of spawning and nursery grounds for several commercially important species. Information on spawning and nursery periods for these different species, including peak spawning times is detailed in Table 4-1.

Table 4-1 Fisheries Sensitivities Within The 51F0 and 51F1 ICES Rectangles

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Anglerfish	N	N	N	N	N	N	N	N	N	N	N	N
Blue Whiting	N	N	N	N	N	N	N	N	N	N	N	N
Cod	S	S*	S*	S								
European hake	N	N	N	N	N	N	N	N	N	N	N	N
Haddock	N	S*N	S*N	S*N	SN	N	N	N	N	N	N	N
Herring	N	N	N	N	N	N	N	N	N	N	N	N
Ling	N	N	N	N	N	N	N	N	N	N	N	N
Mackerel	N	N	N	N	N	N	N	N	N	N	N	N
Norway pout	SN	S*N	S*N	SN	N	N	N	N	N	N	N	N
Saithe	S*	S*	S	S								
Spurdog	N	N	N	N	N	N	N	N	N	N	N	N
Whiting	N	SN	SN	SN	SN	SN	N	N	N	N	N	N
S = Spawning, N = Nursery, SN = Spawning and Nursery; * = peak spawning; Species = High nursery intensity as per Ellis *et al*, 2012; Species = High intensity spawning as per Ellis *et al* (2012); Species = High concentration spawning as per Coull *et al.*, 1998;												

Spawning areas for most species are not rigidly fixed and fish may spawn either earlier or later from year to year. In addition, the mapped spawning areas represent the widest known distribution given current knowledge and should not be seen as rigid unchanging descriptions of presence or absence (Coull *et al*, 1998). Whilst most species spawn into the water column of moving water masses over extensive areas, benthic spawners (e.g., herring) have very specific habitat requirements, and therefore their spawning grounds are relatively limited and potentially vulnerable to seabed disturbance and change.

The Tern Area represents low intensity or undetermined intensity spawning ground for saithe (*Pollachius virens*), Norway pout (*Trisopterus esmarkii*), whiting (*Merlangius merlangus*) and haddock (*Melanogrammus aeglefinus*) (Ellis *et al*., 2012; Coull *et al*.,1998). ICES rectangle 51F1, where Kestrel is located, represents high intensity spawning ground for cod (See Figure 4-6).

The Tern Area is also a potential nursery ground for anglerfish (*Lophius piscatorius*), blue whiting (*Micromesistius poutassou*), European hake (*Merluccius merluccius*), haddock, herring (*Clupea harengus*), ling, mackerel (*Scomber scombrus*), spurdog (*Squalus acanthias*), whiting and Norway pout. Blue whiting is the only species with a high intensity nursery ground in the Tern Area while other species have a lower nursery intensity (Coull *et al*, 1998; Ellis *et al*., 2012) (See Figure 4-7).

Haddock, saithe, and Norway pout are known to produce pelagic eggs. Herring are benthic spawners, but these are not reported to spawn within the Tern Area (Coull *et al*, 1998; Ellis *et al*., 2012).

Fisheries sensitivity maps produced by Aires *et al*., (2014) for Marine Scotland Science detail the likelihood of aggregations of fish species in the first year of their life (group 0 or juvenile fish). These do not represent ‘nursery grounds’ as described in Coull *et al*. (1998) and Ellis *et al*. (2012), as nursery grounds can comprise a larger spread of ages and sizes. With this caveat in mind, the modelling indicates the presence, in medium densities, of juvenile fish (less than one year old) for six species within the Tern Area. This includes haddock, whiting, Norway pout, anglerfish, blue whiting, and European Hake. All other species were low (Aires *et al*., 2014).

The following species listed above are also listed as Scottish PMFs and are considered as of natural heritage importance: anglerfish, blue whiting, herring, ling, mackerel, Norway pout, saithe, spurdog, herring, and cod (SNH, 2014).

Blue whiting, herring, Norway pout, saithe, spotted ray, and whiting are also on the IUCN Red List (although listed as species of 'least concern' at a European level) (IUCN, 2018). Herring, cod, whiting, hake, blue whiting, ling, plaice, mackerel, Norway pout and spurdog are on the Scottish Biodiversity List which identifies species of most importance for biodiversity conservation in Scotland (NatureScot, 2020). Spurdog are on the OSPAR (2008) List of Threatened and/or Declining Species and Habitats. Species of conservation interest which were identified during surveys are discussed in Section 4.2.3.

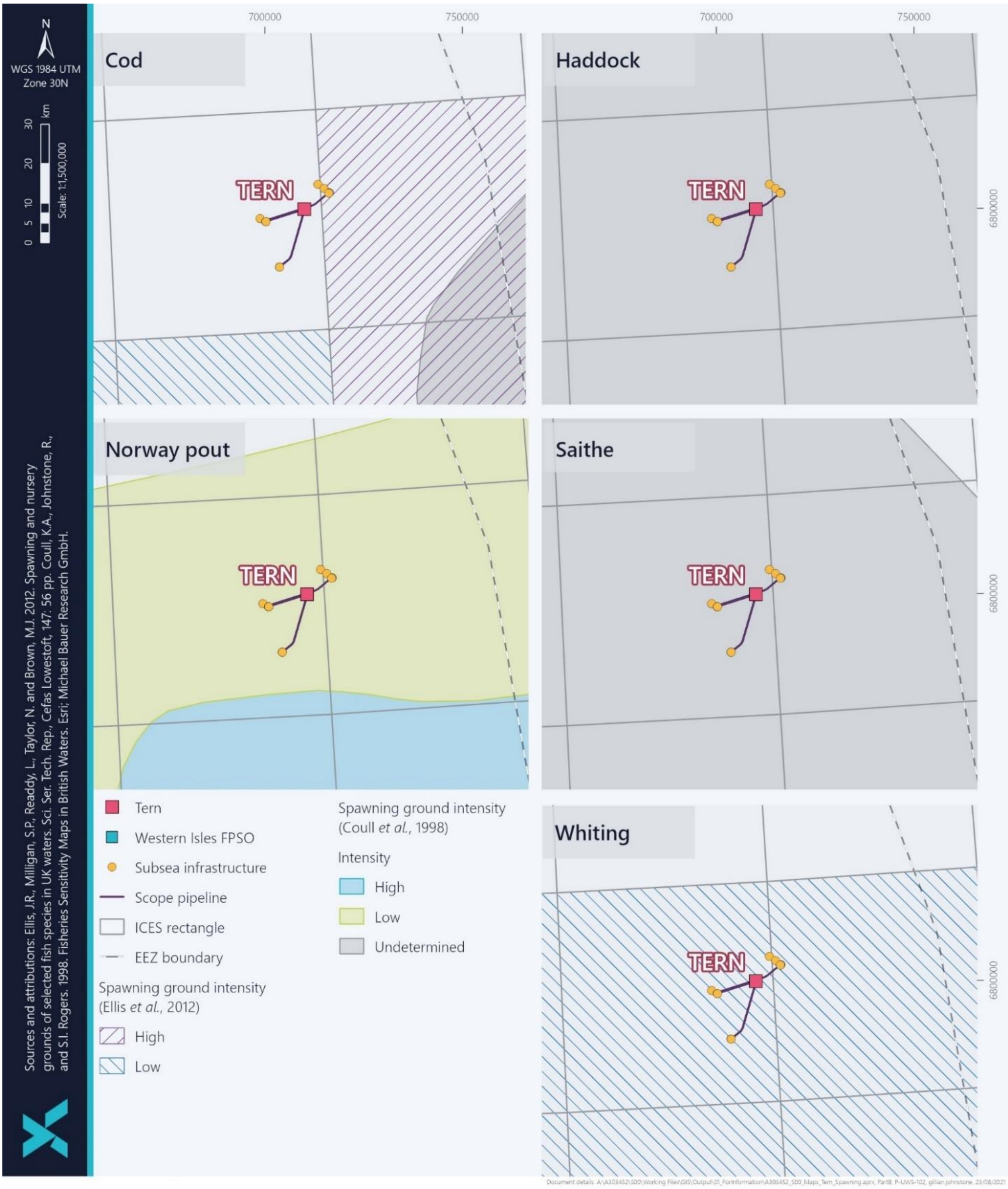


Figure 4-6 Potential Fish Spawning Grounds

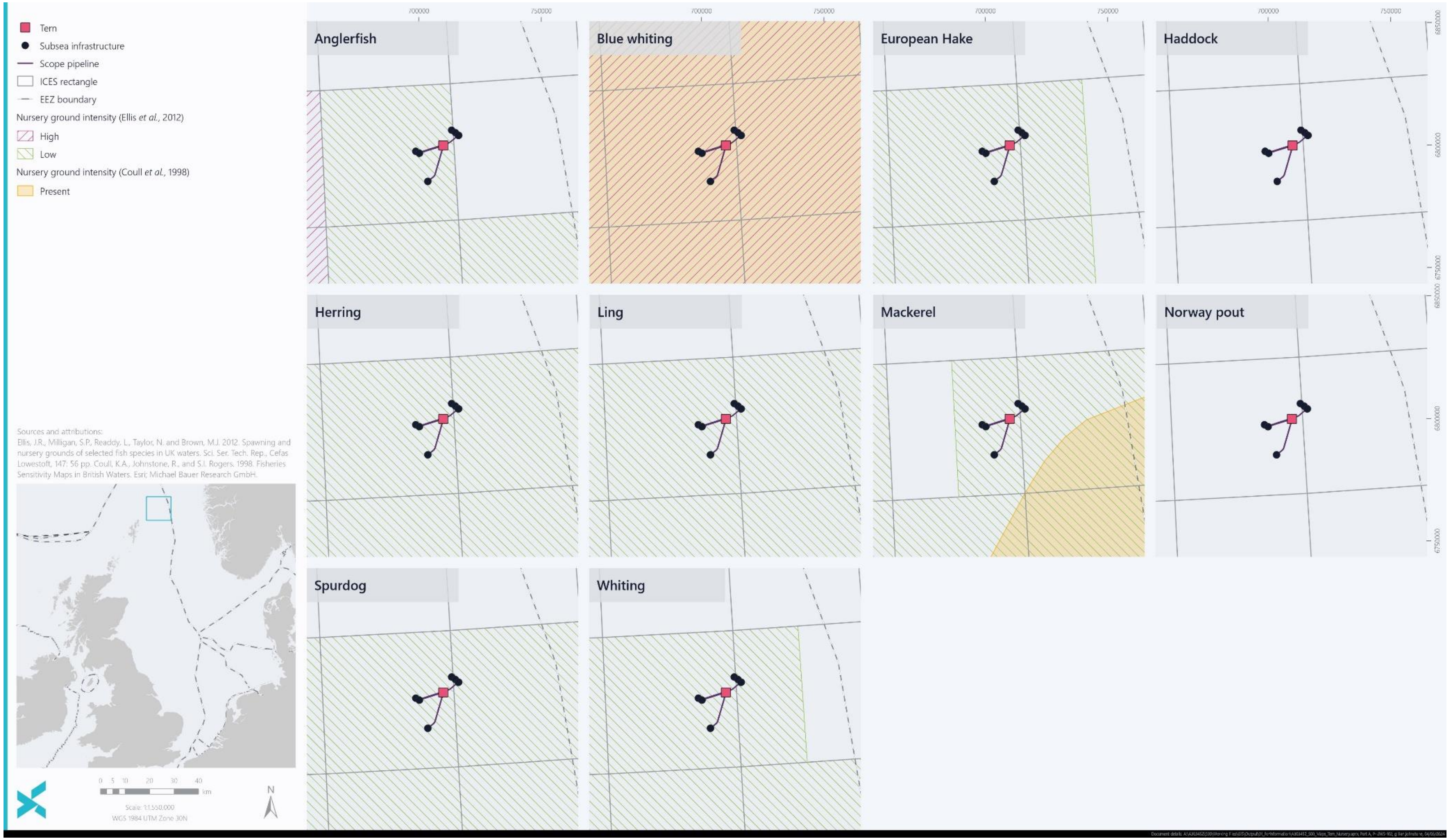


Figure 4-7 Potential Fish Nursery Habitats

4.2.6 Seabirds

Much of the North Sea and its surrounding coastline is an internationally important breeding and feeding habitat for seabirds. In the NNS the most numerous species present are likely to be northern fulmar (*Fulmarus glacialis)*, black-legged kittiwake (*Rissa tridactyla)* and common guillemot (*Uria aalge)* (DECC, 2009; DECC, 2016). Seabirds are not normally affected by routine offshore oil and gas operations. In the unlikely event of an oil release, however, birds are vulnerable to oiling from surface pollution, which could cause direct toxicity through ingestion, and hypothermia, because of the birds' inability to waterproof their feathers. Birds are most vulnerable in the moulting season when they become flightless and spend a large amount of time on the water surface.

After the breeding season ends in June, large numbers of moulting auks, including common guillemot, razorbill (*Alca torda)* and Atlantic puffin (*Fratercula arctica*), disperse from their coastal colonies and into the offshore waters from July onwards. At this time these high numbers of birds are particularly vulnerable to oil pollution. In addition to auks; black-legged kittiwake, northern gannet (*Morus bassanus)*, and northern fulmar are present in sizable numbers during the post breeding season.

Kober *et al*. (2010) have identified hotspots for several breeding seabirds in UK waters. The Tern Area is located within or in the vicinity of a wider area of hotspots for northern fulmar, northern gannet, European storm petrel (*Hydrobates pelagicus)*, Arctic skua (*Stercorarius parasiticus)*, great skua (*Stercorarius skua)*, black-legged kittiwake, herring gull (*Larus argentatus)*, Arctic tern (*Sterna paradisaea)*, guillemot, razorbill, and Atlantic puffin during their breeding season.

The offshore presence of these species during the breeding season is confirmed by the maximum foraging distances from colonies reported by Thaxter *et al*. (2012). Of the most abundant species in the Tern Area listed above, the northern fulmar has been recorded up to 580 km from colonies, the common guillemot up to 135 km, the northern gannet up to 590 km, and the Atlantic puffin up to 200 km (Thaxter *et al*., 2012).

The Seabird Oil Sensitivity Index (SOSI) (Webb *et al*., 2016) identifies sea areas where seabirds are likely to be most sensitive to oil pollution. SOSI values across the Tern area (red highlight) and adjacent Blocks are listed in Table 4-2. Overall, seabird sensitivity to oil pollution in the region of the Tern Area subsea infrastructure is considered low (score of 5) throughout most of the year. Sensitivity is extremely high (score of 1) across most of the area in December and January. However, in the majority of the Blocks containing the Tern facilities, sensitivity is low even in December and January.

Table 4-2 Seabird Oil Sensitivity in Blocks 210/24, 210/25, 210/29, 210/30, 211/16, 211/21 and Adjacent Blocks (Webb *et al*., 2016)

Block	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
210/18	1	5	5	5*	5	5*	5	5	5	5*	N	1*
210/19	1	5	5	5*	5*	5*	5	5	5	5*	N	1*
210/20	3	5	5	5*	N	5*	5	5	5	5*	4*	4
210/23	1	5	5	5*	5*	5*	5	5	5	5*	5*	5
210/24	1	5	5	5*	5*	5*	5	5	5	5*	5*	5
210/29	2	5	5	5*	3*	3	5	5	5	5*	5*	5
211/16	4*	5	5	5*	N	5*	5	5	5	5*	4*	4
210/25	5	5	5	5*	N	5*	5	5	5	5*	5*	5
211/26	5	5	5	5*	5*	5	5	5	5	5*	5*	5
210/30	5	5	5	5*	5*	5	5	5	5	5*	5*	5
2/4	5	5	5	5*	3*	3	5	5	5	5*	5*	5
2/5	5	5	5	5*	5*	5	5	5	5	5*	5*	5
3/1	5	5	5	5*	5*	5	5	5	5	5*	5*	5
210/22	1	5	5	5*	5	5*	5	5	5	5*	N	1*
210/27	1	5	5	5*	5*	5*	5	5	5	5*	5*	5
210/28	1	5	5	5*	5*	5*	5	5	5	5*	5*	5
2/2	1	5	5	5*	5*	5*	5	5	5	5*	5*	5
2/3	1	5	5	5*	3*	3	5	5	5	5*	5*	5
211/17	3*	5	5	5*	N	5*	5	5	5*	N	3*	3
211/21	5	5	5	5*	N	5*	5	5	5	5*	5*	5
211/22	5	5	5	5*	N	5*	5	5	4	4*	4*	4
211/27	5	5	5	5*	5*	5	5	5	4	4*	5*	5
Key	1 = Extremely high		2 = Very high		3 = High		4 = Medium		5 = Low		N = No data	
* in light of coverage gaps, an indirect assessment of SOSI has been made												

4.2.7 Marine Mammals

4.2.7.1 Cetaceans

The NNS has a moderate to high diversity and density of cetaceans, with a general trend of increasing diversity and abundance with increasing latitude. Harbour porpoise (*Phocoena phocoena)* and white-beaked dolphin (*Lagenorhynchus albirostris)* are the most widespread and frequently encountered species, occurring regularly throughout most of the year. Minke whales (*Balaenoptera acutorostrata)* are regularly recorded as frequent seasonal visitors. Coastal waters of the Moray Firth and east coast of Scotland support an important population of bottlenose dolphins (*Tursiops truncates)*, while killer whales (*Orcinus orca)* are sighted with increasing frequency towards the north of the area. Atlantic white-sided dolphin (*Lagenorhynchus acutus)*, Risso's dolphin (*Grampus griseus)* and long-finned pilot whale (*Globicephala melas)* can be considered occasional visitors, particularly in the north of the area (DECC, 2016).

White-sided dolphin, harbour porpoise, killer whale and minke whale have been recorded in the vicinity of the Tern field (Reid *et al*, 2003). The harbour porpoise has been recorded at high densities (approximately 10-100 individuals cited per hour) in February and August (Reid *et al*., 2003).

In 2022, the fourth series of Small Cetaceans in European Atlantic waters and the North Sea (SCANS-IV) survey was conducted in European Atlantic waters. This involved a large-scale ship and aerial survey to study the distribution and abundance of cetaceans. Harbour porpoise, white-beaked dolphin, minke whale and beaked whale were the most abundant species recorded in the survey block covering the Tern Area, with specific densities listed in Table 4-3 (Gilles *et al.,* 2023). Other species recorded within this survey block were killer whale and fin whale however there was not sufficient data for these species to provide abundance estimates (Hammond *et al*., 2017).

The proposed operations are within areas of concern for seismic surveys from January - May in Blocks 210/24, 210/25, 211/21 and 210/29 (NSTA, 2022) However, Tern Area decommissioning operations do not include seismic survey.

Table 4-3 Densities of Cetaceans in The Tern Area (Gilles et al., 2023)

Species	Density of Cetaceans in The Survey Block NS-E (Animals Per KM^2)
Harbour porpoise	0.439
White-beaked dolphin	0.306
Minke whale	0.027
Beaked whale	0.001

4.2.7.2 Seals

Two species of seal live and breed in the UK, namely the grey seal (*Halichoerus grypus*) and harbour seal (*Phoca vitulina*), both of which are protected under Annex II of the EU Habitats Directive and are listed as Scottish PMFs (SNH, 2014; Jones *et al*., 2015; DECC, 2016).

Approximately 38% of the world's grey seals breed in the UK with 88% of these breeding at colonies in Scotland with the main concentrations in the Outer Hebrides and in Orkney. Birth rates have grown since the 1960s, although according to data from the Special Committee on Seals (SCOS) population growth is levelling off (SCOS, 2014). Approximately 36% of the world's population breed in the UK and approximately 32% of harbour seals are found in the UK (SCOS, 2020). Following significant population declines due to disease in 1988 and 2002, harbour seal numbers on the English east coast have been rising since 2006 and have remained relatively constant (SCOS, 2020). Harbour seals are widespread around the west coast of Scotland and throughout the Hebrides and Northern Isles (SCOS, 2017).

Grey and harbour seals will feed both in inshore and offshore waters depending on the distribution of their prey, which changes both seasonally and yearly. Both species tend to be concentrated close to shore, particularly during the pupping and moulting season. Seal tracking studies from the Moray Firth have indicated that the foraging movements of harbour seals are generally restricted to a 40–50 km range of their haul-out sites (SCOS, 2020). The movements of grey seals can involve larger distances of several hundred kilometres, although most forage within 100 km of their haul out (SCOS, 2020).

Since the wider Tern Area is located approximately 104 km offshore, grey and harbour seals may be encountered from time to time, but it is not likely that they use the area with any regularity or in great numbers, and this is especially the case for harbour seals. This is confirmed by the grey and harbour seal distribution maps published by the Sea Mammal Research Unit (SMRU) (Carter *et al.*, 2020). These report the presence of grey and harbour seals in the Tern Area as between 0 – 0.001% of the British Isles at-sea population per 25 km^2 for both species (Carter *et al*., 2020).

4.3 Conservation

4.3.1 Offshore Conservation

There are no Nature Conservation Marine Protected Areas (NCMPAs), Special Areas of Conservation (SACs) or Special Protection Area (SPAs) within 40 km of the Tern Area. The closest protected site is the Pobie Bank Reef SAC, approximately 72 km south west of the Tern platform. The closest SPA is Hermaness, Saxa Vord and Valla Field SPA, approximately 104 km west of the Tern platform (Figure 4-8).

The seabed around the Tern Area infrastructure is within a wider area of 'subtidal sand and gravels' (NMPI, 2019), a seabed type designated as a PMF in Scottish waters (Tyler-Walters *et al.*, 2016). 'Subtidal sands and gravels' also support internationally important commercial fisheries e.g., scallops, flatfish, sandeels, and are important nursery grounds for juvenile commercial fish species such as sandeels, flatfish, bass, skates, rays and sharks (SNH, 2014). However, the distribution of this feature is relatively wide in the North Sea (NMPI, 2022).

4.3.2 Onshore Conservation

The Tern Area is located approximately 104 km from the northeast coast of Shetland. Due to this distance, no impacts to onshore conservation sites are expected from routine operations at the Tern Area decommissioning project.

4.3.3 Protected Species

Four species listed under Annex II of the EU Habitats Directive are found in UK waters; harbour porpoise, bottlenose dolphin, grey seal, and harbour seal. Grey and harbour seals are unlikely to be observed near the Tern decommissioning area with any regularity as both species have very low densities in these areas, as shown by the seal density maps produced by the SMRU in NMPI (2022). There is a resident population of bottlenose dolphins in the Moray Firth, but this population typically remains close to the coast. This species is however transient and therefore can occur in other areas around the North East of Scotland and also into NNS waters but they have not been recorded in the vicinity of the proposed operations. Therefore, harbour porpoise is the only Annex II species which is likely to be present in the vicinity of the Tern Area. However, due to their mobile nature, these species are likely to move away and not be adversely affected by the proposed decommissioning activities. All species of cetacean recorded within the proposed operations area are listed as European Protected Species (EPS).

It cannot be ruled out that *A. islandica*, ocean quahog, is present in the area (Xodus, 2018). This species is listed as PMF in Scottish waters (Tyler-Walters *et al.*, 2016) and is on the OSPAR List of Threatened and/or Declining Species (OSPAR, 2008). The distribution of *A. islandica* is relatively widespread in the North Sea (OSPAR, 2009). As described in Section 4.2.3, very few *A. islandica* (<10 individuals) were identified during site-specific surveys; however, the abundances do not constitute an aggregation.

All species of conservation concern which were identified in the Tern Area are described in Section 4.2.3.

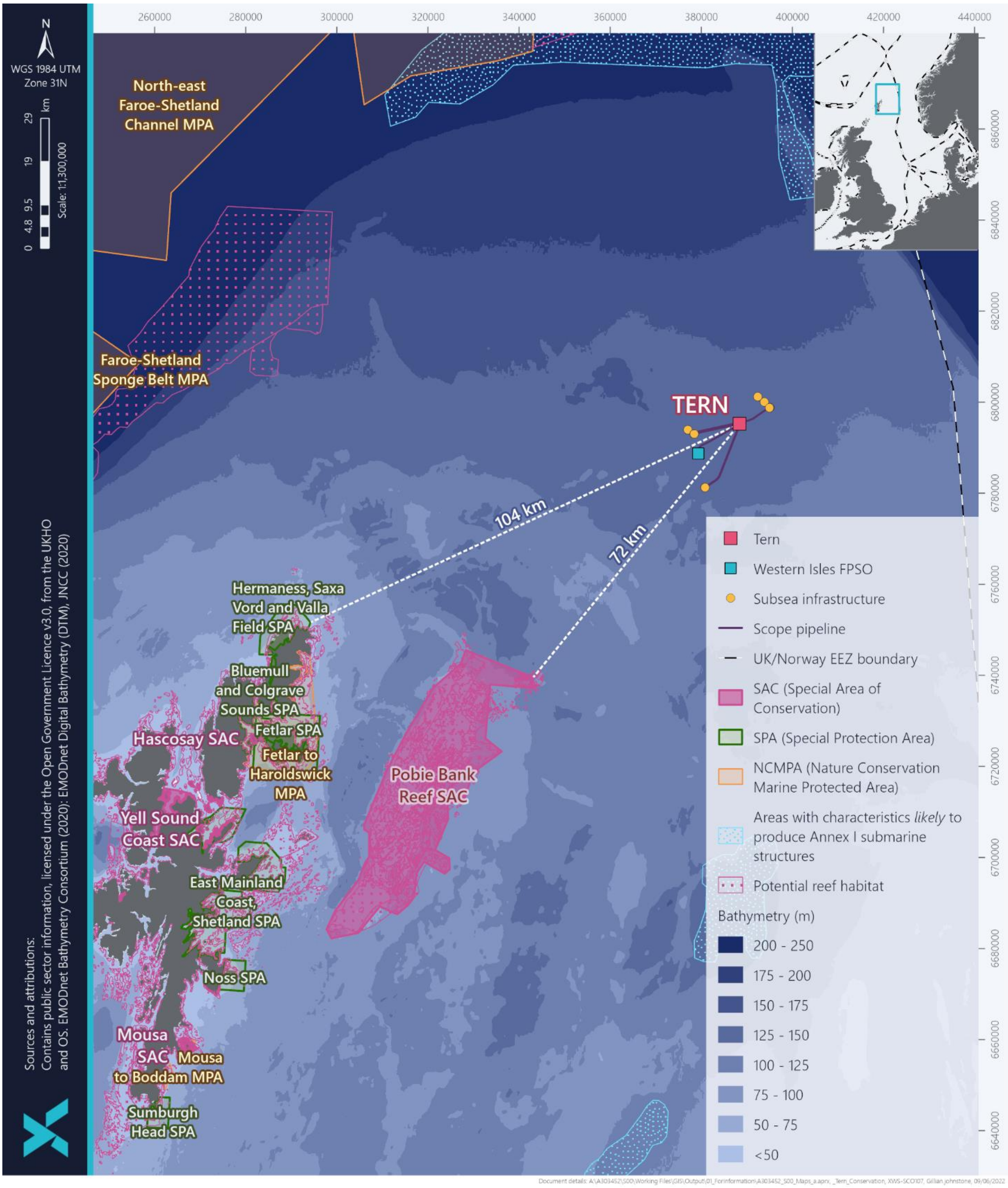


Figure 4-8 Location of The Tern Area Relative to Protected Areas

4.3.4 National Marine Plan

The NMP covers the management of both Scottish inshore waters (out to 12 nautical miles) and offshore waters (12 to 200 nautical miles). The aim of the NMP is to help ensure the sustainable development of the marine area through informing and guiding regulation, management, use and protection of the NMP areas. The proposed operations described in this EA have been assessed against the Marine Plan General Planning Principles, specifically GEN 1, 4, 5, 9, 12, 14 and 21 (Section 4.3.4.1 to Section 4.3.4.7) and OIL AND GAS 2, 3 and 6 (Section 4.3.4.8 to Section 4.3.4.10).

Assessment of compliance against relevant policies has already been achieved through the impact assessment in Section 6 in support of this EA. The proposed operations do not compromise any of the marine plan objectives and policies. TAQA will comply with all policies associated with the NMP, with particular attention being paid to the following policies:

4.3.4.1 GEN 1 – General Planning Principle

Development and use of the marine area should be consistent with the Marine Plan, ensuring activities are undertaken in a sustainable manner that protects and enhances Scotland's natural and historic marine environment. TAQA will ensure that any potential impacts associated with the selected Tern Area subsea infrastructure decommissioning operations will be kept to a minimum as discussed in Section 6.

4.3.4.2 GEN 4 – Co-existence

Where conflict over space or resource exists or arises, marine planning should encourage initiatives between sectors to resolve conflict and take account of agreements where this is applicable. TAQA will ensure that any potential impacts on other sea users associated with the proposed Tern subsea decommissioning operations will be kept to a minimum.

4.3.4.3 GEN 5 – Climate Change

Marine planners and decision makers should seek to facilitate a transition to a low carbon economy. They should consider ways to reduce emissions of carbon and other greenhouse gasses. TAQA will ensure that any potential impacts associated with the selected Tern Area subsea infrastructure decommissioning operations will be kept to a minimum as discussed in Section 6.

4.3.4.4 GEN 9 – Natural Heritage

Development and use of the marine environment must:

- Comply with legal requirements for protected areas and protected species
- Not result in significant impact on the national status of PMF
- Protect and, where appropriate, enhance the health of the marine area

TAQA will ensure that any potential impacts to protected species and sites associated with the selected Tern Area subsea infrastructure decommissioning operations will be kept to a minimum, as discussed in Section 6.

4.3.4.5 GEN 12 – Water Quality and Resource

Developments and activities should not result in a deterioration of the quality of waters to which the Water Framework Directive, Marine Strategy Framework Directive or other related Directives that apply. TAQA will ensure that any potential impacts to water quality associated with the selected Tern Area subsea infrastructure decommissioning operations will be kept to a minimum, as discussed in Section 6.

4.3.4.6 GEN 14 – Air Quality

Development and use of the marine environment should not result in the deterioration of air quality and should not breach any statutory air quality limits. Some development and use may result in increased emissions to air, including particulate matter and gasses. Impacts on relevant statutory air quality limits must be taken into account and mitigation measures adopted, if necessary, to allow an activity to proceed within these limits. TAQA will ensure that any potential impacts to air quality with the selected Tern subsea decommissioning operations will be kept to a minimum, as discussed in Section 6.

4.3.4.7 GEN 21 – Cumulative Impacts

Cumulative impacts affecting the ecosystem of the marine plan area should be addressed in decision making and plan implementation and where necessary, in collaboration with other operators working in the Tern Area. TAQA will ensure that any potential cumulative impacts to air and water quality and biological communities with the selected Tern Area subsea infrastructure decommissioning operations will be kept to a minimum, as discussed in Section 6.

4.3.4.8 OIL AND GAS 2 – Decommissioning End-Points

Where re-use of oil and gas infrastructure is not practicable, either as part of oil and gas activity or by other sectors such as carbon capture and storage, decommissioning must take place in line with standard practice, and as allowed by international obligations. Re-use or removal of decommissioned assets from the seabed will be fully supported where practicable and adhering to relevant regulatory process. TAQA will ensure that any material returned to shore as a result of the Tern Area subsea infrastructure decommissioning activities adheres to the waste hierarchy (Figure 3-10) as discussed in Section 3.7.

4.3.4.9 OIL AND GAS 3 – Minimising Environmental and Socio-Economic Impacts

Supporting marine and coastal infrastructure for oil and gas developments, including for storage, should utilise the minimum space needed for activity and should consider environmental and socio-economic constraints. TAQA will ensure that the onshore resources required for the Tern Area subsea infrastructure decommissioning activities will be minimised, as discussed in Section 6.

4.3.4.10 OIL AND GAS 6 – Risk Reduction

Consenting and licensing authorities should be satisfied that adequate risk reduction measures are in place, and that operators should have sufficient emergency response and contingency strategies in place that are compatible with the National Contingency Plan and the Offshore Safety Directive. TAQA will have the relevant risk reduction measures and emergency response provisions in place for the deconstruction of the Tern Area subsea infrastructure, as discussed in Section 6.

4.4 Socio-Economic Environment

4.4.1 Commercial Fisheries

To provide the fullest picture of fisheries within the area, and the associated landings and effort trends, data from 2018 to 2022 are considered (see Table 4-4 and Table 4-5). The Tern Area is located in ICES rectangles 51F0 and 51F1, which in general are targeted primarily for demersal species in terms of both landed weights and value (see Figure 4-9).

In ICES rectangle 51F0, demersal fish accounted for 99% to 100% of the total landed value and 99% to 100% of the total landed weight between 2018 and 2020 and in 2022 (see Table 4-4). In these same years, shellfish and pelagic species both accounted for <1% of the value and the landed weight. In 2021, the distribution of catch by landings weight and value was still predominantly attributed to demersal fish, accounting for 84% of the landed value and 67% of the landed weight, however, a greater proportion of landings were attributed to pelagic fish in this year, compared with 2018 – 2020 and 2022, accounting for <16% of the landed value and 33% of the landed weight (Marine Directorate, 2023).

The landings value and weight in ICES rectangle 51F1 were similarly weighted towards demersal, pelagic and shellfish, although the dominant species type varied by year. Demersal fish accounted for 100% of the landed value and weight for 2018, 2020 and 2022. In 2019 and 2020 there was a higher proportion of landed weight and value attributed to pelagic fish, which accounted 13% and 16% of landed weight and 3% and 7% of landed value for each year respectively. Shellfish fisheries in the rectangle represent <1% of the landed weight and value across 2018-2022. (Marine Directorate, 2023).

In 2022, the three most valuable species in ICES rectangle 51F0 were hake, whiting and saithe, and whiting, haddock, and cod in 51F1. These five species also made the largest contribution to landed weight and value in 2022. (Marine Directorate, 2023).

Between 2018 and 2022, the average live weight and value of demersal and pelagic fish in ICES rectangle 51F0 and 51F1 was lower than surrounding rectangles 50E9, 50F0 and 50F1 (Figure 4-9). In 2022, demersal fishing closer to Shetland was considerably higher. In ICES rectangle 50F0, immediately south of 51F0, demersal and pelagic catch was 1,882 and 1,108 Te respectively (Marine Directorate, 2023). To put the landings into context, catches amounting to 481,398 Te with a value of £684,497,956 were landed across the UK in 2022. Therefore, ICES rectangles 51F0 and 51F1 present a relatively low contribution to the UK total, comprising 0.19% and 0.28% of weight landed and providing a 0.26% and 0.35% contribution to the total value of the UK commercial fisheries in 2022 for ICES rectangles 51F0 and 51F1, respectively (Marine Directorate, 2023).

Table 4-5 presents the fishing effort in ICES rectangles 51F0 and 51F1 in days per month, between 2018-2022. Fishing effort in ICES rectangles 51F0 and 51F1 is dominated by demersal (trawl) activities and is relatively low in comparison to areas to the south. Fishing effort in 2022 amounted to 187 days in ICES rectangle 51F0 and 197 days in ICES rectangle 51F1 representing a substantial decrease in effort compared to 2021. This is mostly attributed to the decrease in effort all year round. Fishing effort was highest in the months of April, May, June in ICES rectangle 51F0, and higher than effort in 2021 for those respective months (Marine Directorate, 2023). Fishing effort was highest in March, April, and May and then between September to October in ICES rectangle 51F1 in 2022. The effort in March for that year was higher than in 2021, however significantly lower in April, May, June and July (disclosive data) than in 2021.

Trawls were the dominant gear types used in ICES rectangles 51F0 and 51F1. Hooks and lines were also operated across all years in ICES rectangle 51F0 and seine nets were operated in all years in both ICES rectangles 51F0 and 51F1 (recorded as disclosive effort) (Figure 4-9) (Marine Directorate, 2023).

Table 4-4 Live Weight and Value from ICES 51F0 and 51F1 from 2018-2022 (Marine Directorate, 2023)

Species Type	2022				2020				2019				2018				2017			
	Live Weight (Te)		Value (£)		Live Weight (Te)		Value (£)		Live Weight (Te)		Value (£)		Live Weight (Te)		Value (£)		Live Weight (Te)		Value (£)	
	51F0	51F1	51F0	51F1	51F0	51F1	51F0	51F1	51F0	51F1	51F0	51F1	51F0	51F1	51F0	51F1	51F0	51F1	51F0	51F1
Demersal	899	1,327	1,785,537	2,398,088	911	1,702	1,706,031	2,914,228	1,195	877	1,960,181	1,301,666	1,840	1,204	3,526,935	2,136,673	1,003	846	1,625,141	1,381,095
Pelagic	0	-	309	-	454	324	327,991	236,261	0	0	19	199	0	175	178	59,457	-	1	-	637
Shellfish	2	2	10,736	9,137	3	3	7,245	11,430	4	2	10,681	5,734	3	3	12,244	12,507	1	1	2,966	3,272
Total	**902**	**1,329**	**1,796,582**	**2,407,225**	**1,367**	**2,029**	**2,041,267**	**3,161,919**	**1,198**	**879**	**1,970,881**	**1,307,599**	**1,843**	**1,382**	**3,539,357**	**2,208,637**	**1,004**	**848**	**1,628,107**	**1,385,005**

Table 4-5 Fishing Days Per Month (All Gear) In ICES 50F0 And 51F1 From 2018-2022 (Marine Directorate, 2023)

Year	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Total	
	51F0	51F1	51F0	51F1	51F0	51F1	51F0	51F1	51F0	51F1	51F0	51F1	51F0	51F1	51F0	51F1	51F0	51F1	51F0	51F1	51F0	51F1	51F0	51F1	51F0	51F1
2018	D	D	D	10	D	D	19	27	29	14	33	D	23	7	12	17	D	18	10	19	10	D	21	-	157	112
2019	5	11	10	18	17	14	D	32	25	9	D	D	10	D	60	18	23	38	28	21	57	6	6	D	241	167
2020	9	D	23	9	14	11	29	16	47	D	76	11	13	24	25	14	27	7	21	12	18	11	D	D	302	115
2021	4	9	18	D	10	13	15	46	23	68	25	31	23	35	24	10	33	18	22	D	17	15	D	7	214	252
2022	D	10	7	D	13	37	33	23	48	25	34	14	D	D	16	9	14	21	D	24	11	20	11	14	187	197

Note: Monthly fishing effort by UK vessels landing into Scotland: Blank = no data, D = Disclosive data (indicating very low effort) [1], green = 0 – 100 days fished, yellow = 101 – 200, orange =201-300, red = ≥301

[1] The term 'disclosive' is used when fewer than five vessels have been recorded fishing in an area, meaning that detailed data cannot be shown in order to preserve data privacy. It therefore indicates very low levels of effort within the area.

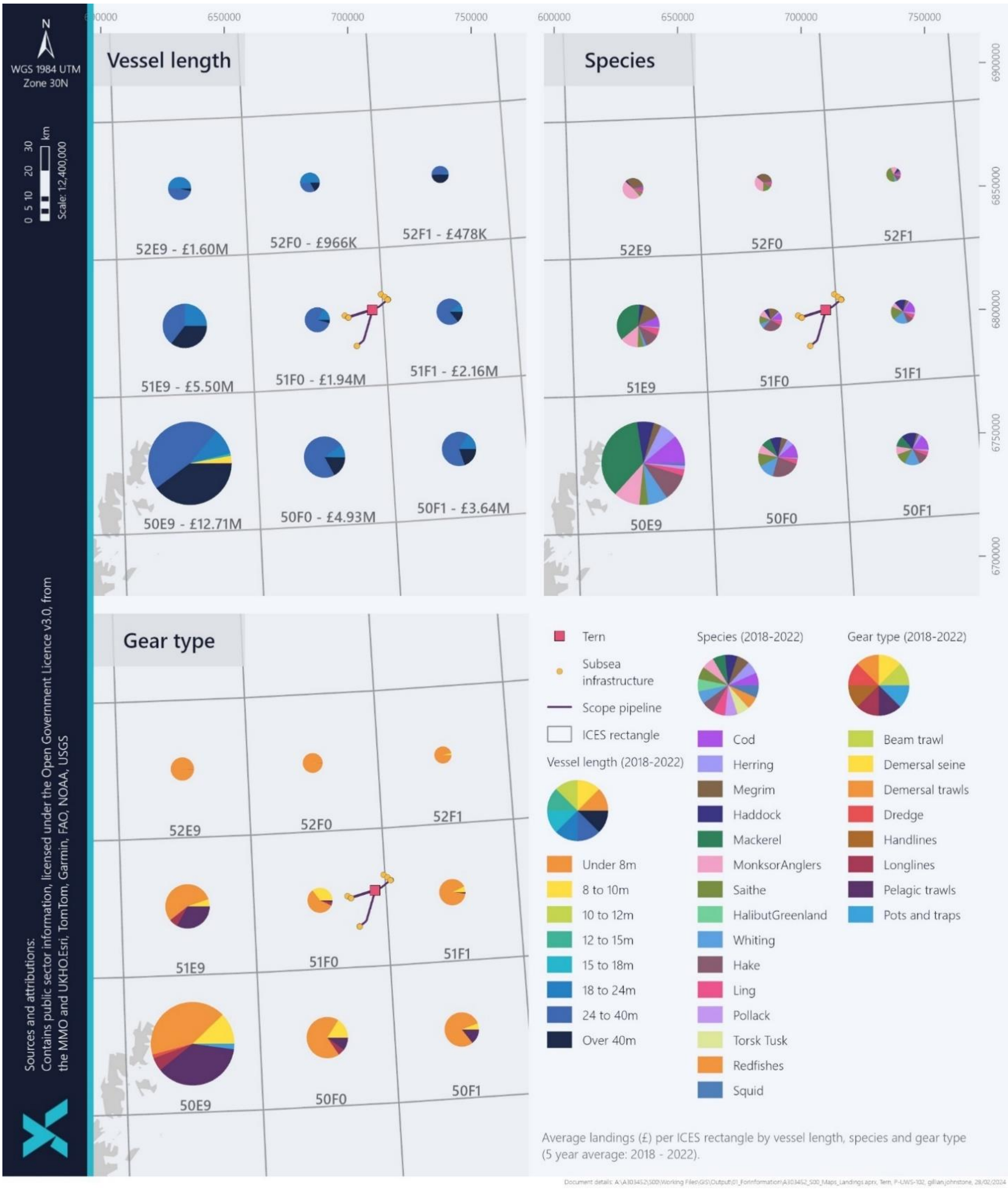


Figure 4-9 Average Landings Values (£) of Demersal, Pelagic and Shellfish Fisheries, Species, and Gear Type in The Vicinity of The Tern Area Subsea Infrastructure by ICES Rectangle (2018-2022)

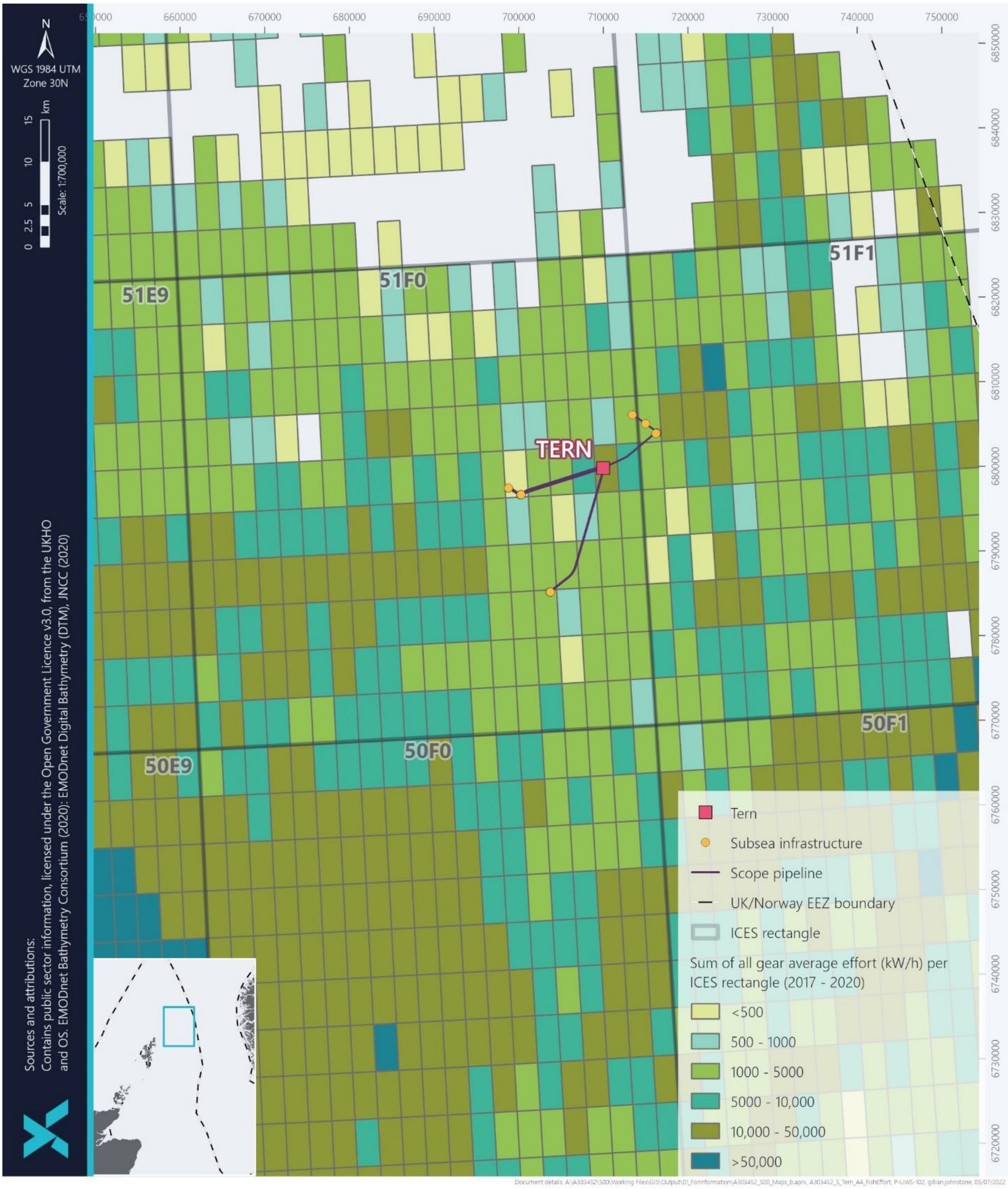


Figure 4-10 Effort (kWh) of Pelagic Fisheries by ICES Rectangle (2017-2020)

4.4.2 Shipping

The North Sea contains some of the world's busiest shipping routes, with significant traffic generated by vessels trading between ports at either side of the North Sea and the Baltic. North Sea oil and gas fields generate moderate vessel traffic in the form of support vessels, principally operating from Peterhead, Aberdeen, Montrose, and Dundee in the north and Great Yarmouth and Lowestoft in the south (DECC, 2016). The level of shipping activity is considered low or very low in Blocks 210/24, 210/25, 211/21, 210/29 and 210/30 (OGA, 2016).

The average weekly density of vessels (all combined) identified from 2019 automatic identification systems (AIS) data varied across the Tern Area (MMO, 2019). There are several regions of higher vessel density at the Tern, Cormorant North and Cormorant Alpha platforms. These areas of higher vessel activity can be attributed to the presence of operational and maintenance vessels around these surface installations. Generally, the data shows increased vessel density towards the coast of Shetland. In the wider offshore area, average annual density of all vessel transits is < 150 per 4 km^2 (Figure 4-11; MMO, 2019).

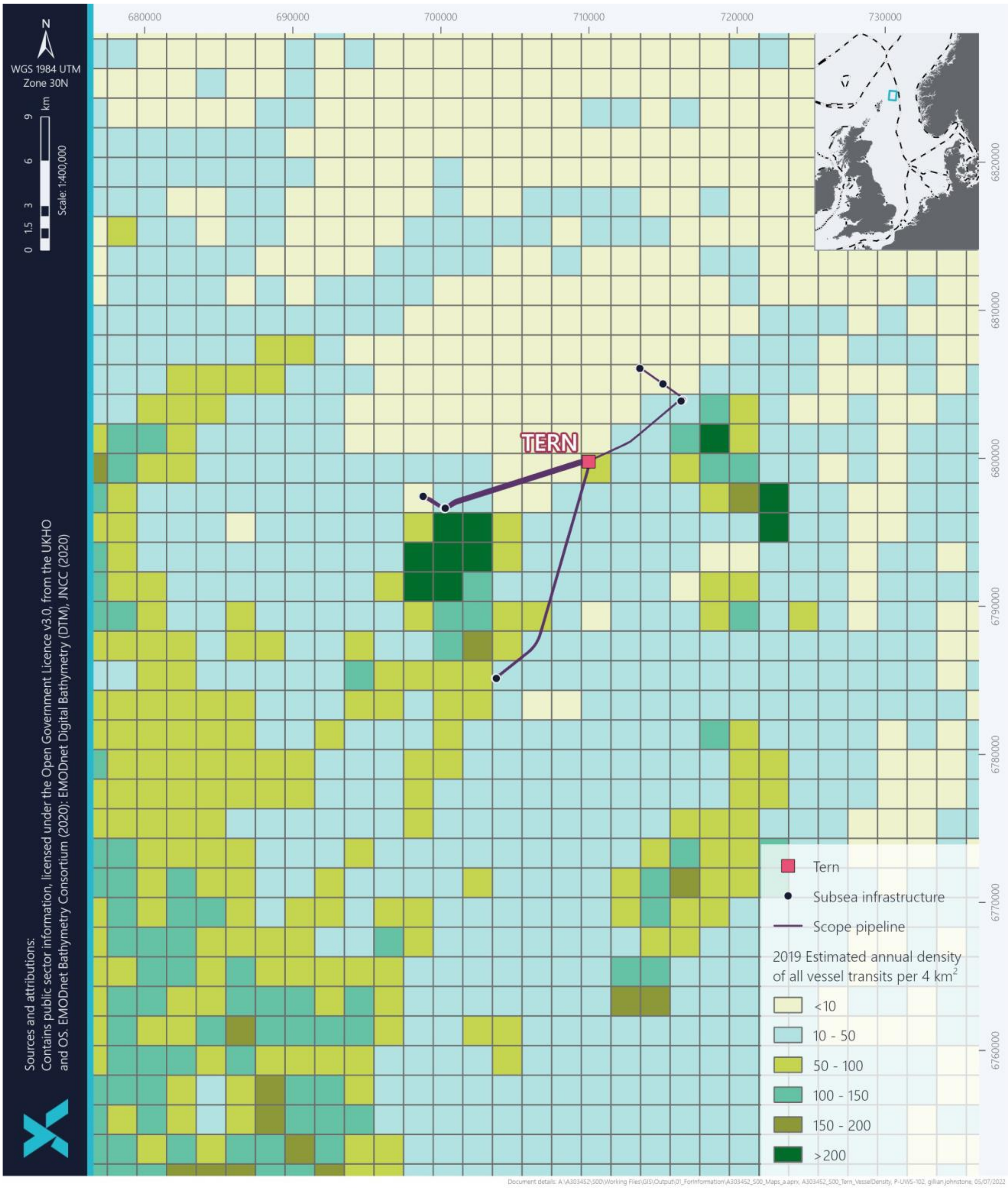


Figure 4-11 Density of Vessel Transits Around The Tern Area in 2019 (MMO, 2019)

4.4.3 Oil and Gas Activity

There are several oil and gas installations in the vicinity of the Tern Area, as outlined in Figure 4-12. Table 4-6 provides the distances to surface installations within 40 km of the Tern Area.

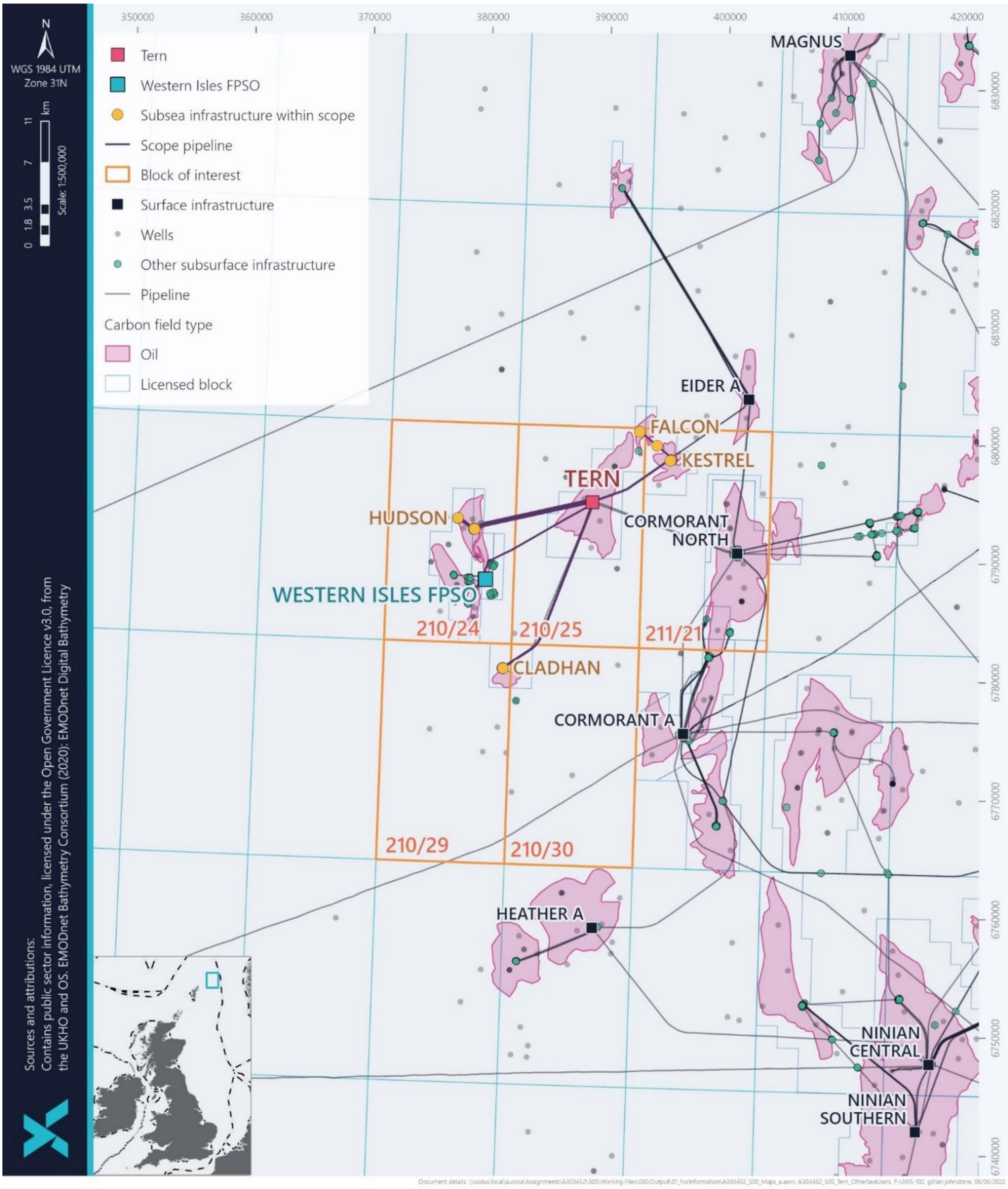


Figure 4-12 Installations in The Vicinity of The Tern Area

Table 4-6 Surface Installations Located Within 40 km of The Tern Area

Installation	Type / Status	Operator	Distance/ Direction from Kestrel	Distance/ Direction from Falcon	Distance/ Direction from Cladhan	Distance/ Direction from Hudson
Tern	Platform / Operational	TAQA	7.6 km Southeast	7.2 km Southeast	15.6 km North Northeast	10.3 km East Northeast
Cladhan	Field / Operational	TAQA	22.5 km Southwest	23km South Southeast	N/A	12 km South
Hudson	Field / Operational	TAQA	17.6 km Southwest	16.2 km South Southwest	12 km North	N/A
Kestrel	Field / Operational	TAQA	N/A	3.5 km Northwest	22.7 km North Northeast	17.6 km Northeast
Falcon	Field / Operational	TAQA	3.5 km Southeast	N/A	23.3 km North Northeast	16.2 km North Northeast
Cormorant Alpha	Platform / Operational	TAQA	23.4 km South	25.8 km South	16.1 km East	24.7 km Southeast
North Cormorant	Platform / Operational	TAQA	9.7 km Southeast	13 km Southeast	22 km Northeast	22.4 km East
Eider	Platform / Non-Operational	TAQA	8.3 km Northeast	9.6 km East Northeast	30.8 km Northeast	25.6 km Northeast
Otter	Field / Operational	TAQA	23.3 km North Northwest	20.9 km North	41.6 km North Northeast	31.5 km North Northeast
Pelican	Field / Operational	TAQA	31.2 km South	34.1 km South Southeast	22.4 km Southeast	32.4 km Southeast
PL4	Pipeline / Operational	TAQA	23.4 km South	25.8 km South	From Cormorant Alpha to Sullom Voe (12.2 km Southeast)	From Cormorant Alpha to Sullom Voe (13.6 km Southeast)
Central UMC	Field / Operational	TAQA	16.9 km South	19.9 km South Southeast	17.5 km East	22.7 km Southeast
PL3186	Pipeline / Operational	Dana Petroleum	N/A	N/A	Crosses beneath Cladhan Water Injection Pipeline PL3574	N/A

4.4.4 Military Activities

Blocks 210/24, 210/25, 211/21, 210/29 and 210/30 are not Blocks of interest to the Ministry of Defence (MoD) (OGA, 2019).

4.4.5 Renewable Energy

There are no operational offshore wind farms (OWFs) in the vicinity of the Tern Area.

Tern Area is located in proximity of the Sectorial Marine Plan (SMP) Innovation and Targeted Oil and Gas (INTOG), areas. INTOG area NE-b lies approximately 15 km southeast of Tern and INTOG area NE-a lies approximately 27 km northwest of Tern (NMPi, 2023).

There are no other renewables developments, proposed or active, within 40 km of the Tern Area.

4.4.6 Telecommunication Cables

There are no planned or operating telecommunication cables in close vicinity (< 40 km) of the Tern Area.

4.4.7 Wrecks

There is one ‘non-dangerous wreck’ approximately 12 km east southeast of Tern platform, as identified by the UK Hydrographic Office (UKHO). All other wrecks are > 20 km from the Tern Area. There are three ‘obstruction points’ associated with the installation, located 0.4 km and 0.9 west southwest and 4 km north northeast from Tern platform (UKHO).

5 IMPACT ASSESSMENT APPROACH

This EA is designed to:

- Identify potential impacts to environmental and societal receptors from the proposed decommissioning activities;
- Evaluate the potential significance of any identified impacts in terms of the threat that they pose to these receptors; and
- Assign measures to manage the risks in line with industry BAT and BEP; and address concerns or issues raised by stakeholders through consultation.

The impact assessment was undertaken using the following approach:

- The potential environmental issues arising from subsea decommissioning activities were identified through a combination of the expert judgement of project engineers and marine environmental specialists, and from previous consultation on the wider area with OPRED, Marine Directorate, Joint Nature Conservation Committee (JNCC) and the Scottish Fishermen's Federation (SFF). The potential environmental issues were grouped under the following key receptor risk groups:
    - Emissions to air;
    - Disturbance to the seabed;
    - Discharges to sea;
    - Physical presence;
    - Underwater noise;
    - Resource use;
    - Onshore activities/waste; and
    - Unplanned events.
- An initial scoping based on a high-level consideration of these aspects against the evaluation criteria was then undertaken which screened aspects in or out of further detailed assessment. Justification statements were compiled detailing the rationale for scoping out any aspects from further assessment (Section 6.1).
- For aspects which were considered potentially significant, their significance of potential impacts against impact criteria definitions was evaluated (Sections 6.3 and 6.4); and
- For any potentially significant impact, any potential mitigation and/or control measures to be used to further reduce any impact to 'as low as reasonably practicable' (ALARP) were captured.

5.1 Stakeholder Engagement

Consultation for the Tern Area subsea decommissioning has been largely based on sharing project expectations from the wider project area approach and overall NNS subsea infrastructure-specific considerations with the key stakeholders (Marine Directorate, JNCC and SFF).

5.2 EA Methodology

5.2.1 Overview

The Tern Area EA methodology was developed by reference to the Institute of Ecology and Environmental Management (IEEM) guidelines for marine impact assessment (IEEM, 2010), the Marine Life Information Network (MarLIN) species and ecosystem sensitivities guidelines (Tyler-Walters *et al*., 2004) and guidance provided by Scottish National Heritage (SNH) in the handbook on environmental impact assessment (SNH, 2013) and by The Institute of Environmental Management and Assessment (IEMA) in the guidelines for environmental impact assessment (IEMA, 2015, 2016).

Environmental impact assessment provides an assessment of the environmental and societal effects that may result from a project's impact on the receiving environment. The terms impact and effect have different definitions in environmental impact assessment, and one drives the other. Impacts are defined as the changes resulting from an action, and effects are defined as the consequences of those impacts.

In general, impacts are specific, measurable changes in the receiving environment (volume, time and/or area); for example, where a number of marine mammals to be disturbed following exposure to vessel noise emissions. Effects (the consequences of those impacts) consider the response of a receptor to an impact; for example, the effect of the marine mammal/noise impact example given above might be exclusion from an area caused by disturbance, leading to a population decline. The relationship between impacts and effects is not always so straightforward; for example, a secondary effect may result in both a direct and indirect impact on a single receptor. There may also be circumstances where a receptor is not sensitive to a particular impact and thus there will be no significant effects/consequences.

For each impact, the assessment identifies a receptor's sensitivity and vulnerability to that effect and implements a systematic approach to understand the scale of the effect. The process considers the following:

- Identification of receptor and impact (including duration, timing, and nature of impact);
- Definition of sensitivity, vulnerability, and value of receptor;
- Definition of magnitude and likelihood of impact; and
- Assessment of consequence of the impact on the receptor, considering the probability that it will occur, the spatial and temporal extent and the importance of the impact. If the assessment of consequence of impact is determined as moderate or major, it is considered a significant impact.

Once the consequence of a potential impact has been assessed it is possible to identify measures that can be taken to mitigate impacts through engineering decisions or execution of the project. This process also identifies aspects of the project that may require monitoring, such as a post-decommissioning survey at the completion of the works to inform inspection reports.

For some impacts, significance criteria are standard or numerically based. For others, for which no applicable limits, standards or guideline values exist, a more qualitative approach is required. This involves assessing significance using professional judgement.

Despite the assessment of impact significance being a subjective process, a defined methodology has been used to make the assessment as objective as possible and consistent across different topics. The assessment process is summarised below. The terms and criteria associated with the impact assessment process are described and defined; details on how these are combined to assess consequence and impact significance are then provided.

5.2.2 Baseline Characterisation and Receptor

To assess potential impacts on the environment, it was necessary to firstly characterise the different aspects of the environment that could potentially be affected (the baseline environment). The baseline environment is described in Section 4 and is based on desk studies combined with additional site-specific studies such as surveys and modelling where required.

The EA process requires identification of the potential receptors that could be affected by the Tern Area subsea decommissioning activities (e.g. other users of the sea, water quality). High level receptors are identified and described in Section 4.

5.2.3 Impact Definition

5.2.3.1 Impact Magnitude

Determination of impact magnitude requires consideration of a range of key impact criteria including:

- Nature of impact, whether it be beneficial or adverse;
- Type of impact, be it direct or indirect;
- Size and scale of impact, e.g. the geographical area;
- Duration over which the impact is likely to occur e.g. less than a year, a few years, etc.;
- Seasonality of impact, i.e. expected to occur all year or at specific times; and
- Frequency of impact, i.e. how often the impact is expected to occur.

Each of these variables is expanded upon in Table 5-1 to Table 5-5 to provide consistent definitions across all EA topics. In each impact assessment, these terms are used in the assessment summary table to summarise the impact and are enlarged upon as necessary in any supporting text. With respect to the nature of the impact (Table 5-1), it should be noted that all impacts discussed in this EA report are adverse unless explicitly stated otherwise.

Table 5-1 Nature of Impact

Nature of Impact	Definition
Beneficial	Advantageous or positive effect to a receptor (i.e. an improvement).
Adverse	Detrimental or negative effect to a receptor.

Table 5-2 Type of Impact

Type of Impact	Definition
Direct	Impacts that result from a direct interaction between the Tern Area decommissioning activities and the receptor. Impacts that are caused by the activities.
Indirect	Reasonably foreseeable impacts that are caused by the interactions with the Tern Area decommissioning activities, but which occur later in time than the original, or at a further distance. Indirect impacts include impacts that may be referred to as 'secondary', 'related', or 'induced'.
Cumulative	Impacts that act together with other impacts (including those from any concurrent or planned future third-party activities) to affect the same receptors as the Tern Area subsea decommissioning activities. Definition encompasses "in-combination" impacts.

Table 5-3 Duration of Impact

Duration	Definition
Short-term	Impacts that are predicted to last for a short duration (e.g. less than one year).
Temporary	Impacts that are predicted to last a limited period (e.g. a few years). For example, impacts that occur during the decommissioning activities and which do not extend beyond the main activity period for the works or which, due to the timescale for mitigation, reinstatement, or natural recovery, continue for only a limited time beyond completion of the anticipated activity.
Prolonged	Impacts that may, although not necessarily, commence during the main phase of the decommissioning activity and which continue through the monitoring and maintenance, but which will eventually cease.
Permanent	Impacts that are predicted to cause a permanent, irreversible change.

Table 5-4 Geographical Extent of Impact

Geographical Extent	Description
Local	Impacts that are limited to the local area surrounding Tern Area subsea decommissioning activities footprint and associated working areas. Alternatively, where appropriate, impacts that are restricted to a single habitat or biotope or community.
Regional	Impacts that are experienced beyond the local area to the wider region, as determined by habitat/ecosystem extent.
National	Impacts that affect nationally important receptors or protected areas, or which have consequences at a national level. This extent may refer to either Scotland or the UK depending on the context.
Transboundary	Impacts that could be experienced by neighbouring national administrative areas.
International	Impacts that affect areas protected by international conventions, European and internationally designated areas or internationally important populations of key receptors (e.g. birds, marine mammals).

Table 5-5 Frequency of Impact

Frequency	Description
Continuous	Impacts that occur continuously or frequently.
Intermittent	Impacts that are occasional or occur only under a specific set of circumstances that occurs several times during the course of the Tern Area subsea decommissioning activities. This definition also covers such impacts that occur on a planned or unplanned basis and those that may be described as 'periodic' impacts.

5.2.3.2 Impact Magnitude Criteria

Overall impact magnitude requires consideration of all the impact parameters described above. Based on these parameters, magnitude can be assigned following the criteria outlined in Table 5-6. The resulting effect on the receptor is considered under vulnerability and is an evaluation based on scientific judgement.

Table 5-6 Impact Magnitude Criteria

Magnitude	Criteria
Major	Extent of change: Impact occurs over a large scale or spatial geographical extent and/or is long term or permanent in nature. Frequency/intensity of impact: high frequency (occurring repeatedly or continuously for a long period of time) and/or at high intensity.
Moderate	Extent of change: Impact occurs over a local to medium scale/spatial extent and/or has a prolonged duration. Frequency/intensity of impact: medium to high frequency (occurring repeatedly or continuously for a moderate length of time) and/or at moderate intensity or occurring occasionally/intermittently for short periods of time but at a moderate to high intensity.
Minor	Extent of change: Impact occurs on-site or is localised in scale/spatial extent and is of a temporary or short-term duration. Frequency/intensity of impact: low frequency (occurring occasionally/ intermittently for short periods of time) and/or at low intensity.
Negligible	Extent of change: Impact is highly localised and very short term in nature (e.g. days/few weeks only).
Positive	An enhancement of some ecosystem or population parameter.
Notes: Magnitude of an impact is based on a variety of parameters. Definitions provided above are for guidance only and may not be appropriate for all impacts. For example, an impact may occur in a very localised area (minor to moderate) but at very high frequency/intensity for a long period of time (major). In such cases informed judgement is used to determine the most appropriate magnitude ranking and this is explained through the narrative of the assessment.	

5.2.3.3 Impact Likelihood for Unplanned and Accidental Events

The likelihood of an impact occurring for unplanned/accidental events is another factor that is considered in this impact assessment. This captures the probability that the impact will occur and also the probability that the receptor will be present and is based on knowledge of the receptor and professional judgement.

5.2.4 Consequence and Significance of Potential Impact

Having determined impact magnitude and the sensitivity, vulnerability, and value of the receptor, it is then necessary to evaluate impact significance. This involves:

- Determination of impact consequence based on a consideration of sensitivity, vulnerability and value of the receptor and impact magnitude;
- Assessment of impact significance based on assessment consequence;
- Mitigation; and
- Residual impacts.

5.2.4.1 Assessment of Consequences and Impact Significance

The sensitivity, vulnerability and value of receptor are combined with magnitude (and likelihood, where appropriate) of impact using informed judgement to arrive at a consequence for each impact, as shown in Table 5-7.The significance of impact is derived directly from the assigned consequence ranking. The assessment of consequence considers mitigation measures that are embedded within the proposed activities.

Table 5-7 Assessment of Consequence

Assessment Consequence	Description (Consideration of Receptor Sensitivity and Value and Impact Magnitude)	Impact Significance
Major consequence	Impacts are likely to be highly noticeable and have long term effects, or permanently alter the character of the baseline and are likely to disrupt the function and status/value of the receptor population. They may have broader systemic consequences (e.g. to the wider ecosystem or industry). These impacts are a priority for mitigation in order to avoid or reduce the anticipated effects of the impact.	Significant
Moderate consequence	Impacts are likely to be noticeable and result in prolonged changes to the character of the baseline and may cause hardship to, or degradation of, the receptor population, although the overall function and value of the baseline/receptor population is not disrupted. Such impacts are a priority for mitigation in order to avoid or reduce the anticipated effects of the impact.	Significant
Low consequence	Impacts are expected to comprise noticeable changes to baseline conditions, beyond natural variation, but are not expected to cause long term degradation, hardship, or impair the function and value of the receptor. However, such impacts may be of interest to stakeholders and/or represent a contentious issue during the decision-making process and should therefore be avoided or mitigated as far as reasonably practicable.	Not significant
Negligible	Impacts are expected to be either indistinguishable from the baseline or within the natural level of variation. These impacts do not require mitigation and are not anticipated to be a stakeholder concern and/or a potentially contentious issue in the decision-making process.	Not significant
Positive	Impacts are expected to have a positive benefit or enhancement. These impacts do not require mitigation and are not anticipated to be a stakeholder concern and/or a potentially contentious issue in the decision-making process.	Not significant

5.2.5 Cumulative Impact Assessment

While the scope of this impact assessment is restricted to the decommissioning of the Tern Area subsea infrastructure as outlined in Section 3, there will be other marine activities which have the potential to interact with the activities completed under the decommissioning work scope. The impact assessments presented in the following sections consider the potential for significant cumulative impacts to occur as a result of overlapping activities.

5.2.6 Transboundary Impact Assessment

For most potential impacts from decommissioning, the likelihood of transboundary impact is low. However, where impacts on mobile receptors are of concern, the likelihood of a transboundary impact is higher. The impact assessments presented in the following sections have identified the potential for transboundary impacts and the potential for transboundary impact is considered within the definition of significance.

5.2.7 Mitigation

Where potentially significant impacts (i.e., those ranked as being of moderate impact level or higher in Table 5-7) are identified, additional mitigation measures must be considered. The intention is that such measures should remove, reduce, or manage the impacts to a point where the resulting residual significance is at an acceptable or insignificant level. Mitigation is also proposed in some instances to ensure impacts that are predicted to be not significant remain so.

6 IMPACT ASSESSMENT AND JUSTIFICATION

An impact assessment scoping discussion was undertaken to discuss the proposed decommissioning activities and any potential impacts these may pose. This discussion identified nine potential impact areas based on the proposed removal methods. Of these nine potential impacts, seven were screened out of further assessment based on the low level of severity, or likelihood of significant impact occurring. The potential impacts are tabulated in Section 6.2, together with justification statements for the scoping decisions and proposed mitigation. *Disturbance to the seabed* and *physical presence of infrastructure decommissioned in situ in relation to other sea users* were scoped in for further assessment and are discussed in Sections 6.3 and 6.4, respectively.

6.1 Receptor Definition

As part of the assessment of impact significance it is necessary to define a receptor's sensitivity, vulnerability, and value. The sensitivity of a receptor is defined as 'the degree to which a receptor is affected by an impact' and is a generic assessment based on factual information whereas an assessment of vulnerability, which is defined as 'the degree to which a receptor can or cannot cope with an adverse impact' is based on professional judgement taking into account an number of factors, including the previously assigned receptor sensitivity and impact magnitude, as well as other factors such as known population status or condition, distribution and abundance. The value of a receptor can be defined as the benefits from use of the natural environment. These benefits may be direct or indirect and they may be from present use and/or future use.

6.1.1 Receptor Sensitivity

These range from negligible to very high and definitions for assessing the sensitivity of a receptor are provided in Table 6-1.

Table 6-1 Sensitivity of Receptor

Receptor Sensitivity	Definition
Very high	Receptor with no capacity to accommodate a particular effect and no ability to recover or adapt.
High	Receptor with very low capacity to accommodate a particular effect with low ability to recover or adapt.
Medium	Receptor with low capacity to accommodate a particular effect with low ability to recover or adapt.
Low	Receptor has some tolerance to accommodate a particular effect or will be able to recover or adapt.
Negligible	Receptor is generally tolerant and can accommodate a particular effect without the need to recover or adapt.

6.1.2 Receptor Vulnerability

Information on both receptor sensitivity and impact magnitude is required to determine receptor vulnerability. These criteria, described in Table 5-6 and Table 6-1 are used to define receptor vulnerability as per Table 6-2.

Table 6-2 Vulnerability of Receptor

Receptor Vulnerability	Definition
Very high	The impact will have a permanent effect on the behaviour or condition on a receptor such that the character, composition or attributes of the baseline, receptor population or functioning of a system will be permanently changed.
High	The impact will have a prolonged or extensive temporary effect on the behaviour or condition on a receptor resulting in long term or prolonged alteration in the character, composition or attributes of the baseline, receptor population or functioning of a system.
Medium	The impact will have a short-term effect on the behaviour or condition on a receptor such that the character, composition, or attributes of the baseline, receptor population or functioning of a system will either be partially changed post development or experience extensive temporary change.
Low	Impact is not likely to affect long term function of system or status of population. There will be no noticeable long-term effects above the level of natural variation experience in the area.
Negligible	Changes to baseline conditions, receptor population of functioning of a system will be imperceptible.

It is important to note that the above approach to assessing sensitivity and vulnerability is not appropriate in all circumstances and in some instances professional judgement has been used in determining sensitivity. In some instances, it has also been necessary to take a precautionary approach where stakeholder concern exists with regard to a particular receptor. Where this is the case, this is detailed in the relevant impact assessment in Section 6.

6.1.3 Receptor Value

The value or importance of a receptor is based on a pre-defined judgement based on legislative requirements, guidance, or policy. Where these are absent, it is necessary to make an informed judgement on receptor value based on perceived views of key stakeholders and specialists. Examples of receptor value definitions are provided in Table 6-3.

Table 6-3 Value of Receptor

Receptor Value	Definition
Very high	Receptor of international importance (e.g. United Nations Educational, Scientific and Cultural Organisation (UNESCO) World Heritage Site). Receptor of very high importance or rarity, such as those designated under international legislation (e.g. EU Habitats Directive) or those that are internationally recognised as globally threatened (e.g. IUCN red list). Receptor has little flexibility or capability to utilise alternative area. Best known or only example and/or significant potential to contribute to knowledge and understanding and/or outreach.
High	Receptor of national importance (e.g. , Marine Conservation Zone (MCZ)). Receptor of high importance or rarity, such as those which are designated under national legislation, and/or ecological receptors such as United Kingdom Biodiversity Action Plan (UKBAP) priority species with nationally important populations in the study area, and species that are near-threatened or vulnerable on the IUCN red list. Receptor provides the majority of income from the Tern Area. Above average example and/or high potential to contribute to knowledge and understanding and/or outreach.
Medium	Receptor of regional importance. Receptor of moderate value or regional importance, and/or ecological receptors listed as of least concern on the IUCN red list, but which form qualifying interests on internationally designated sites, or which are present in internationally important numbers. Any receptor which is active in the Tern Area and utilises it for up to half of its annual income/activities. Average example and/or moderate potential to contribute to knowledge and understanding and/or outreach.
Low	Receptor of local importance. Receptor of low local importance and/or ecological receptors such as species which contribute to a national site, are present in regionally. Any receptor which is active in the Tern Area and reliant upon it for some income/activities. Below average example and/or low potential to contribute to knowledge and understanding and/or outreach.
Negligible	Receptor of very low importance, no specific value or concern. Receptor of very low importance, such as those which are generally abundant around the UK with no specific value or conservation concern. Receptor of very low importance and activity generally abundant in other areas/ not typically present in the Tern Area. Poor example and/or little or no potential to contribute to knowledge and understanding and/or outreach.

6.2 Scoping of Potential Impacts

Table 6-4 Scoping of Potential Impacts

Impact Area	Further Assessment	Rationale	Proposed Mitigation and Best Practice
Emissions to air	No	Scoping discussions centred around the inevitability of the activities which lead to the production of emissions and the potential magnitude of these emissions. Anticipated emissions were placed in context with cumulative emissions on the UKCS whilst also considering the bigger Net Zero picture. Emissions during decommissioning activities, (largely comprising fuel combustion gases) will occur following CoP. Emissions generated by infrastructure, equipment and vessels associated with operation of the assets will be replaced by those from vessel use as well as the recycling of decommissioned materials. Reviewing historical EU Emissions Trading Scheme data and comparison with the likely emissions from the proposed workscope suggests that emissions relating to decommissioning will be small relative to those during production. The estimated CO_2 emissions to be generated by the selected decommissioning options for the Tern Area are 87,269 Te. The majority of these emissions are related to offshore transportation (50,956 Te CO_2), equating to less than 0.42 % of the total UKCS oil and gas emissions in 2023 (20.9 million Te; OEUK, 2023). Vessel emissions have been calculated assuming a worst-case of approximately 749 (24 hour) vessel days across the duration of the decommissioning project. This vessel time is split across five types of vessels which will participate in a variety of activities including: structure removal, pipeline/umbilical end cutting, rock placement and a post-decommissioning monitoring. The total emissions estimate also includes the emissions associated with the re-manufacture of recyclable materials decommissioned *in situ*, which represents the second-largest CO_2 contribution after vessel use (24,612 Te CO_2). Appendix D provides a breakdown of the CO_2 emissions associated with the project. Review of available decommissioning EAs suggests that atmospheric emissions in highly dispersive offshore environments are not considered to present significant impacts in the context of UKCS and global emissions. Most submissions also note that emissions from short-term	• Vessel management in accordance with TAQA's marine procedures • Minimal vessel use/movement • Vessel sharing where possible • Engine maintenance

Impact Area	Further Assessment	Rationale	Proposed Mitigation and Best Practice
		decommissioning activities are small compared to those previously arising from the asset over its operational life. Scoping discussions led to the conclusion that the decommissioning emissions associated with the Tern subsea decommissioning activities are inevitable but of a minor magnitude and ultimately of low consequence. TAQA do however acknowledge the context of global climate change, and in line with the NSTA's (2021) expectations (in particular, Stewardship Expectation 11) TAQA is dedicated to minimising greenhouse gas emissions from decommissioning operations, as far as is reasonable for each project. TAQA is committed to working with the supply chain and joint ventures as part of meeting these commitments.	
Disturbance to the seabed	Yes	Scoping discussions for disturbance to the seabed focussed on the high likelihood and moderate magnitude of the potential activities and the uncertainly around the temporary and permanent impacts of these. There is also potential for decommissioning activities to generate disturbance to the seabed and cuttings piles located at the Tern platform, Hudson manifold and Hudson satellite wells. These include activities associated with decommissioning of pipelines *in situ*, the removal of subsea structures and the surface laid pipelines and umbilicals and remediation of free-spans and exposures. Drill cuttings surveys at the Tern platform, the Hudson manifold and the surrounding area concluded that THC was elevated in comparison to historical survey data but was comparable to other cutting piles in the North Sea. Areas that contained elevated hydrocarbon residuals and heavy metal concentrations are most likely influenced by their proximity to drill cuttings piles and current and historic drill centres. Impacts to the seabed from project activities are considered to be of a moderate consequence (significant) and are therefore assessed further in Section 6.3.	• See Section 6.3

Impact Area	Further Assessment	Rationale	Proposed Mitigation and Best Practice
	No	Marine growth may be removed to aid access for cutting or may also fall from the subsea structures during removal activities. A small quantity of marine growth may land on the seabed within, or very close to the footprint left by the subsea structures. Any such discharges are unlikely to cause significant disturbance to the seabed. Scoping discussions led to the conclusion that the potential impact associated with falling marine growth are of a negligible magnitude and ultimately of negligible consequence.	• Focussed removal of marine growth to enable safe cutting and lifting • Any marine growth will be removed in place so will not be introduced to a new seabed environment
Discharges to sea	No	Discharges to sea were considered during a scoping workshop where discussion focussed on the highly regulated processes established through monitoring and permitting regimes, Discharges are negligible and temporary in nature, with low receptor vulnerability. Pipelines will be flushed prior to decommissioning where feasible. Where this is not possible, this will be discussed with OPRED, and a mutual solution will be agreed. As far as practicable, any condensate liquids (light hydrocarbons) in the pipelines will be flushed to the Tern platform. The Oil Discharge Permit for these operations will detail the measures to be used. Discharges from vessels are typically well-controlled activities that are regulated through vessel and machinery design, management, and operation procedures. Discharges to sea are considered to be of a negligible consequence (not significant) and are therefore not assessed further.	• MARPOL compliance • Compliance with the Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005 • Compliance with the Offshore Chemical Regulations 2002 (as amended) • Bilge management procedures • Vessel audit procedures • Contractor management procedures
Physical presence of vessels in relation to other sea users	No	Scoping discussions centred around the inevitability of the vessel activities (high likelihood) and the low potential for conflict with other sea users. The presence of a small number of vessels for pipeline and umbilicals and subsea installation decommissioning activities will be relatively short-term in the context of the life of the assets involved. Activity will occur using similar vessels to those currently deployed for oil and gas installation, operation, and decommissioning activities. The small number of vessels	• Minimal vessel use/movement • Notification to Mariners • Opening up of 500 m safety exclusion zones following close-out

Impact Area	Further Assessment	Rationale	Proposed Mitigation and Best Practice
		required will also generally be in use within the existing 500 m safety zones at the individual field sites and will not occupy any new areas. Other sea users will be notified in advance of activities occurring meaning those stakeholders will have time to make any necessary alternative arrangements for the very limited period of operations. The decommissioning of the Tern Area pipelines, umbilicals and subsea structures is estimated to require up to four vessel types, however these would not all be on location at the same time (maximum of two at any one time). The physical presence of vessels in relation to other sea users is considered to be of a negligible consequence (not significant) and is therefore not assessed further.	
Physical presence of infrastructure decommissioned *in situ* in relation to other sea users	Yes	Scoping conversations focussed on the low likelihood of an interaction but the major (significant) consequences possible should a snagging event occur, accounting for the concerns of the fishing industry. Subsea installations and surface-laid pipelines and umbilicals will be fully removed other than small sections of surface laid lines in close proximity to the Tern jacket/sub-structure footings which may be decommissioned in place if derogation is granted to decommission the footings in place. "Close proximity" is considered within approximately 75 m of the platform footings. Logical break points between portions decommissioned *in situ* and portions removed will be selected, e.g., pipeline crossings, etc. Seabed disturbance from the removal of infrastructure has the potential to modify the habitat in a way which might impact upon other sea users which utilise the seabed. The seabed typical of the Tern Area may lend itself to the formation of clay mounds in areas of occasionally muddy benthic habitat. Clay mounds may pose a potential snagging hazard to commercial fishing gears which make contact with the seabed. Following decommissioning, the seabed will be surveyed and remediated as required. Due to the presence of cuttings contamination at both Hudson and Tern, there is the potential for demersal fishing gear to interact and disturb the contaminated sediment. Field studies designed to trawl over a known	• See Section 6.4

Impact Area	Further Assessment	Rationale	Proposed Mitigation and Best Practice
		cuttings pile and measure the dispersion of cuttings resulting from the trawling activities were conducted by the Fisheries Research Services in 2000 (OSPAR, 2019). The results indicated that trawling activities disturbed relatively little material to a significant height into the water column. To address any Stakeholder concerns, Section 6.4 provides more detail regarding survey of the seabed and seabed remediation following decommissioning of the Tern Area subsea facilities.	
Underwater noise emissions	No	Scoping discussions for underwater noise focussed on the high likelihood potential noise-producing activities, the concurrent (cumulative) nature of these activities and the potential for disturbance to sensitive species, in particular marine mammals. Aside from vessel noise and cutting activities, there will be no other noise-generating activities. Cutting techniques will either be diamond wire or abrasive water jet. The recently published DESNZ 2023 guidance on "The Use and Environmental Impact of Explosives in the Decommissioning of Offshore Wells and Facilities" states that *"Sound radiated from the diamond wire cutting of a conductor or abrasive water jets is not easily discernible above the background noise."* Vessel presence will be limited in duration. Diamond wire and hydraulic shear cutting operations are not readily discernible above background noise levels. Thus, vessel presence during the cutting process will mask the cutting noise generated (Pangerc *et al.*, 2016). As a result, noise generated during the decommissioning activities will be largely undetectable. Furthermore, the project is not located within an area protected for marine mammals. With industry-standard mitigation measures in place and adherence to JNCC (2023) guidance in place to minimise the risk of injury to marine mammals, EAs for offshore oil and gas decommissioning projects typically show no significant disturbance (Shell, 2017; CNRI, 2013; CNRI, 2017; and Marathon, 2017). Underwater noise emissions are considered to be of minor consequence (not significant) and are therefore not assessed further.	• Vessel management • Minimal vessel use/movement. • Vessel sharing where possible • Cutting activities will be minimised and carried out separately from other noisy activities where possible • Adherence to JNCC (2023) Guidance

Impact Area	Further Assessment	Rationale	Proposed Mitigation and Best Practice
Resource use	No	Scoping discussion highlighted that resource use from the proposed activities will require limited raw materials and be largely restricted to fuel use. Such use of resources is not typically an issue of concern in offshore oil and gas. The estimated total energy usage for the decommissioning activities is 1,016,636 GJ. Most of this energy use is related to offshore transportation and operation of vessels offshore. A large amount (325,865 GJ) of this total is a theoretical value associated with the remanufacture of recyclable materials decommissioned *in situ.* Material will be returned to shore as a result of project activities. The project aspiration is that all ferrous and non-ferrous metals, concrete and plastics will be recycled where possible, in line with the waste hierarchy, and TAQA will work closely with waste contractors to ensure that this is the case to minimise landfill requirements. Resource use is considered to be of a negligible consequence (not significant) and is therefore not assessed further.	• Adherence to the Waste Hierarchy • Vessel management • Minimal vessel use/movement • Vessel sharing where possible • Engine maintenance
Onshore impacts/ Waste	No	Waste management is often cited as a stakeholder concern across DPs. The waste to be brought to shore, which will be routine in nature, will be managed in line with TAQA's Waste Management Strategy and the Waste Hierarchy, as part of the project AWMP, using approved waste contractors and in liaison with the relevant Regulators. Waste management was considered to be of a minor consequence during scoping discussions due to the highly regulated and routine nature of the activity. On this basis, onshore impacts and waste are not assessed further.	• Overall 'Duty of Care' • Waste Management Strategy and Active waste tracking • Waste Hierarchy • Selection of suitably licenced site (if applicable) • Communication with relevant Regulator(s) e.g. SEPA established • EEMS tracking and close-out reporting • Contractor management

Impact Area	Further Assessment	Rationale	Proposed Mitigation and Best Practice
Unplanned events	No	Scoping discussions centred around the potential damage to sensitive receptors from an oil or diesel spill and very low likelihood of an unplanned event, given the established mitigation measures in place. Pipeline flushing will be undertaken prior to decommissioning activities. The remaining risk for a hydrocarbon release relates to loss of diesel from a vessel involved in decommissioning activities. A maximum of five vessels will be deployed over the course of the decommissioning activities, but not all at one time. These may include a CSV, DSV, guard vessel, a rock placement vessel (if remediation is not carried out by DSV) and a survey vessel. Although the risk of oil spill is remote, the Tern Area OPEP (TAQA, 2018a) will be updated to cover the Tern Area decommissioning activities. Any spills from vessels in transit and outside the 500 m zones are covered by separate SOPEPs. Any potential from dropped objects (Tern Area infrastructure) whilst in transit, onto active subsea facilities, would be covered within 'Dropped object procedures', which are industry-standard. There is only a very remote probability of any interaction with any live infrastructure. The *in situ* decommissioning of some infrastructure will also limit the potential for dropped objects or dislodged materials/objects. Considering the above, the potential impacts from accidental chemical/hydrocarbon releases or dropped objects during decommissioning activities are not anticipated to be significant and are not assessed further.	• OPEP in place for operations • SOPEP on all vessels • Navigational warnings in place • 500 m zones operational until seabed clearance certified • Spill response procedures • Contractor management and communication • Lifting operations management of risk • PON2 submission • Careful planning, selection of equipment, subsequent management, and implementation of activities • The location of any dropped or dislodged material will be recorded and reported via Hydrographic Office and Kingfisher notification system

6.3 Disturbance To the Seabed

6.3.1 Approach

The two seabed impact pathways associated with the proposed activities are direct and indirect disturbance. Direct disturbance is the physical disturbance of natural and potentially contaminated seabed sediments and habitats. Direct disturbance has the potential to cause temporary or permanent changes to the marine environment, depending upon the nature of the associated activity. Permanent impacts are generally considered to represent a worst-case where required. Activities which contribute to the direct disturbance impact pathway include the removal of infrastructure and remediation of snagging hazards, either from re-burial or placement of material (rock armour) on the seabed. The total area of seabed expected to be impacted by direct physical disturbance has been calculated by adding together the individual areas of physical disturbance estimated for each activity.

Indirect disturbance is that which occurs outside of the direct disturbance footprint. It may be caused by the suspension and re-settlement of natural seabed sediments and cuttings pile materials disturbed during activities. This secondary impact pathway is considered temporary in all instances. The scale of indirect disturbance due to re-suspension and re-settlement of natural and potentially contaminated sediment has been estimated based on the expected area of direct disturbance from any activity. The estimated indirect disturbance area is assumed to be double the direct disturbance area for all installations and activities taking place.

The seabed impacts resulting from the activities associated with the Tern Area decommissioning can also be classified as temporary or permanent. Temporary impacts are defined here as those which have transient impacts lasting a few days to a few years. Permanent impacts are those which will continue to have an impact for decades to centuries following decommissioning. In the following sections, potential impacts will also be defined either as temporary or permanent.

6.3.2 Sources of Potential Impacts

The following activities have been identified as potential sources of direct or indirect seabed disturbance:

- Subsea infrastructure removal:
    - Cladhan: manifold with foundation piles, SSIV and 3 x Xmas Tree
    - Hudson: manifold and cross-over skid with associated foundation piles, FSM protection structure and 9 x Xmas Tree
    - Kestrel: SSIV, SDU, 2 x SkoFlo Skid, SDU, 3 x Xmas Tree and 9 x sentry bollards with foundation piles
    - Falcon: Xmas Tree (Section 6.3.2.1)
    - Remediation of depressions following removal of infrastructure (Section 6.3.2.1).
- Decommissioning of pipelines, umbilicals, and flowlines:
    - Removal of pipeline, pipeline ends, exposed midline sections and surface-laid pipeline spools and jumpers (Section 6.3.2.2)
    - Removal of stabilisation and protection structures (Section 6.3.2.3)
- Pipelines decommissioned *in situ* (Section 6.3.2.4)

6.3.2.1 Subsea Structures

All subsea structures within the Tern Area are to be fully removed (as described in Section 3.5). The Tern Area subsea wells will be Phase 3 abandoned, in accordance with OEUK well decommissioning guidance (2022). This will involve, isolating the reservoir with permanent barriers, retrieving well tubulars isolating intermediate permeable zones and potentially installing cement plugs, and retrieving the wellheads, and Xmas trees and the well conductors to a depth of 3 m below the seabed.

To calculate the area of direct disturbance the dimensions of the structures have been used. To account for the potential extended impact due to removal methods, a 5 m buffer has been added to the length and width of the structures. This methodology has been used in the interest of being conservative and calculating a worst-case possible impact for the removal of the Tern Area subsea structures.

An estimate has been made of the possible indirect disturbance due to re-suspension and settlement of sediment. Most re-suspended sediment will settle within the initial disturbance area, but it has been assumed that some will land beyond that area. As a conservative estimate, the area of indirect disturbance has been assumed to be double the area of direct disturbance. This disturbance will be temporary, and resettlement will only occur as long as activities are underway and shortly afterwards.

Rock will also be used as local remediation for depressions in the seabed following the removal of the subsea infrastructure in the Tern Area. A maximum seabed area of 80 m^2 (20 m^2 per field) has also been included in the seabed footprint for this activity. Remediation of depressions is associated with permanent disturbance and further discussed in Section 6.3.2.4 and Table 6-8.

The direct and indirect disturbance areas associated with these proposed operations are summarised in Table 6-5.

Table 6-5 Seabed Disturbance Associated with The Decommissioning of Structures

Field	Activity	Quantity and Dimensions	Expected Duration Of Disturbance	Temporary Direct Disturbance Area (km^2)	Temporary Indirect Disturbance Area (km^2)
Cladhan	Removal	1 x Manifold - 10 m (L) x 6.5 m (W) 4 x Piles - 0.61 m (D)	Temporary	0.0007655	0.001531
Cladhan	Removal	1 x SSIV - 13 m (L) x 6 m (W)	Temporary	0.000368	0.000736
Cladhan	Removal	3 x Xmas Tree – 7.6 m (L) x 7.6 m (W)	Temporary	0.0001733	0.0003466
Hudson	Removal	1 x Manifold – 25 m (L) x 13.5 (W) 4 x Piles - 0.61 m (D)	Temporary	0.0007655	0.001531
Hudson	Removal	1 x Cross-over Skid – 4 m (L) x 3.4 m (W) 1 x Piles – 0.76 m (D)	Temporary	0.0001951	0.0003902
Hudson	Removal	1 x FSM Protection Structure – 8 m (L) x 3.8 m (W)	Temporary	0.0002484	0.0004968
Hudson	Removal	2 x Xmas Tree – 3.6 m (L) x 3.2 m (W)	Temporary	0.000359	0.000718
Hudson	Removal	7 x Xmas Tree – 3.6 m (L) x 3.7 m (W)	Temporary	0.001304	0.002608
Kestrel	Removal	1 x SSIV – 8 m (L) x 4 m (W)	Temporary	0.000252	0.000504
Kestrel	Removal	1 x SDU – 2.52 m (L) x 2.02 m (W)	Temporary	0.0001505	0.000301
Kestrel	Removal	2 x SkoFlo Skid (Well P1 & P2) – 1.4 m (L) x 0.6 m (W)	Temporary	0.0001416	0.0002832
Kestrel	Removal	3 x Xmas Tree: P1 – 4.24 m (L) x 3.86 m (W) P2 & W1 – 3.91 m (L) x 3.66 m (W)	Temporary	0.0005774	0.0011548
Kestrel	Removal	9 x Sentry Bollards – 2 m (L) x 1.5 m (W) 9 x Piles – 0.76 m (D)	Temporary	0.001756	0.003512
Falcon	Removal	1 x Xmas Tree – 5.1 m (L) x 5.1 m (W)	Temporary	0.000228	0.000456
			Total (km^2)	**0.007284**	**0.014568**

*Please note, any apparent discrepancy in the totals is due to rounding within the table.

6.3.2.2 Removal of Pipelines/Umbilicals, Midline Sections, Ends and SSIV Umbilical

Where outlined in Section 3.4.2, pipelines/umbilicals will be decommissioned *in situ*. Pipeline/umbilicals ends and the surface laid umbilicals will be cut and removed, and rock will be placed over the pipeline ends as remediation. However, small sections of surface laid lines in close proximity to the Tern jacket/sub-structure footings may be decommissioned in place if derogation is granted to leave the footings in place. If derogation is not granted, then these surface laid portions will be removed. Rock will be deposited along the pipelines where midline exposures and spans have been identified (Appendix B - Pipeline Exposures and Free Spans Summary).

The area of seabed disturbed by recovery of each individual pipeline end and SSIV umbilical to the surface has been estimated by multiplying the length of each individual line section which will be removed by a 1 m buffer width. The areas disturbed by recovery of each individual line have then been summed to give an overall area of disturbance.

Indirect disturbance has been assumed to be twice that of the direct area. This accounts for the resuspension of sediment generated (both natural and potentially contaminated) due to direct disturbance, most of which will settle within the direct footprint. However, in light of the very fine sand sediment composition, the resettlement of sediment is likely to be minimal. If contaminated sediment is disturbed, it is likely that only the unconsolidated (looser) layers of sediment in the top layers will be dispersed beyond the immediate area. The contaminant content of the top (approximately 100 mm) layer of a cuttings pile is often relatively low, having leached into the water column over time and biodegraded (Genesis, 2014) and this is supported by lower THC in the top core sections than in the middle and bottom core sections of each cuttings pile (Section 4.1.5.

The direct and indirect disturbance areas associated with these proposed operations are summarised in Table 6-6. A full inventory of infrastructure dimensions is available in Section 3. All disturbance will be temporary.

Table 6-6 Temporary Seabed Disturbance Associated With The Decommissioning of Pipelines/Umbilicals Pipeline/Umbilicals Ends, Pipeline Midline Sections, Spools and SSIV Umbilical

Field	Activity	Quantity and Dimensions	Direct Disturbance Area (km^2)	Indirect Disturbance Area (km^2)
Cladhan	Removal	PLU3575	0.000877	0.001754
Cladhan	Removal	PL3572, PL3573	0.002306	0.004612
Cladhan	Removal	PL3572, PL3573, PLU3575	0.008051	0.016102
Cladhan	Removal	PL3574	0.005033	0.010066
Cladhan	Removal	PLU3577 SSIV control umbilical	0.000534	0.001068
Cladhan	Removal	PL3572JWP1, PL3572JWP2, PL3573JWP1, PL3573JWP2, PL3574JWP1, PLU3575JWP1, PLU3575JWP2, PLU3576	0.000506	0.001012
Kestrel and Falcon	Removal	PL1851	0.00257	0.00514
Kestrel and Falcon	Removal	PL1851, PL1852, PLU1854	0.001404	0.002808
Kestrel and Falcon	Removal	PL1852	0.001196	0.002392
Kestrel and Falcon	Removal	PLU1854JP1 & PLU1854JP2	0.0001	0.0002

Field	Activity	Quantity and Dimensions	Direct Disturbance Area (km^2)	Indirect Disturbance Area (km^2)
Kestrel and Falcon	Removal	PLU1854	0.00175	0.0035
Kestrel and Falcon	Removal	PL1317JKEU-W1	0.00049	0.00098
Kestrel and Falcon	Removal	PL2765, PL2766	0.000883	0.001766
Kestrel and Falcon	Removal	PL2765, PL2766, PLU2767	0.001844	0.003688
Kestrel and Falcon	Removal	PLU2767	0.00083	0.00166
Kestrel and Falcon	Removal	PLU2976	0.00001	0.00002
Kestrel and Falcon	Removal	PLU2977 (JP1 & JP2)	0.00009	0.00018
Kestrel and Falcon	Removal	PLU2978JW1	0.00006	0.00012
Kestrel and Falcon	Removal	PLU2979	0.00001	0.00002
Kestrel and Falcon	Removal	PLU6295	0.000052	0.000104
Hudson	Removal	PLU6238, PLU6239	0.00014	0.00028
Hudson	Removal	PL6240, MeOH	0.00002	0.00004
Hudson	Removal	PL6246	0.000506	0.001012
Hudson	Removal	PL1021AJM	0.000045	0.00009
Hudson	Removal	PL1022.3	0.000035	0.00007
Hudson	Removal	PL1022.4	0.000025	0.00005
Hudson	Removal	PL1022.5	0.000035	0.00007
Hudson	Removal	PL1022.6	0.000025	0.00005
Hudson	Removal	PLU6450 Umbilical from Tern to Hudson Manifold)	0.001467	0.00456
Hudson	Removal	PLU6451 (Umbilical from Hudson Manifold to Well L1) , PLU6452 (Umbilical from Hudson Manifold to Well L2)	0.003388	0.006776
Hudson	Removal	PLU6453 (Umbilical from Hudson Manifold to Well L3)	0.000065	0.00013
Hudson	Removal	PLU6449 (Umbilical from Hudson Manifold to Well L4)	0.00006	0.00012
Hudson	Removal	PLU6448 (Umbilical from Hudson Manifold to Well U1)	0.00008	0.00016
Hudson	Removal	PLU6447 (Umbilical from Hudson Manifold to Well U2)	0.00006	0.00012
Hudson	Removal	PL1026	0.000035	0.00007
Hudson	Removal	PL1027	0.000025	0.00005
Hudson	Removal	PL1028	0.000035	0.00007

Field	Activity	Quantity and Dimensions	Direct Disturbance Area (km^2)	Indirect Disturbance Area (km^2)
Hudson	Removal	PL1029	0.000025	0.00005
Hudson	Removal	PL1783	0.00003	0.00006
Hudson	Removal	PL1784	0.000028	0.000056
Hudson	Removal	PL1785	0.00003	0.00006
Hudson	Removal	PL1786	0.00003	0.00006
Hudson	Removal	PL1787	0.00003	0.00006
Hudson	Removal	PL1788, PL1789, PL1790 & PL1791	0.0004	0.0008
Hudson	Removal	PL3090	0.000065	0.00013
Hudson	Removal	PL3091	0.000065	0.00013
Hudson	Removal	PL3092	0.000065	0.00013
Hudson	Removal	PL3093	0.000065	0.00013
Hudson	Removal	PL4339	0.000041	0.000082
Hudson	Removal	PL4340	0.000039	0.000078
Hudson	Removal	PL1018/A	0.00015	0.0003
Hudson	Removal	PL1018	0.001411	0.002822
Hudson	Removal	PL1019	0.001457	0.002914
Hudson	Removal	PL1020	0.001495	0.00299
Hudson	Removal	PL1021	0.000924	0.001848
Hudson	Removal	PL1018/A, PL1019/A & PL1020/A	0.006817	0.013634
Hudson	Removal	PL1018	0.000721	0.001442
Hudson	Removal	PL1019	0.000738	0.001476
Hudson	Removal	PL1020	0.000725	0.00145
Hudson	Removal	PL1021	0.000689	0.001378
Hudson	Removal	PL1018/A, PL1019/A & PL1020/A	0.005856	0.011712
Hudson	Removal	PL1024/A, PL1025/A, PL1022.1 (piggyback of PL1024) & PL 1022.2 (Piggyback of PL1025	0.002725	0.00545
Hudson	Removal	PL1024/A, PL1025/A & PL1024	0.002945	0.00589
Hudson	Removal	PL1025, PL1022.1 & PL1022.2	0.003169	0.006338
Hudson	Removal	PL1024/A & PL1025/A	0.002508	0.005016
		Total	**0.067674**	**0.135642**

Note: PL1023 consists of cores and sub-cores which were formerly numbered from PL1023.1 to PL1023.31.

- PLU6447 Umbilical from Hudson Manifold to Well U2 – PL1023.6, PL1023.12, PL1023.31, PL1023.31.1
- PLU6448 Umbilical from Hudson Manifold to Well U1 - PL1023.5, PL1023.11, PL1023.30, PL1023.30.1
- PLU6449 Umbilical from Hudson Manifold to Well L4 - PL1023. 4, PL1023. 10, PL1023. 29, PL1023. 29.1

Field	Activity	Quantity and Dimensions	Direct Disturbance Area (km^2)	Indirect Disturbance Area (km^2)
• PLU6450 Umbilical from Tern to Hudson Manifold - PL1023.15, PL1023.16, PL1023.17, PL1023.20, PL1023.21, PL1023.22, PL1023.23, PL1023.24, PL1023.25 • PLU6451 Umbilical from Hudson Manifold to Well L1 - PL1023.1, PL1023.7, PL1023.13, PL1023.18, PL1023.26, PL1023.26.1, PL1023.26.2 • PLU6452 Umbilical from Hudson Manifold to Well L2 - PL1023.2, PL1023.8, PL1023.14, PL1023.19, PL1023.27, PL1023.27.1, PL1023.27.2 • PLU6453 Umbilical from Hudson Manifold to Well L3 - PL1023.3, PL1023.9, PL1023.28, PL1023.28.1.				

6.3.2.3 Stabilisation and Protection (Mattresses, Grout Bags)

Concrete mattresses and grout bags have previously been deployed across the Tern Area to stabilise and protect the seabed infrastructure. The intention is that, where possible and if condition of material allows, all concrete mattresses and grout bags will be recovered; this will cause temporary direct and indirect disturbance. There are an estimated 1,331 concrete mattresses across the Tern area which will be removed where possible. The dimensions of the concrete mattresses (6 m by 3 m) were used to determine the area of cover. It is likely that mattresses are overlapping or have been used in conjunction with other forms of remediation, therefore the seabed footprint of these mattresses likely represents an overestimate.

There are an estimated 36,029 grout bags in the Tern Area. Full inventory details are presented in Section 3.1.1. Grout bags are used in conjunction with different subsurface installations to provide protection or stability. As such, they are usually stacked or piled on top of one another or on top of other installations/mattresses. The exact location and layout of the bags is unknown. A maximum area of 1 m^2 of impact has been assumed for each individual grout bag.

The direct and indirect seabed disturbance areas associated with the stabilisation materials are summarised in Table 6-7. As mentioned previously, the indirect impact has been assumed to be double the direct impact area.

Table 6-7 Area of Seabed Impact Associated with The Decommissioning of Protection Materials

Activity	Quantity and dimensions	Expected duration of disturbance	Direct disturbance area (km^2)	Indirect disturbance area (km^2)
Removal of existing concrete mattresses	Estimated 1,331 concrete mattresses (6 m (L) x 3 m (W) x 0.15 m (H))	Temporary	0.023958	0.047916
Removal of grout bags	Estimated 36,029 grout bags of 1 m^2	Temporary	0.036029	0.072058
Grout support	Estimated 6 grouted support; 3 grouted support 4 m^2 and 3 of 16 m^2	Temporary	0.00006	0.000104
		Total (km^2)	**0.060047**	**0.120078**

6.3.2.4 Pipelines and Umbilicals Decommissioned *In situ*

All trenched/buried flexible lines and umbilicals within the Tern Area are to be decommissioned *in situ*. All Tern Area flexible risers, riser umbilicals, surface laid umbilicals/cables, spools, and jumpers are to be fully removed. However, limited sections of surface laid pipelines and umbilicals in close proximity to the Tern jacket/sub-structure footings may be decommissioned in place, subject to derogation and agreement with OPRED. “Close proximity” is considered within approximately 75 m of the platform footings. If derogation is not granted, all close proximity surface laid pipelines and umbilical sections will be recovered and taken to shore for appropriate recycling, or disposal.

Cladhan rigid pipelines, that are trenched and buried, are to be decommissioned *in situ* with any surface laid sections including transitions removed and recovered to shore for recycling or disposal. Hudson rigid trenched and buried pipelines are also to be decommissioned *in situ* with any surface laid sections including transitions removed and recovered to shore for recycling or disposal. Pipeline ends, mid-line exposures and free spans will be removed by cut and lift with cut ends remediated via rock placement.

The approach to remediation will be assessed on case-by-case basis and rock cover represents a worst-case scenario. Subject to future surveys, additional rock cover required for remediation activities will be covered by relevant environmental permits. Permits will also address associated seabed and emissions impacts (if required).

The factors that will be considered for remediation approach include:

- The length of time required to cut a span/spans and the associated GHGs;
- The GHGs associated with quarrying, transporting, and placing rock; and
- The amount of rock required to safely remediate a cut end, versus required to remediate a span.

The Hudson rigid pipelines which are trenched but insufficiently buried are to be re-trenched and backfilled over the entire length to a minimum of 0.6 m depth.

As any remediation activities will overlie the temporary impact footprint of the activities associated with the cutting of pipelines, the area of impact only relates to the permanent direct and temporary indirect impact due to the placement of rock. The area of seabed disturbed by recovery of the pipeline ends and associated remediation (concrete mattresses and grout bags) has been estimated in GIS defining the outer extent of all the pipelines due for removal and a 5 m buffer width was added to ensure that all pipeline remediation had been incorporated in the disturbance footprint. Additionally, pipeline exposures and freespans surveys (see Appendix B) were utilised to perform GIS calculations (See Figure 6-1, Figure 6-2, and Figure 6-3).

Where pipeline ends become exposed during removal activities (e.g. where spools are removed either side of existing rock placement) they will be covered by an overtrawlable rock berm which will be 10 m wide, 5 m long. This represents a permanent impact (see Figure 6-1, Figure 6-2, and Figure 6-3).

The permanent direct and temporary indirect disturbance areas associated with these proposed operations are summarised in Table 6-8. A full inventory of infrastructure is available in Section 3.5.

Structural degradation of the pipelines and umbilicals will be a long-term process caused by corrosion, and eventual collapse of the pipelines under their own weight and that of the overlying sediment. During this process, degradation products derived from the exterior and interior of the pipe and umbilical will breakdown and potentially become bioavailable to benthic fauna in the immediate vicinity. Pathways from the pipelines to the receptors would be via the interstitial spaces in seabed sediments.

There is currently no survey data on the presence of any free spans or exposures along the Cladhan pipelines, however TAQA is committed to undertaking pre-decommissioning surveys along each line scheduled to be decommissioned *in situ.* Should any free spans or exposures be found, these will be remediated via rock placement (spans measuring less than 20 m) or cut and lift (spans measuring more than 20 m). The Hudson pipelines and umbilicals to be decommissioned *in situ* have a number of exposures and free spans identified along them, with total length of 170 m, however, some of these exposures are located at pipeline ends and may therefore be removed along with the pipeline ends (see Figure 6-1 and Figure 6-2). The remediation activities associated with the decommissioning of the pipelines *in situ* are considered a permanent disturbance and represent a worst-case scenario. As a conservative estimate, the indirect disturbance is twice that of the direct area, however this type of impact is considered temporary. The permanent direct and temporary indirect disturbance areas associated with these proposed operations are summarised in Table 6-8. A full inventory of infrastructure dimensions is available in Section 3.1.1.

Rock will also be used as localised remediation for depressions in the seabed following the removal of the subsea infrastructure in the Tern Area (see section 6.3.2.1). A maximum seabed area of 80 m^2 (20 m^2 per field) has also been included in the seabed footprint for this activity (Table 6-8).

Table 6-8 Area of Seabed Impact Associated with The Remediation of Pipeline Ends, Exposures and Spans Along The Pipelines Decommissioned *In situ* and Seabed Depressions

Field	Activity	Expected Duration of Disturbance	Permanent Direct Disturbance Area (km^2)	Temporary Indirect Disturbance Area (km^2)
Cladhan	Remediation of Pipeline Ends	Temporary/ Permanent	0.000359	0.000718
	Contingency estimate for remediation of future formation of mid-line spans / exposures	Temporary/ Permanent	0.00511	0.01022
	Remediation of seabed depressions Estimated 20 m^2	Temporary/ Permanent	0.00002	0.00004
Hudson	Remediation of Pipeline/Umbilical Ends and Exposures and Spans	Temporary/ Permanent	0.004075	0.00815
	Remediation of seabed depressions Estimated 20 m^2	Temporary/ Permanent	0.00002	0.00004
Kestrel and Falcon	Remediation of Pipeline/Umbilical Ends	Temporary/ Permanent	0.00021	0.00042
	Contingency estimate for remediation of future formation of mid-line spans / exposures	Temporary/ Permanent	0.002017	0.004034
	Remediation of seabed depressions Estimated 40 m^2	Temporary/ Permanent	0.00004	0.00008
		Total (km^2)	**0.011851**	**0.023702**

Notes:

1. Trenched and buried pipelines, umbilicals, and flexible lines are to be decommissioned *in situ* with pipeline cut ends remediated with rock. Exposures and free spans of the rigid pipelines to be cut and removed, and the cut ends remediated with rock.

2. Rock cover represents an indicative worst-case scenario. The remediation approach will be assessed on case-by-case basis. Subject to future surveys, additional rock cover required for remediation activities will be covered by relevant environmental permits.

The seabed disturbance associated with the lengths of PL1022 and PL1021/A being decommissioned *in situ* by retrenching and backfilling of those pipelines has been calculated in Table 6-9. This has been calculated using the exact dimensions of the pipelines multiplied by 5m corridor.

Table 6-9 Area of Seabed Impact Associated with The Re-Trenching and Backfilling of Pipelines

DP/ Fields	Flowline/ Umbilical	Length (km)	Disturbance Corridor Width (km)	Expected Duration of Disturbance	Temporary Direct Disturbance Area (km^2)	Temporary Indirect Disturbance Area (km^2)
Hudson	PL 1022	10.571	0.005	Temporary	0.052855	0.10571
	PL 1021/A	10.211			0.051055	0.10211
				Total (km^2)	**0.10391**	**0.20782**

6.3.2.5 Summary of Seabed Disturbance

The seabed disturbance from the decommissioning activities calculated throughout this section is summarised in Table 6-10 and in Figure 6-1 and Figure 6-2. This illustrates a worst-case scenario for seabed disturbance, in which most of the temporary seabed impact is associated with the removal and relocation of existing remediation materials and most of the permanent seabed impact is associated with rock remediation over free spans/exposures and pipeline ends on pipelines decommissioned *in situ*.

Table 6-10 Total Potential Seabed Disturbance from The Decommissioning Activities

Activity	Temporary Direct Disturbance Area (km^2)	Temporary Indirect Disturbance Area (km^2)	Permanent Direct Disturbance Area (km^2)
Removal of structures	0.007284	0.014568	0
Removal of pipelines/umbilicals, pipeline/umbilicals ends, pipelines midline sections, spools and SSIV umbilicals	0.067674	0.135642	0
Removal of protection material (mattresses, grout bags, grouted support)	0.060047	0.120078	0
Remediation of pipeline ends and exposures and spans along the pipelines decommissioned *in situ and* seabed depressions	0	0.023702	0.011851
Re-trenching and backfilling	0.10391	0.20782	0
Total (km^2)	**0.238915**	**0.50181**	**0.011851**

Tern Area infrastructure decommissioning activities will result in temporary direct and indirect disturbance to the seabed. Temporary direct disturbance has the potential to impact 0.24 km^2 of seabed. Temporary indirect disturbance has the potential to impact 0.50 km^2. There will be a 0.0119 km^2 area of permanent disturbance because of new rock placement (for pipeline ends, exposures/spans and depressions remediation). These are considered highly conservative estimations of the likely impact of the proposed decommissioning activities, as the buffers added to the structures are likely to overestimate the range of impact generated by various removal methods. Overall, given the localised nature of the seabed disturbance, and the very small area of seabed that will be permanently impacted the magnitude of the impacts on seabed habitats and fauna is considered minor.

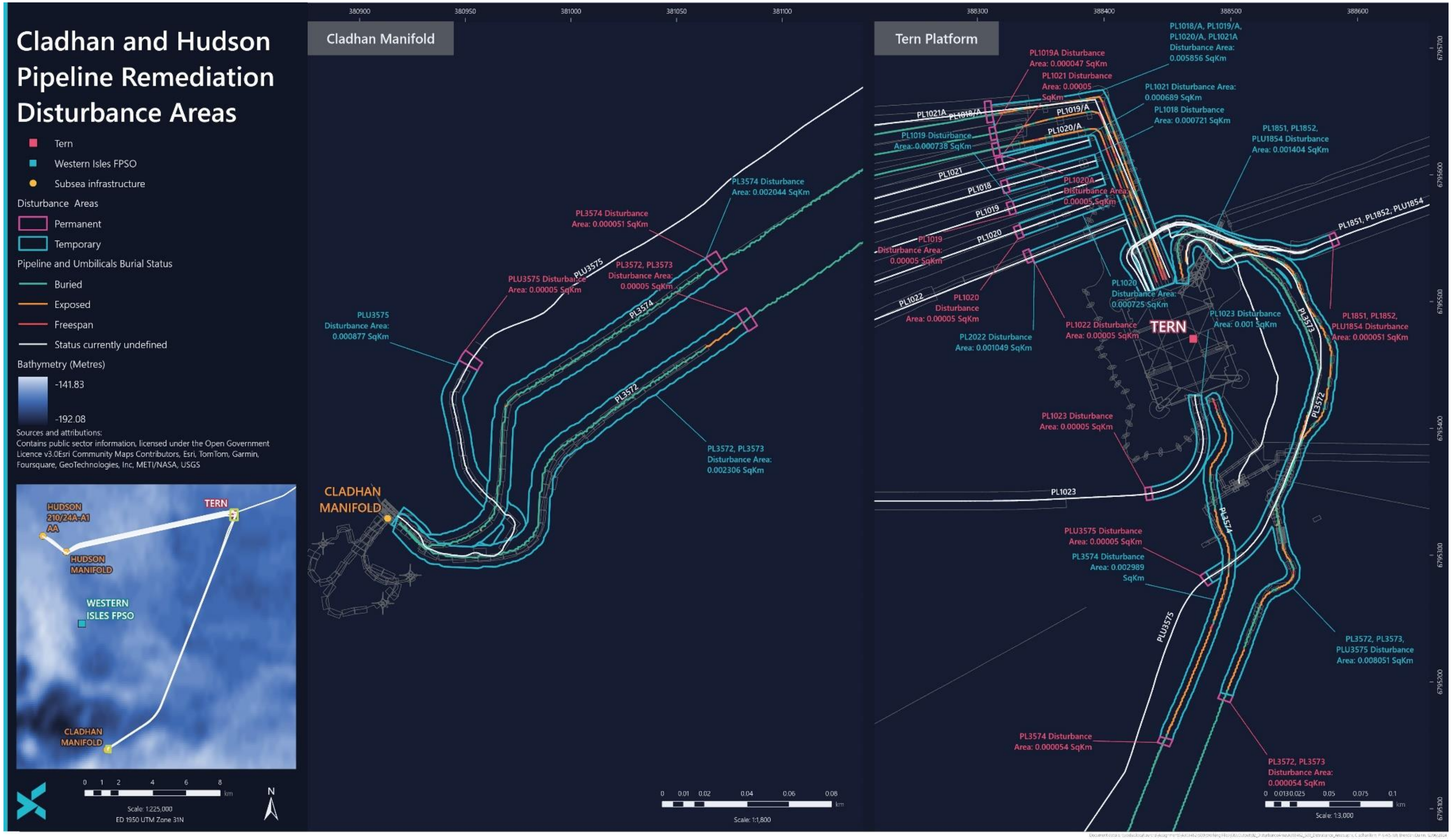


Figure 6-1 Cladhan and Hudson Manifold and Wellhead Pipeline Remediation Disturbance Areas

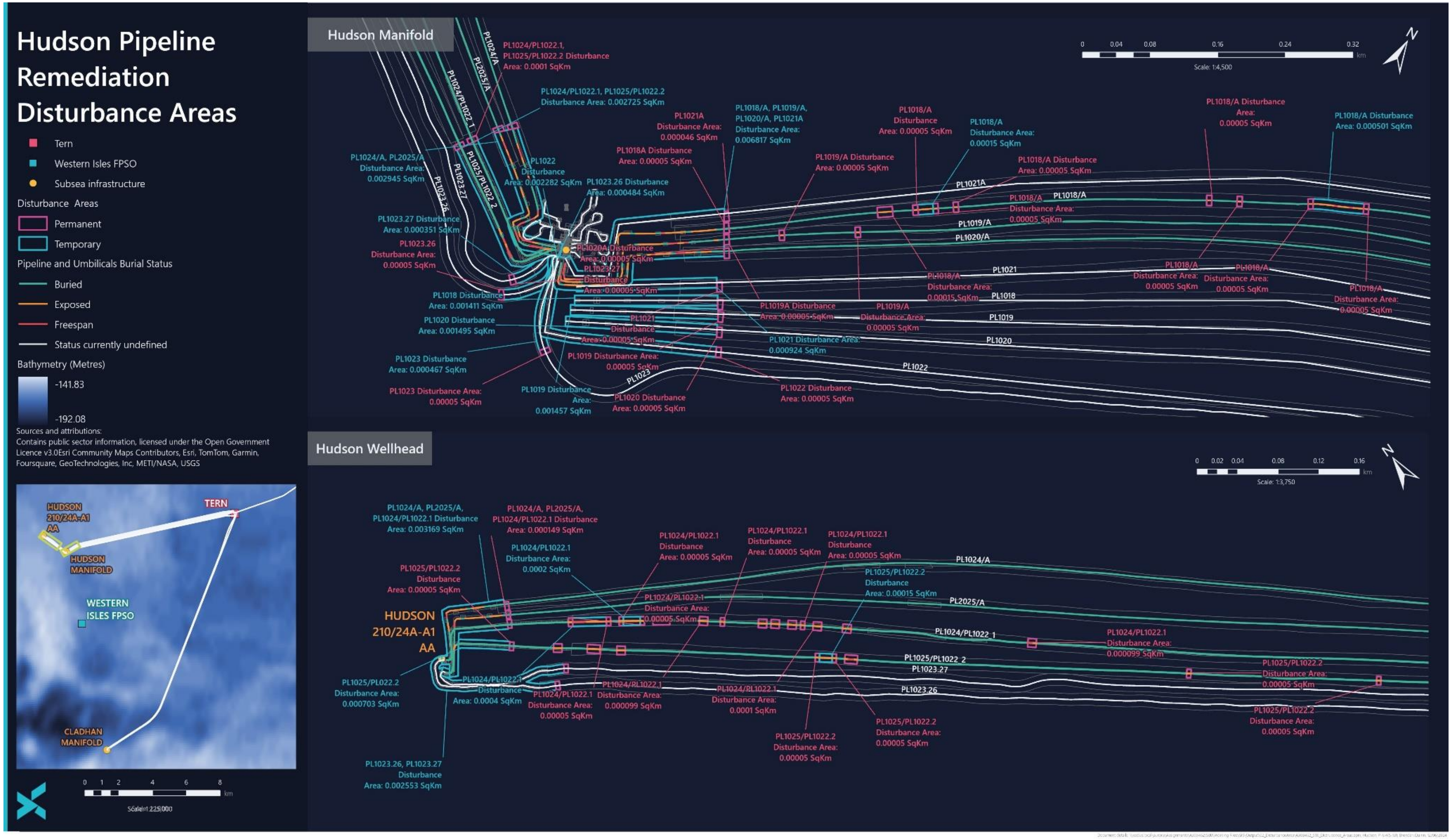


Figure 6-2 Hudson Manifold Pipeline Remediation Disturbances Areas

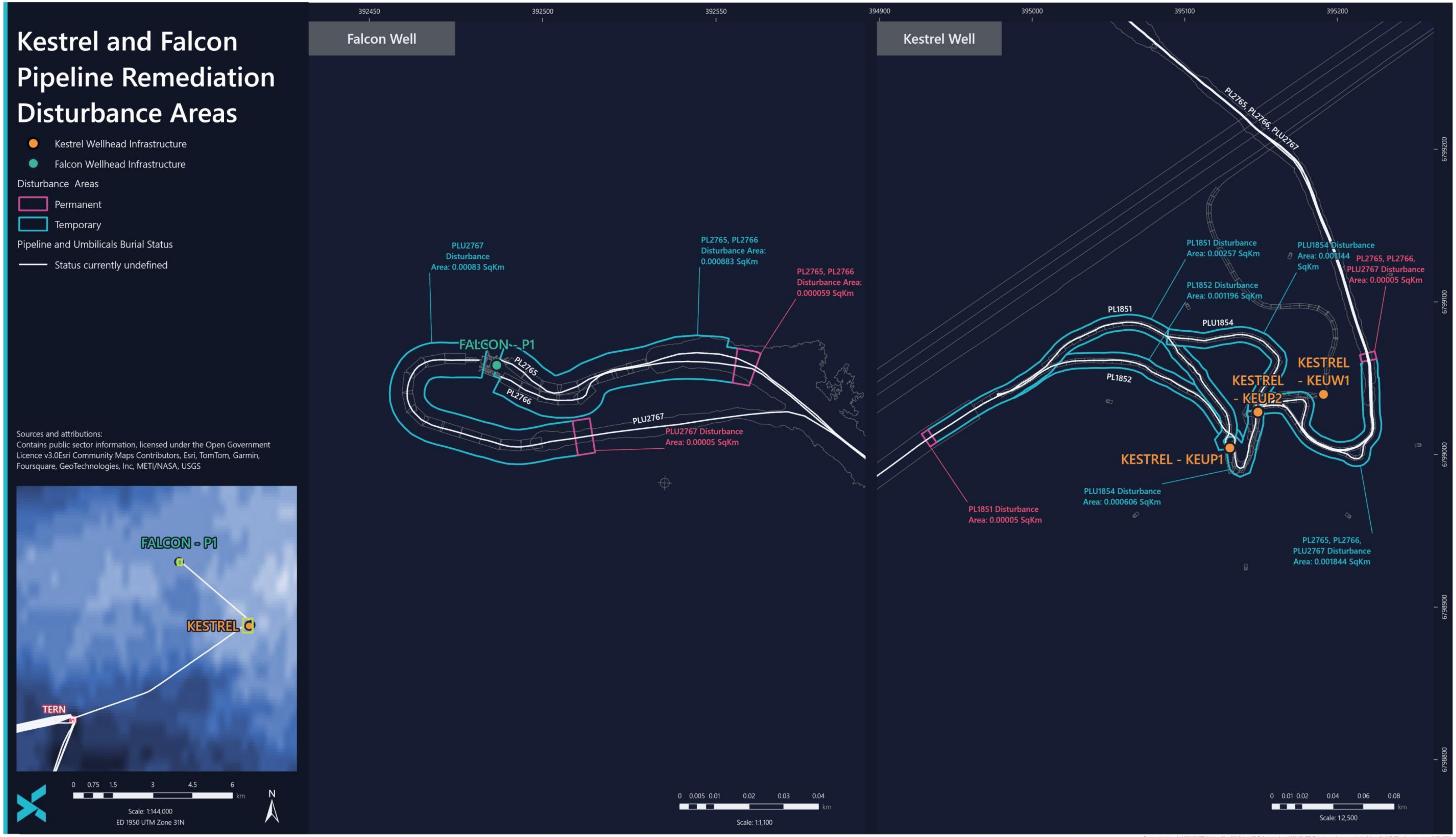


Figure 6-3 Kestrel and Falcon Pipelines Remediation Disturbances Areas

6.3.3 Effects on Sensitive Receptors

6.3.3.1 Direct Disturbance

Decommissioning activities are expected to lead to two types of direct physical disturbance. The first is temporary disturbance, which will result from the removal of pipelines and infrastructure from the seabed, and the placement of protective material. The sediment will be disturbed by the action of retrieving equipment from the seabed and rock placement, but once decommissioning is complete, the affected areas will be free of anthropogenic material. In the case of rock placement, temporary disturbance will only apply to the wider area impacted by suspended sediments, not the area covered by rock. Temporary disturbance should allow recovery in line with natural processes such as sediment re-suspension and deposition, movement of animals into the disturbed area from the surrounding habitat, and recruitment of new individuals from the plankton.

The second type of direct disturbance will be permanent disturbance caused by the deposition of additional rock armour on the seabed to protect infrastructure decommissioned *in situ*. This type of disturbance will effectively change the seabed type in the affected areas from the naturally occurring silty sand to a hard substrate. These materials will be permanently decommissioned on the seabed and potentially become fully buried by the deposition of new natural sediment. While the seabed will eventually recover and the substrate will return to pre-disturbance conditions, the time frame over which this occurs is so long-term that the disturbance is considered permanent. The temporary and permanent seabed effects associated with direct disturbance are discussed below.

6.3.3.1.1 Temporary Direct Disturbance

Decommissioning disturbance will cause mortality, due to injuries arising from the crushing of benthic and epibenthic fauna which are sedentary or unable to move quickly. Mobile fauna will likely also be disturbed. The sediment structure, including the burrows of any animals present, will be affected. Past surveys of the Tern Area consistently report infauna to be prolific and consist of polychaetes and bivalve molluscs (Xodus, 2018). The epifauna present in all areas is generally noted as sparse and typically features mobile species that have wide distributions throughout the North Sea. These include, for example, hermit crabs, various starfish and sea urchins.

The primary features of conservation and environmental concern in the Tern Area include:

- ‘Submarine structures made by leaking gases’ Annex I Habitat
- Ocean quahog *Arctica islandica* – OSPAR list of threatened and/or declining species and habitats (Region II – Greater North Sea)
- ‘Seapens and burrowing megafauna in circalittoral mud’ – OSPAR list of threatened and/or declining species and habitats (Region II – Greater North Sea), a component of which is the Scottish PMF habitat ‘Burrowed mud’
- Blue Carbon sequestration

Numerous seabed depressions that resembled pockmarks were also observed throughout the Tern Area. However, none were thought to be associated with Methane- Derived Authigenic Carbonates (MDAC). The lack of MDAC present in pockmarks identified across the Tern Area indicates that Annex I ‘Submarine structures caused by leaking gases’ are not present (Benthic Solutions, 2022).

A single ocean quahog individual was identified during the taxonomic analysis at station TERN_EBS_07 (Benthic Solutions, 2019). Low abundances of *A. islandica* were identified at Hudson during the most recent survey effort (Benthic Solutions, 2022). No evidence of distinct *A. islandica* siphons was seen on any of the video footage within the survey area. No *A. islandica* individuals were observed in surveys of the Cladhan, Kestrel, and Falcon fields (Fugro, 2008, 2014; Gardline, 2009, 2010a, 2011, 2012a, 2012b; Cale-survey, 2012, Xodus, 2018).

Ocean quahogs live at the surface of sediments while feeding but can burrow to depths of 14 cm, therefore they are vulnerable to physical abrasion from removal of infrastructure and smothering from placement of rock cover. They are long-lived bivalves which take 5 – 15 years to reach sexual maturity and spawn over a short period in the year. Recruitment is sporadic and variable (Tyler-Walters & Sabatini, 2017). Considering these, the recoverability of ocean quahog to physical abrasion is very low. While ocean quahog has been shown to occur in the Tern Area surveys, there is no evidence of aggregations within the areas surveyed. While scattered individuals of ocean quahog may occur in the Tern Area, they would not be expected to occur either in significant densities or in communities of specific conservation value.

'Seapen and burrowing megafauna communities' also have the potential to be found within the Tern Area. Benthic Solutions (2019) estimated the density of burrow openings at the seabed using representative video transects from sampling stations within the Tern field and found that the density of small and large burrows across the two transects were recorded as 'occasional' on the SACFOR scale and therefore not considered to be a high enough density to be classified as a FOCI or as an OSPAR Habitat (see Figure 4-2 for evidence of burrows in the Tern field). A small patch of burrows was present 450 m northwest of the Hudson manifold. They were classified as 'rare' on the SACFOR scale and as such, the area would not be considered 'Seapen and burrowing megafauna communities' (Benthic Solutions, 2022). No surveys conducted within any of the other fields identified presence of the 'Seapen and burrowing megafauna communities' habitat (Xodus, 2018).

Seapens have some resistance to being disturbed and generally can reinsert themselves into the sediment if removed, as long as they remained undamaged. However, damaged individuals show poor recovery, and therefore resilience is considered low, giving an overall sensitivity of medium (Hill, Tyler-Walters and Garrard, 2020). As such, temporary disturbance is expected to cause some mortality to any seapens that are physically damaged during operations, but this is expected to be extremely localised and not have any effect on the viability of the local population. Replacement of damaged individuals would be expected to occur either from plankton or from "adult" seapens moving in from the surrounding area. Where there has been a disturbance but the seapens remain undamaged, recovery may be rapid (<2 years; Hill, Tyler-Walters and Garrard, 2020). The nature of the activities is such that the removal of subsea structures should only have a highly localised impact on the seabed and there will be no placement of items thus the crushing of benthos is unlikely. Given the extent of their habitat across the North Sea, the recovery of seapens and burrowing megafauna would be swift.

The percentage carbonate in the top 10 cm of superficial sediments in UKCS Blocks 210/24, 210/25, 210/29, 210/30 and 211/21 ranges from 10 to 40% (BGS, 2022) which is above average compared the UKCS more generally (UKCS average value is 10.1%; Burrows *et al*., 2014; NMPi, 2022). The variation in carbonate sequestration can be attributed to the sediment composition across the fields, with sandy and muddy (fine) sediment generally exhibiting a higher percentage uptake of carbonate (Burrows *et al*., 2014). The seabed type within the Tern Area is primarily classified under the EUNIS biotope complex A5.27 (deep circalittoral sand) with areas of A5.45 (Deep circalittoral mixed sediment); A5.37 (Offshore circalittoral mud) and A5.35 (Circalittoral sandy mud), which could explain this variation.

Where there is direct impact to contaminated sediments (i.e. the Tern and Hudson cuttings piles) this impact is likely to be negligible for any of the environmental receptors of concern given the low species numbers and diversity associated with the (Section 4.2.2). Indirect impact may be more of a concern where contaminated sediments are released into a relatively 'natural' sedimentary environment and as such this is addressed in Section 6.3.3.2.

As noted in Section 6.3.2.5, approximately 0.24 km^2 of seabed would be affected by temporary direct disturbance. The scale of the disturbance is minimal when compared to other forms of disturbance that occur in the area, such as commercial trawling. A commercial trawler with a 12 m wide beam trawl trawling at its slowest rate of approximately 4.7 km/h would cover an area of roughly 0.06 km^2 per hour (FAO, 2019) so would therefore take approximately four hours to cover the anticipated direct disturbance area.

6.3.3.1.2 Permanent Direct Disturbance

The immediate effect of the introduction of new rock cover will be mortality and injury of immotile benthic and epibenthic fauna, as well as disturbance of motile fauna. Following the introduction of the rock cover, the ongoing effect will be the change of an area of softer habitat to a hard substrate, and a related change in the types of organisms that can use the habitat. Organisms such as sea pens and burrowing bivalves, anemones and crustaceans will no longer be able to use the area affected, while new habitat will be created for other groups such as encrusting sponges and anemones.

The ‘Seapens and burrowing megafauna in circalittoral fine mud’ habitat has no resistance to physical loss or change of substrate – where the soft sediment is no longer available, the community ceases to exist. Seapens themselves show poor recovery when physically damaged (Hill, Tyler-Walters and Garrard, 2020). While the habitat could be affected by the remediation activities, this represents a highly localised impact. Furthermore, the prevalence of the habitat in the Tern Area would ultimately promote quick recovery of seapens.

While the introduction of rock cover clearly results in a change in the habitat type and associated fauna present, the scale of the impact is negligible considering the very large extent of seabed of a similar composition available in the NNS. Rock remediation will be targeted and localised.

Permanent direct disturbance will occur due to placing further rock cover on the seabed in perpetuity. Approximately 0.0119 km^2 of seabed will be subject to permanent direct disturbance due to the introduction of rock placement, as detailed in Table 6-8.

6.3.3.1.3 Temporary Indirect Disturbance

Indirect disturbance (being twice the area of direct disturbance) is projected to have an area of temporary impact of 0.50 km^2. The temporary indirect disturbance area of increased sediment in the water column is expected to dissipate rapidly as generally it is the coarser, upper layers of sediment that would be disturbed. Given the very fine sand nature of the sediments, the overall level of re-suspended sediment will be low. However, increased suspended sediment may reduce feeding efficiency of filter feeders due to clogging of feeding structures. However, though not well studied, the bioturbation associated with burrows will generate sediment resuspension, thus implying that species typical of the ‘Sea pen and burrowing megafauna communities’ habitat may have some natural tolerance to sedimentation (Hill, Tyler-Walters and Garrard, 2020). Experimental evidence suggests that seapens are not sensitive to increased suspended sediment. Both species observed in the area (*P. phosphorea* and *V. mirabilis*) are tolerant to heavy smothering and siltation. *V. mirabilis* in particular are capable of retracting into their burrows thereby cleaning themselves of excess sediment by the production of mucous within the burrow (Hill, Tyler-Walters and Garrard, 2020). As such, effects due to increased suspended sediment are not expected to impact the benthos of the Tern Area.

As previously detailed, cuttings piles are located at the base of the Tern Jacket, Hudson manifold and Hudson L1/L2 satellite wells. There is potential for the decommissioning activities planned, namely the removal of the Hudson manifold and Xmas trees, to interact and disturb the associated cutting piles. Cuttings pile disturbance at the Tern jacket may be minimised as limited sections of surface laid pipelines and umbilicals in close proximity (75 m) to the jacket footings may be decommissioned in place, should derogation be granted.

The cuttings pile at both the Hudson manifold and L1/L2 Xmas trees have been deemed to be respectively 'medium' and 'small' in size (NorOG, 2016), with the manifold cuttings pile covering an area of 8,957 m^2 and the Xmas trees cuttings piles covering a combined 2,314 m^2. Both piles fall below OSPAR thresholds and were deemed insignificant regarding potential environmental impact (OSPAR, 2006 & UKOOA, 2001). The seabed disturbance occurring from the removal of the manifold would be 765.5 m^2 and 359 m^2 for the removal of both Xmas trees.

Contaminants within cuttings piles generally have low solubility and are mainly bound to particulate matter (OSPAR, 2016). Therefore, most of the contaminants follow the solids to the seabed where they settle. A proportion of each disturbed cuttings pile is likely to resettle on seabed sediment that has not been previously impacted by cuttings. Environmental impacts resulting from deposition or re-deposition of cuttings include smothering, grain size changes, deoxygenation, and toxicity, which in turn can result in changes to the benthos and other organisms.

The time needed for sediment to recover following deposition of mud and cuttings is influenced by several processes (Rye *et al*., 2001):

- The depth of deposition;
- Particle size;
- The rates of biodegradation of organic chemicals in the sediment;
- The resuspension and redistribution of matter on the sea floor due to currents and wave action; and
- The time for recolonization of the biota after disturbance on the sea floor.

The evidence indicates that short term uptake of contaminants in zoobenthos is to be expected, including crustaceans and molluscs. Demersal fish that feed on the zoobenthos may take up contaminants in the short term, but they are likely to be able to metabolise oils quickly and are unlikely to be significantly affected in the medium or long term. The majority of impacts from cuttings piles are noted within 100 m of the centre of the pile and generally beyond 500 m there is little discernible impact (UKOOA, 2002; ERT, 2004; DNV, 2008; BMT Cordah, 2013; OSPAR, 2019). Given the small area of disturbance in comparison to the overall size of the cuttings piles, and the highly localised activities which will be occurring to remove the subsea infrastructure, it is unlikely that the activities will pose significant environmental impact.

Any localised benthic communities impacted will recover initially through the recruitment of new colonising organisms and the migration from adjacent undisturbed sediments. Recovery will occur successively, and different species will dominate at various time intervals during the restitution of the sediment. Estimated times for re-colonization vary and are in the order of five years maximum (Rye *et al*., 2006).

6.3.3.2 Impact of Pipelines Decommissioned *In situ*

The decommissioning of items *in situ* has associated legacy impacts. This arises from the gradual breakdown of materials decommissioned *in situ*. In this instance, the pipelines and umbilicals will undergo long-term structural degradation caused by corrosion, leading to the eventual collapse of the pipelines under their own weight and that of overlying pipeline coating material, scale, and sediment. During this process, degradation products derived from the exterior and interior of the pipe will breakdown and potentially become bioavailable to benthic fauna in the immediate vicinity.

The primary degradation products will originate from the following pipeline components:

- Pipeline scale;
- Steel; and
- Plastic coating

As the Tern Area pipelines will have already been flushed prior to decommissioning activities, the pipeline and contents will be limited to treated seawater. Where umbilicals are decommissioned *in situ* in proximity to the Tern platform, they are likely to contain residual hydraulic fluid. Further discussion may be required where flushing and cleaning has not been possible or feasible (i.e., due to a blocked line) or where an umbilical may be required to be decommissioned *in situ* (within a 75 m proximity of the Tern platform) with hydraulic fluid contained within it until platform decommissioning activities commence. In either of these instances a separate risk assessment will be undertaken as part of the permitting process. OPRED will be consulted to agree on a mutual approach to this. Therefore, the impact of the contents of the pipelines and umbilicals decommissioned *in situ* is not considered further in this EA.

6.3.3.2.1 Heavy Metals

Metals with a relatively high density or a high relative atomic mass are referred to as heavy metals. It is expected that these metals will be released into the sediments and water column during the breakdown of the components of the pipeline scale, steel, and sacrificial anodes.

The toxicity of a given metal varies between marine organisms for several reasons, including their ability to take up, store, remove or detoxify these metals (Kennish, 1997). Concentrations of the metals are not expected to exceed acute toxicity levels at any time owing to the decommissioning. However, chronic toxicity levels may be reached for short periods within the interstitial spaces of the sediments or in close proximity to the pipelines. At these levels, heavy metals act as enzyme inhibitors, adversely affecting cell membranes, and can damage reproductive and nervous systems. Changes in feeding behaviour, digestive efficiency and respiratory metabolism can also occur. Growth inhibition may also occur in crustaceans, molluscs, echinoderms, hydroids, protozoans, and algae (Kennish, 1997). It is expected that any toxic impacts will be short lived and localised with minimal potential to impact populations of marine species. The potential for uptake and concentration of metals would also be limited to the local fauna. Due to the slow release of these chemicals, it is unlikely to result in a significant transfer of metals into the food chain.

The slow release of the metals associated with the pipeline steel is expected to have a negligible impact on the local environment. However, it is anticipated that both degradation and resultant failure of the pipelines would be an exceedingly slow process, with failure only estimated to occur after many years (up to 400 years) (HSE, 1997).

Along buried pipeline corridors, heavy metals may accumulate in the sediments as the pipelines degrade. The finer fractions of these sediments (silts and clays) are likely to form bonds with these metals, making them less bioavailable to marine organisms. The sandy (coarser fraction) of the sediments surrounding the pipelines are less likely to retain metals (MPE, 1999). The seabed within the Tern Area is largely composed of silty sand and is therefore likely to retain any metals, prolonging their release to the surrounding seawater.

The pipelines to be decommissioned *in situ* cover 0.03 km^2 within the context of the wider NNS. Degradation is unlikely to occur at a constant rate and across the entire length of the pipeline. Therefore, due to the highly localised nature of any degradation products and the low concentrations of contaminants being released over an elongated period, it is highly unlikely that these products will be detectable above current background conditions.

6.3.3.2.2 Plastics

There are plastic components within the composition of the pipelines within the Tern Area. However, as no micro-organisms have evolved to utilise chemically resistant polymer chains as a carbon source, these plastics can be expected to persist in the environment for centuries (OGUK, 2013). As the rate of biodegradability in the marine environment is also low, it can be assumed that the environmental effect of leaving these plastics in place is insignificant (MPE, 1999).

Opportunity also exists for microplastics to enter the food chain. Adverse effects of microplastics on marine organisms can potentially arise from the physical obstruction or damage of feeding appendages or digestive tract or other physical harm. In addition, microplastics can act as vectors for chemical transport into marine organisms causing chemical toxicity (Hylland and Erikson, 2013). However, the pipeline degradation process which facilitates the availability of plastics to marine organisms will occur very gradually over a highly protracted timeframe.

Due to the highly localised nature of any degradation products, the burial status of the pipelines and the low concentrations of contaminants being released over an elongated period it is highly unlikely that these products will be detectable above current background conditions in the area.

6.3.4 Cumulative and Transboundary Impacts

Decommissioning activities may be integrated with the overall Tern Area and the wider NNS decommissioning scope to maximise synergies, optimise the use of resources and minimise disturbance to the environment. Most of the surrounding NNS oil and gas assets will be subject to decommissioning in the coming years, however the timescale of those decommissioning operations has yet to be defined. Therefore, cumulative impacts are difficult to assess.

Most of the surrounding NNS oil and gas assets will be subject to decommissioning in the coming years. This is aligned with Tern Upper Jacket EA (TAQA, 2024d), within which the seabed impact was scoped out from further assessment. The anticipated seabed footprint of these activities is currently unknown. As it stands, there is no anticipated cumulative seabed impact with the other decommissioning activities. Therefore, cumulative impacts to the seabed caused by decommissioning activities are considered to be negligible.

The Tern Area subsea facilities are located approximately 40 km from the closest point of the UK/Norway median line. Given this distance, and the area of indirect temporary disturbance being 0.50 km^2, there is no potential for sediment to travel beyond the immediate vicinity of the decommissioning area and into neighbouring territorial waters. Transboundary impacts are highly unlikely.

6.3.5 Mitigation Measures

The following measures will be adopted to ensure that seabed disturbance and its impacts are minimised to a level that is as low as reasonably practicable:

- A pre-decommissioning environmental baseline survey will be conducted in Q4 2022 to fill any environmental data gaps. The results of this survey will be shared with OPRED
- All activities which may lead to seabed disturbance will be planned, managed, and implemented in such a way that disturbance is minimised
- Careful planning, selection of equipment, management, and implementation of activities
- A debris survey will be undertaken at the completion of the decommissioning activities. Any debris identified as resulting from oil and gas activities will be recovered from the seabed where possible
- Rock armour will be placed by a fall pipe vessel equipped with an underwater camera on the fall pipe or the positioning of rock bags monitored by ROV. This will ensure accurate placement of the rock armour and reduce unnecessary spreading of the rock armour footprint and ensuring that minimum safe quantity or rock is used
- Clear seabed verification will ensure there is no residual risk to other sea users and will be agreed with OPRED. Non-intrusive verification techniques will be considered in the first instance and in agreement with fishing bodies. Post-decom survey specifications will be agreed in advance with OPRED to ensure that any protected species or areas of

conservational importance are not inadvertently compromised in any way by any clear seabed trawling activities or other obtrusive methods.

6.3.6 Seabed Disturbance Residual Impact

Table 6-11 Seabed Disturbance Residual Impact

Receptor	Magnitude	Sensitivity	Vulnerability	Value
Seabed habitats and fauna	Minor	High	Low	Low

Tern Area infrastructure decommissioning activities will result in temporary direct and indirect disturbance to the seabed. Temporary direct disturbance has the potential up to impact 0.24 km^2 of seabed. Temporary indirect disturbance of natural and potentially contaminated sediment could impact up to 0.50 km^2. There will be a 0.0119 km^2 area of permanent disturbance because of new rock placement (for pipeline/umbilicals ends, exposures/spans and depressions remediation). These are considered highly conservative estimations of the likely impact of the proposed decommissioning activities, as the buffers added to the structures are likely to overestimate the range of impact generated by various removal methods. Overall, given the localised nature of the seabed disturbance, and the very small area of seabed that will be permanently impacted, the magnitude of the impacts on seabed habitats and fauna is considered minor.

Surveys of the Tern Area indicated the presence of several potentially sensitive habitats and species, including the Annex I protected habitat 'Submarine structures made by leaking gases' (pockmarks), the OSPAR and UK BAP protected habitat 'Seapen and burrowing megafauna communities' and the OSPAR protected habitat, ocean quahog.

The lack of MDAC present in pockmarks identified across the Tern Area indicates that Annex I 'Submarine structures caused by leaking gases' are not present.

The OSPAR 'Seapen and burrowing megafauna communities' habitat were recorded as 'occasional' on the SACFOR scale. The general benthos and the species associated with the OSPAR 'Seapen and burrowing megafauna communities' habitat specifically are likely to have some natural resilience to increased sedimentation, if not to abrasion associated with direct disturbance.

Very low abundances of ocean quahog were observed in the Tern Area however, the presence of aggregations is unlikely. The species could be affected by the proposed decommissioning activities via physical abrasion and smothering, and recoverability to these pressures is very low due to the low level of recruitment. However, the decommissioning activities have a highly localised impact as demonstrated in this chapter, it is therefore expected that a very low number of individuals would be impacted by the proposed decommissioning activities.

Some benthos may be impacted by the indirect dispersion of contaminants resulting from removal activities within the Tern and Hudson cuttings piles. Any impact would be expected to be highly localised with the majority of contaminants settling out within the existing extent of the cuttings piles. Recovery of benthic communities would be over a timescale of less than five years.

Given the very small area of direct and indirect impact predicted to be generated by the proposed decommissioning activity, the vulnerability of the seabed receptors is considered as being low.

Based on the anticipated localised and temporary nature of the disturbance, the proposed decommissioning of the Tern Area will have a negligible impact on seabed receptors.

Consequence	Significance
Negligible	Not significant

6.4 Physical Presence of Infrastructure Decommissioned *In Situ* in Relation to Other Sea Users

6.4.1 Approach

The proposed Tern Area decommissioning activities have the potential to impact upon other users of the sea, namely commercial fisheries. This may happen during the decommissioning activities themselves or after, should any infrastructure or cuttings piles decommissioned *in situ* interact with fishing gear. Sea users, other than commercial fisheries, are unlikely to be affected by the proposed decommissioning. These aspects are assessed throughout the rest of this Section.

6.4.2 Sources of Potential Impacts

In this instance, only the midline sections of the Tern Area trenched and buried pipelines/umbilicals are proposed to be decommissioned *in situ* and the remaining infrastructure will be removed, with a clear seabed to be confirmed following remediation and removal activities. The cuttings piles located at the base of Tern Jacket, Hudson manifold and Hudson L1/L2 satellite wells will also be decommissioned *in situ* and there is a potential for interaction with demersal trawlers. Generally, interactions between oil and gas infrastructure and fishing gear are most prevalent in the NNS where demersal fishing effort is relatively high (Rouse, Hayes and Wilding, 2018).

The long-term presence of subsea infrastructure decommissioned *in situ* has the potential to interfere with other sea users. The greatest identified risk to commercial fisheries is the potential snagging of demersal fishing gear on exposures or free spans associated with infrastructure decommissioned *in situ*, as well as any clay mounds or depressions generated by the removal of infrastructure. These potential snagging risks may arise during initial decommissioning and/or over the longer-term. In addition to the physical presence of the flowlines and rock placement decommissioned *in situ*, local pipeline remediation (i.e., rock placement) may increase the potential for interaction with fishing gear. The length of rock placement being decommissioning *in situ* was calculated based on the pipeline surveys data. Total weight of existing rock cover is 126,616 Te (Table 3-5, Table 3-10 and Table 3-15) and the seabed footprint amounts to 0.101 km^2. This value is determined by multiplying the length of rock cover by 10 m to represent the maximum rock cover scenario. This approach likely represents overestimate.

Limited sections of surface laid pipelines, umbilicals, and protection material in close proximity to the Tern platform jacket/sub-structure footings may be decommissioned in place, subject to derogation agreement with OPRED. “Close proximity” is considered within approximately 75 m of the platform footings. Logical break points between portions decommissioned *in situ* and portions removed will be selected, e.g., pipeline crossings, etc. This option represents a reasonable balance between the level of risk associated with removing the facilities, the degree of disturbance of the seabed, the use of resources during decommissioning, and, following decommissioning, the loss of amenity for other sea users. If derogation is not granted, all surface laid pipelines and umbilicals will be recovered and taken to shore for appropriate re-use, recycling, or disposal.

6.4.3 Effects on Sensitive Receptors

Annual fishing effort in the Tern Area (ICES rectangles 51F0 and 51F1) is targeted primarily for demersal species. Both rectangles are deemed to be of low contribution to the total UK landings values and weights.

In 2022 there were 187 days of effort in ICES rectangle 51F0 and 197 days of effort in ICES rectangle 51F1. When compared with the four preceding years, this represents a general decrease in effort in ICES rectangle 51F0 since 2020 and a decrease in effort in ICES rectangle 51F1 from 2021 (Table 4-5).

The landings values and weights were dominated by demersal fish in ICES rectangle 51F0, accounting for >99% of landed value and > 99% of landed weight between 2018 and 2020 and in and 2022. In these same years, shellfish and pelagic species both accounted for <1% of the value and the landed weight. In 2021, the distribution of catch by landings weight and value was still predominantly attributed to demersal fish, accounting for 84% of the landed value and 67% of the landed weight, however, a greater proportion of landings were attributed to pelagic fish in this year accounting for <16% of the landed value and 33% of the landed weight (Marine Directorate, 2023).

The landings value and weight in ICES rectangle 51F1 were similarly weighted towards demersal, pelagic and shellfish, although the dominant species type varied by year. Demersal fish accounted for 100% of the landed value and landed weight for 2018, 2020 and 2022. In 2019 and 2020 there was a higher proportion of landed weight and value attributed to pelagic fish, which accounted for 13% and 16% of landed weight and 3% and 7% of landed value for each year respectively. There is little evidence of shellfish fisheries in the area with <1% of the landed weight and value across 2018 – 2022.

Trawls are the most utilised gear in ICES rectangles 51F0 and 51F1, although hooks and lines were also operated across all years in ICES rectangle 51F0 and seine nets were operated in all years in both ICES rectangle 51F0 and 51F1. It is likely that most of the trawl effort in ICES rectangle 51F0 and 51F1 is attributed to demersal fish, due to the higher proportion of demersal catch, however, some pelagic fishing effort is likely to occur, especially in ICES rectangle 51F1 where pelagic catch is higher.

6.4.3.1 Snagging Risk

Currently there is no data available for any exposures and free spans along the Cladhan pipelines or fishing (demersal) trawls across the pipeline area. However, TAQA are committed to undertaking pre-decommissioning surveys to ensure that any areas of exposure or free span are identified and suitably remediated with rock placement. The latest pipeline survey and associated environmental impact information will be incorporated in relevant permits.

Pipeline events listings (Fugro, 2018) data indicate that the Hudson pipelines and accompanying piggyback pipelines remain mostly trenched and buried below the seabed. However, as detailed in Appendix B - Pipeline Exposures and Free Spans Summary and shown in Figure 6-1, a large majority of the exposures and spans that are present occur close to either end of the pipelines. The areas where exposures and spans are located coincide with areas of lower trawling intensity, as can be seen for the Hudson, Kestrel and Falcon lines within Figure 6-4. No trawling intensity data is currently available for the Cladhan lines, however it can likely be assumed that this would follow a similar pattern to that of the Hudson, Kestrel and Falcon lines, whereby fishing intensity is more significant over the midline sections. For any pipeline being decommissioned *in situ* all exposures and free spans will be remediated as appropriate using rock placement.

Post decommissioning surveys and over-trawlable trials will be run along all pipelines decommissioned *in situ* and at sites of subsea facilities, in agreement with OPRED following completion of the project activities.

The seabed in the surrounding area is relatively stable, which further reduces the risk of exposure over time. Any potential changes in burial status of the pipelines resulting in legacy impacts to commercial fisheries due to degradation over time will be managed through continued monitoring and communication with relevant users of the sea, as detailed in Section 6.4.4.

Overall, the region experiences low fishing effort with corresponding low fish landings from the area in terms of both tonnage and value. Some snagging risks will arise in areas of exposures or free-spans and at the pipeline ends and at any clay berms which result from infrastructure being removed. All exposures, free spans and pipelines ends will be remediated by rock cover; however, these extend across a short portion of the pipeline only. Further, all rock cover will be designed with an overtrawlable (1:3) profile to minimise any residual risk to commercial fishers. Should any berms be apparent following infrastructure removal, these shall be remediated in an appropriate manner. Considering this, and the low fishing effort observed within the Tern Area and the remediation strategies to be put in place, the snagging risks associated with the decommissioning of the pipelines *in situ* is considered minimal.

6.4.3.2 Drill Cuttings Interaction

Trawling is a key mechanism of seabed disturbance, resulting in suspension of sediment in a cloud of particles. This can lead to the release of nutrients, pore water, hydrocarbons, and metals from the sediment into the water column. Independent studies have found that trawling gear typically re-suspends the equivalent of 1 mm depth of seabed sediment. The contaminant content of the top (approximately 100 mm) layer of a cuttings pile is often relatively low, having leached into the water column over time and biodegraded (Genesis, 2014). The amount of sediment disturbed depends primarily on the fishing gear and rigging type, the hydrodynamic conditions, and the sediment type. Results suggest that scallop dredging gear has the greatest potential for sediment disturbance and this is typically not an activity undertaken in proximity to cuttings pile such as those in the Tern Area.

Following over-trawl using demersal nets, drill cuttings contamination will likely spread but this would not be expected to be in amounts or at rates that would pose serious wider contamination or toxicological threats to the marine environment. The act of spreading will encourage, albeit at a slow rate, increased aeration of deposited material which will enable its further degradation by natural processes (OSPAR, 2009c, 2019).

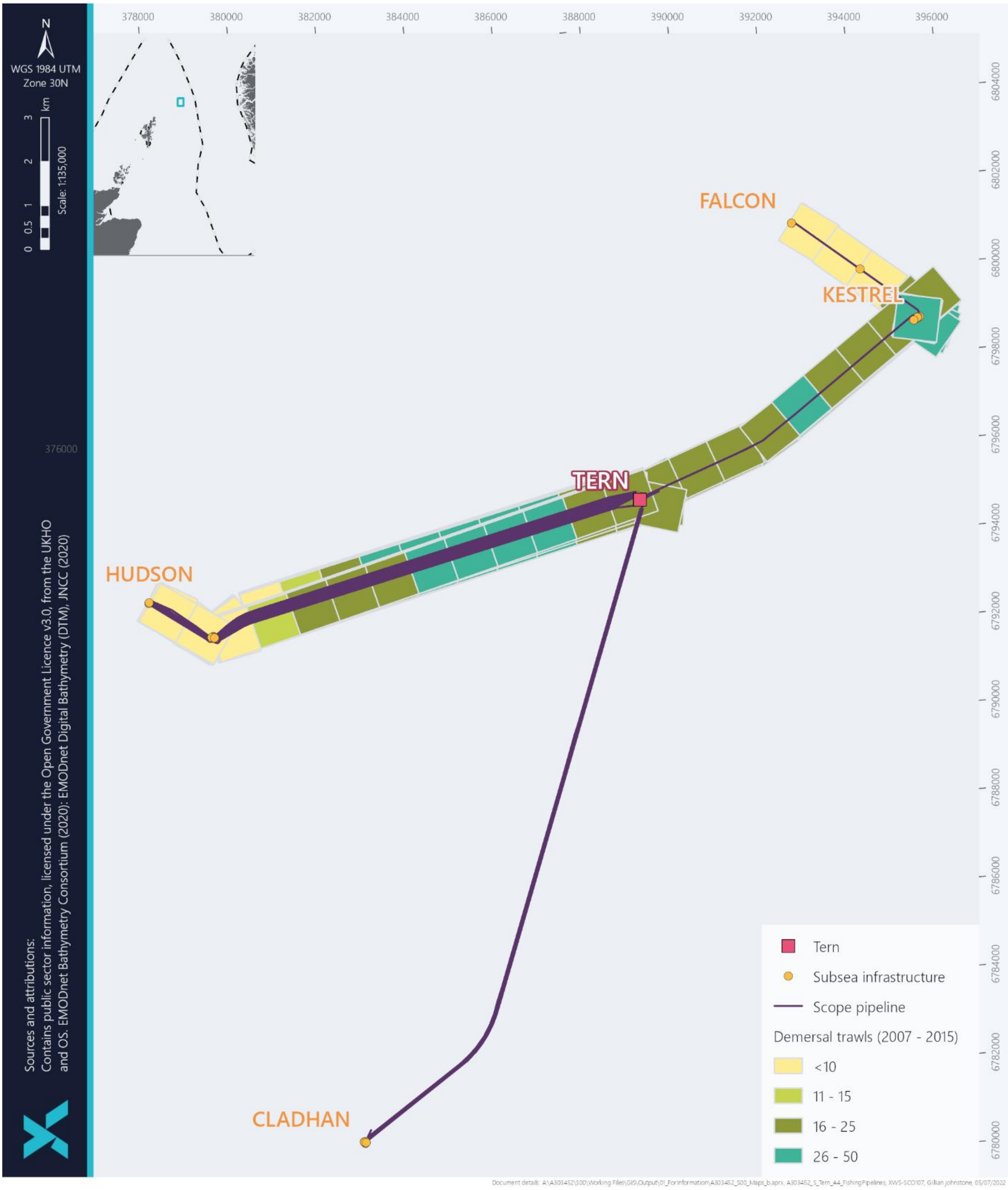


Figure 6-4 Trawling Across The Tern Area Pipelines

6.4.4 Cumulative and Transboundary Impacts

The Tern Area infrastructure is located approximately 47 km from the UK/Norway border. The most recent AIS vessel track data shows the density of vessels in 2017 was generally low across the pipelines. Following the decommissioning activities, pipeline exposures will be remediated, and the seabed will be decommissioned in an overtrawlable condition, so no impacts to any UK and/or foreign fishing fleets are expected to result from the proposed activities.

There is the potential for cumulative impacts to occur with other activities occurring nearby to the Tern Area which could also interfere with commercial fishing activity. Most of the surrounding NNS oil and gas assets will be subject to decommissioning in the coming years. The anticipated schedule for activities is currently unknown.

It is expected that adequate mitigations will be in place at these fields to minimise snagging risk as far as possible. In addition, snagging risk or interference with commercial fisheries may arise due the decommissioning of wells within the Tern Area and the removal of other infrastructure, however, these will be remediated/mitigated prior to the removal of any 500 m safety zones. Overall, considering the low potential for snagging risk within the project area and the fact that any rock placement will be overtrawlable, no cumulative impacts are expected to arise.

6.4.5 Mitigation Measures

The following measures will be adopted to ensure that snagging risks to commercial fisheries as a result of the Tern pipelines being decommissioned *in situ* are reduced to ALARP:

- The Tern Area pipelines are currently shown on Admiralty Charts, the FishSafe system and the NSTA Infrastructure data systems (NSTA Open Data). Once decommissioning activities are complete, updated information (i.e. which infrastructure remains *in situ* and which has been removed) will be made available to allow Admiralty charts and the FishSafe system to be updated
- Any exposures or cut pipeline ends will be rock covered to ensure they are overtrawlable by fishing vessels
- If clay berms are identified during post decommissioning surveys these will be remediated to ensure there are no potential snagging hazards. The remediation approach will be assessed on a case-by-case basis and in consultation with OPRED where required
- Any objects dropped during decommissioning activities will be removed from the seabed where appropriate
- TAQA will monitor the seabed to assess any seabed depressions or clay berms which may present a snag risk. The survey results will be used in discussion with OPRED prior to the commencement of any intervention
- Clear seabed verification will ensure there is no residual risk to other sea users and will be agreed with OPRED. Non-intrusive verification techniques will be considered in the first instance, but if deemed necessary, seabed clearance may require conventional overtrawl survey methods. If there is evidence of residual snagging hazards (e.g. any spans, berms, dropped objects, etc.), then intervention in the form of overtrawling to re-level the seabed or the addition of rock placement will be discussed with OPRED, and implemented as appropriate
- Ongoing consultation with fisheries representatives
- TAQA recognises its obligation to monitor any infrastructure decommissioned *in situ* and therefore intends to set up arrangements to undertake post-decommissioning monitoring.

The frequency of the monitoring that will be required will be agreed with OPRED and future monitoring will be determined through a risk-based approach established from the findings of each survey in turn. During the period over which monitoring is required, the burial status of the infrastructure decommissioned *in situ* would be reviewed and any necessary remedial action undertaken to ensure it does not pose a risk to other sea users.

6.4.6 Physical Presence of Material Decommissioned *In Situ:* Residual Impact

Table 6-12 Residual Impact of Material Decommissioned *In Situ*

Receptor	Magnitude	Sensitivity	Vulnerability	Value
Fisheries	Moderate	Low	Low	Low

While the impact magnitude may be considered major owing to the potential severity of a snagging events, the frequency of such an event is relatively unlikely and is therefore considered to be Moderate.

The pipelines being decommissioned *in situ* are largely anticipated to be buried to a suitable depth however, any exposures and free spans will be remediated with rock placement. There is currently no data along the Cladhan pipelines that are scheduled to be decommissioned *in situ,* however, TAQA are committed to undertaking pre-decommissioning surveys to identify any areas of exposure of free span which will also be remediated with rock placement. Following decommissioning, the project area will undergo non-intrusive methods in the first instance to confirm there are no potential snagging risks. Furthermore, a monitoring schedule, in agreement with OPRED, will be produced for any pipeline decommissioned *in situ*. The drill cuttings piles to be decommissioned *in situ* fall below the relevant OSPAR threshold values for contamination and surface trawling is not expected to spread contaminants in amounts or at rates that would pose serious wider contamination or toxicological threats to the marine environment. Therefore overall, the magnitude is considered moderate for fisheries.

These impacts will be restricted to commercial fisheries that make active contact with the seabed, such as bottom trawls and dredging gears. Commercial fisheries as a receptor are considered to be of low sensitivity as the industry is able to accommodate change. The vulnerability of the receptor is also considered low as the presence of the pipelines are not likely to influence fishing activity in the area beyond current natural variation. The value of commercial fisheries is also considered low when comparing the financial value and contribution of the catch within the wider regional context. The re-opening of the 500 m safety zones around the Tern Area will also expand the available fishing grounds. Foreign fleets are also not considered to be highly dependent on the area, based on recent AIS data.

Coupled with mitigation measures which include non-intrusive and intrusive surveys (as required), impacts to commercial fisheries from snagging risk and interaction with drill cuttings are deemed negligible and not significant.

Consequence	Significance
Negligible	Not significant

7 CONCLUSIONS

Following detailed review of the proposed decommissioning activities, the environmental sensitivities characteristic of the area surrounding the Tern Area subsea infrastructure, industry experience and consideration of stakeholder concerns, it was determined that potential project-related impacts to the seabed, and commercial fisheries, required further consideration.

The Tern Area infrastructure is located approximately 104 km offshore in the NNS, remote from coastal sensitivities. There are no NCMPAs, SACs or SPAs within 40 km of the Tern Area. The closest protected site is the Pobie Bank Reef SAC, approximately 72 km southwest of the Tern platform.

Decommissioning activities within the Tern Area will result in temporary direct and indirect disturbance to the seabed (Section 6.3). Temporary direct disturbance has the potential to impact 0.24 km^2 of seabed. Temporary indirect disturbance has the potential to impact 0.50 km^2 of seabed. Rock remediation activities will permanently impact an area of approximately 0.0119 km^2. For context, the estimated seabed footprint of existing rock cover amounts to 0.101 km^2. These activities have the potential to cause minor discernible change to the baseline of existing benthic receptors. Considering the temporary and/or localised nature of the activities and the mitigation measures outlined, the habitat, though sensitive, is not likely to be affected significantly by the decommissioning. Based on the anticipated localised and temporary nature of the disturbance, the proposed decommissioning of the Tern Area subsea infrastructure will have a negligible impact on seabed receptors.

Activities with the potential to impact upon commercial fisheries were limited to the possible legacy impacts from the decommissioning of drill cuttings, pipelines, and associated rock armour *in situ* (Section 6.4). Such impacts are restricted to commercial fisheries which make active contact with the seabed, such as those which operate bottom trawl or dredging gears. All pipelines will be adequately buried and all exposures, free spans and seabed depressions will be remediated. In the wider regional context, the waters in which the Tern Area subsea infrastructure is located experience overall low fishing effort. Based on these observations, the fact that the relevant cuttings piles are below the OSPAR thresholds and coupled with mitigation measures which include focussed surveys and ongoing monitoring for exposures, impacts to commercial fisheries from snagging risk from the decommissioning of the Tern Area subsea infrastructure are deemed negligible.

This EA has considered the objectives and marine planning policies of the NMP across the range of policy topics including biodiversity, natural heritage, cumulative impacts and the oil and gas sector. TAQA considers that the proposed decommissioning activities are in alignment with these objectives and policies.

Based on the findings of this EA including the identification and subsequent application of appropriate mitigation measures, and project management according to TAQA's HSSE Policy and EMS, it is considered that the proposed Tern Area subsea infrastructure decommissioning activities do not pose any significant threat of impact to environmental or societal receptors within the UKCS.

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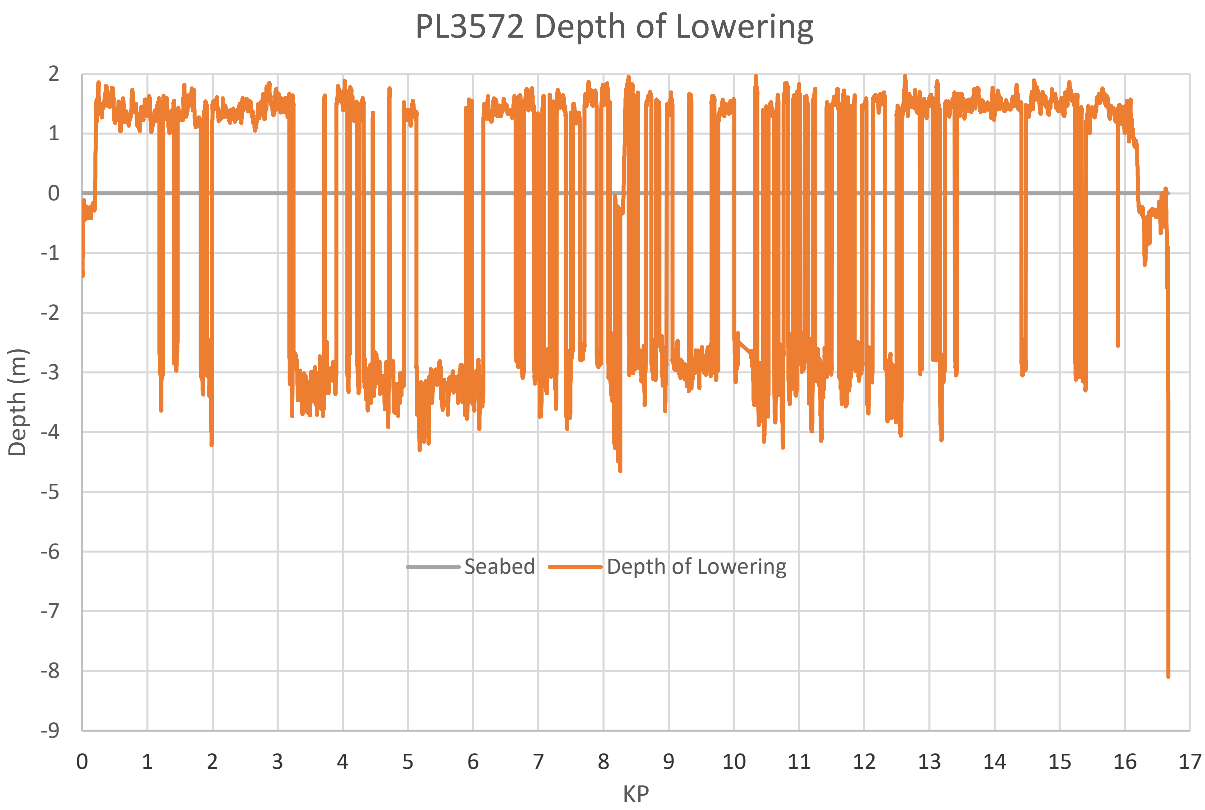
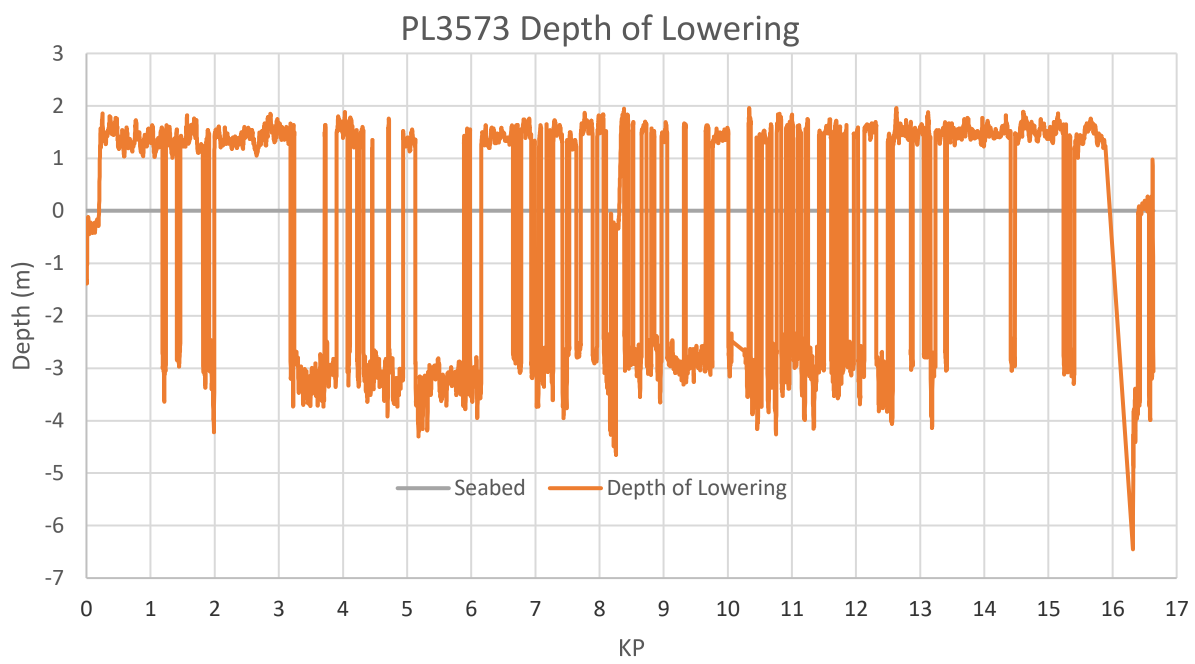
APPENDIX A – PIPELINE DEPTH OF BURIAL

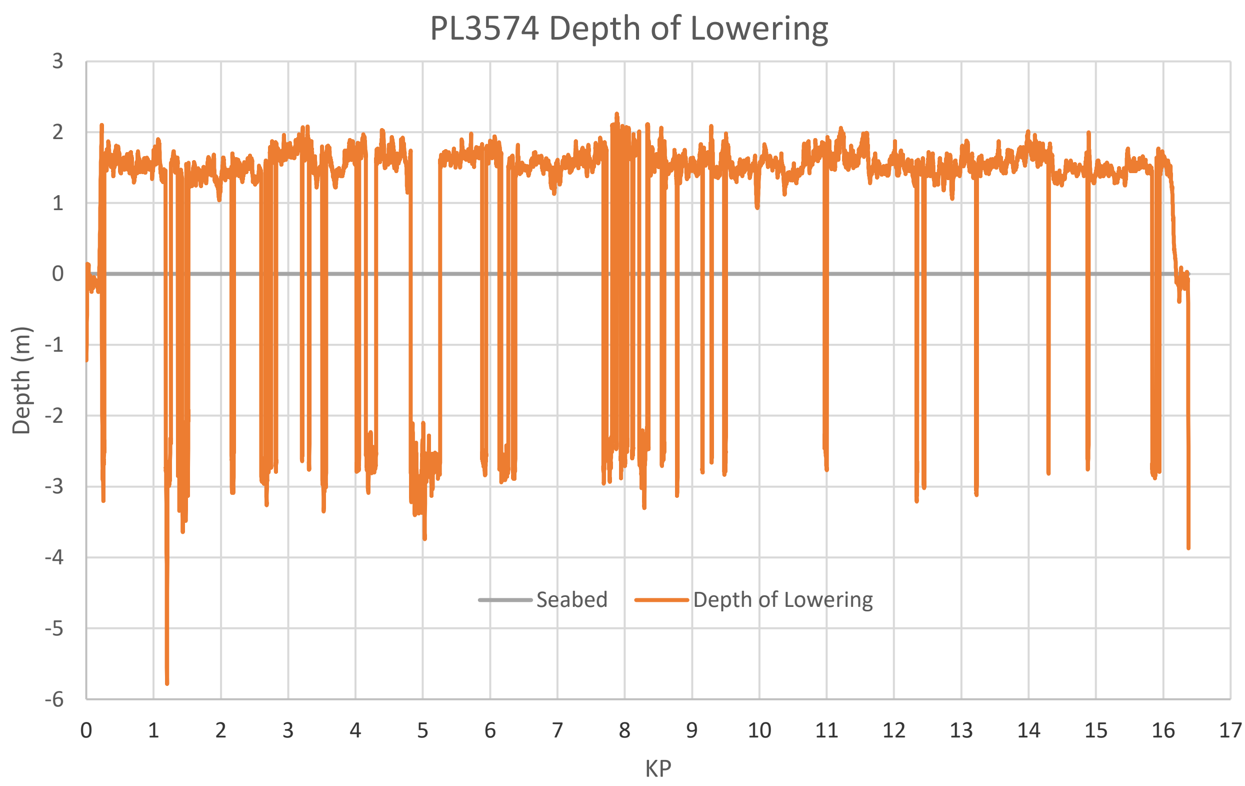
Depth of burial profiles are presented in this Appendix. In the situation where DOB data are incomplete the depth of lowering is used to present the pipeline burial status. Depth of lowering is defined as difference between the top of the pipeline and seabed level.

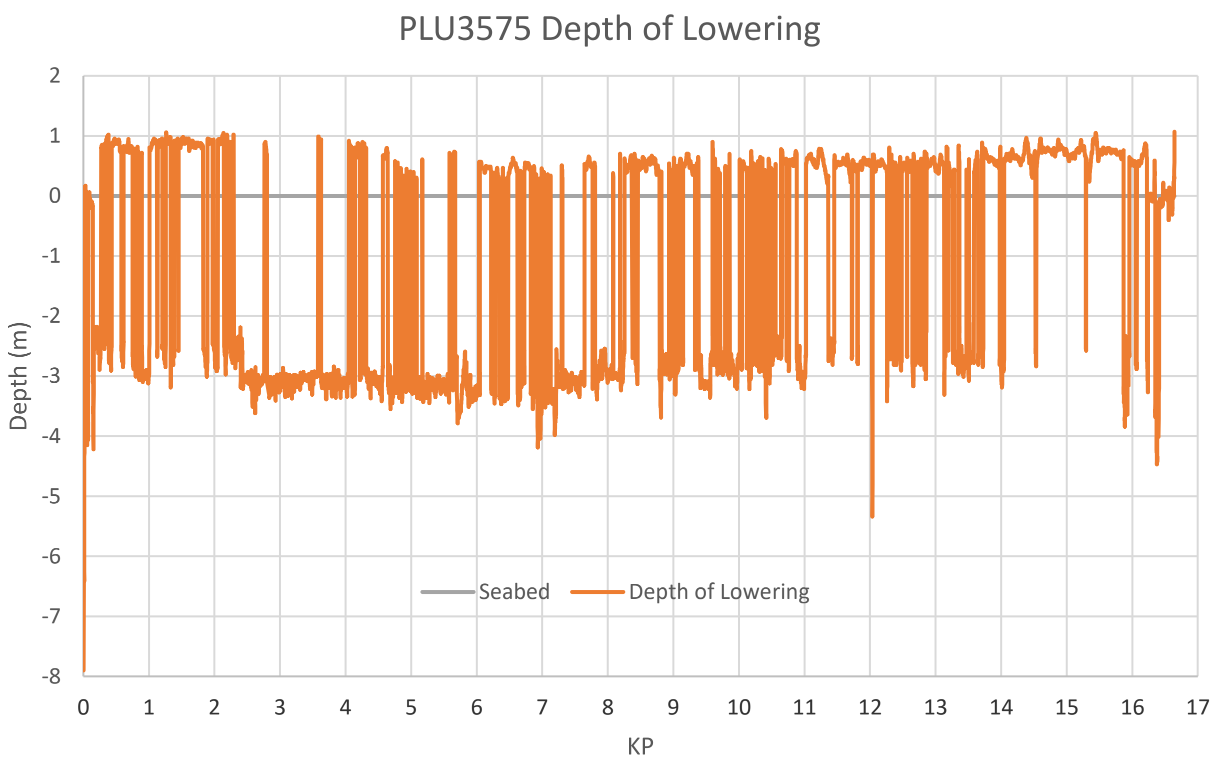
Cladhan

Depth of burial surveys data are incomplete, therefore the depth of lowering pipeline burial data for the Cladhan field are presented below where data is available, based on current understanding. Data for PL3572, PL3573, PL3574 and PL3575 seems spurious with numerous false data points, perhaps reflections of the trench edges rather than the pipeline itself. Burial depth will be confirmed using pipe-tracker survey techniques prior to the commencement of decommissioning activities, to provide an accurate and current picture of the situation for each of the pipelines proposed to be decommissioned *in situ*. Should remediation of these pipelines be required following the pre-decommissioning surveys, this will be carried out via the permitting process.

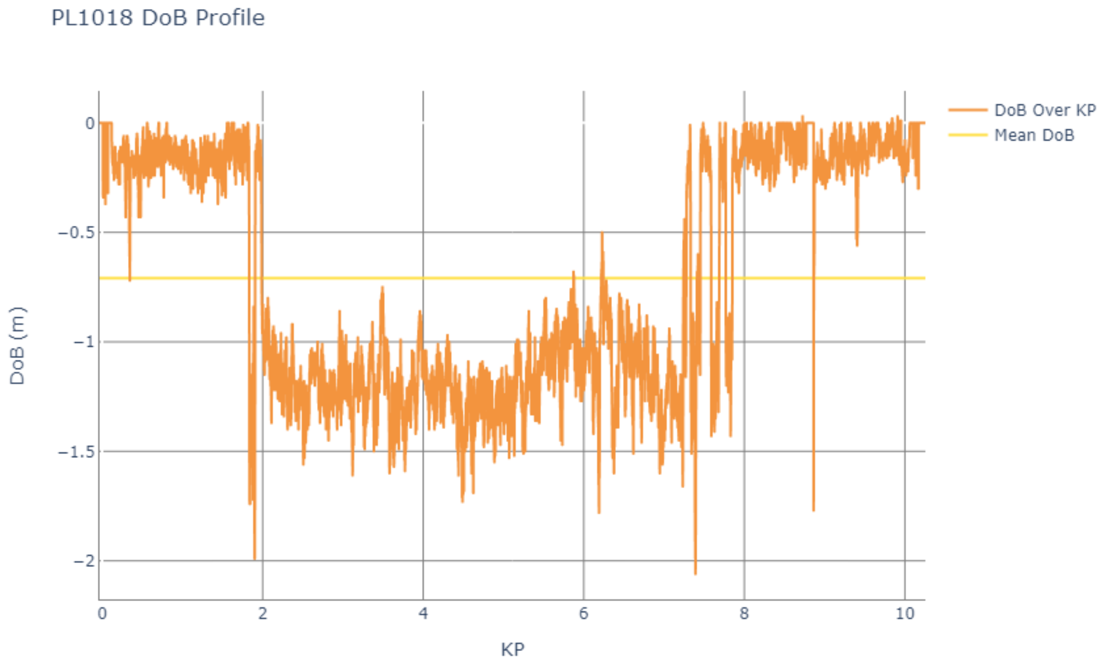


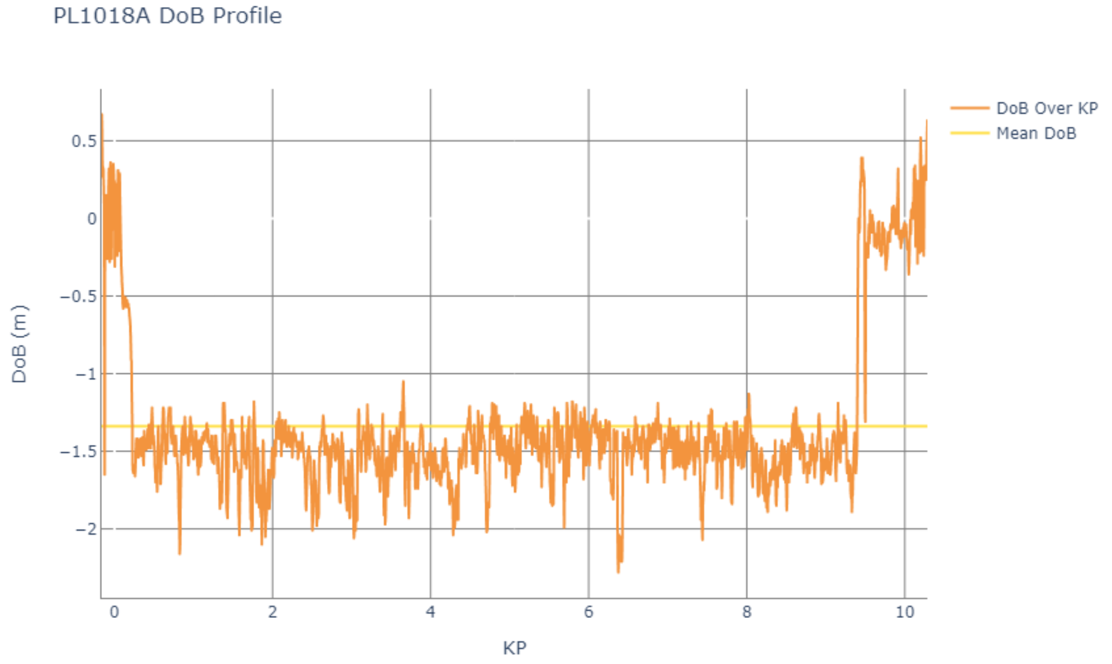

PL3573 Depth of Lowering
Depth (m)
KP
Seabed
Depth of Lowering
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17

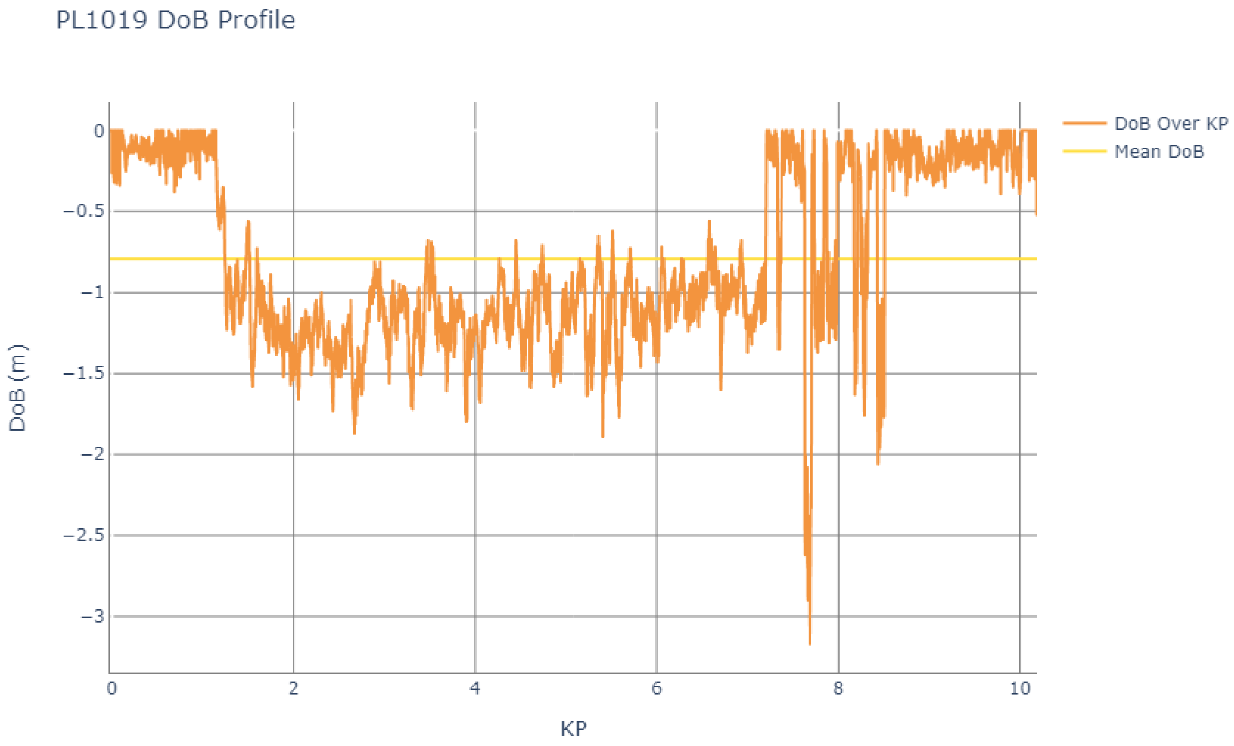

PL3574 Depth of Lowering
Depth (m)
KP
Seabed
Depth of Lowering
3
2
1
0
-1
-2
-3
-4
-5
-6
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17

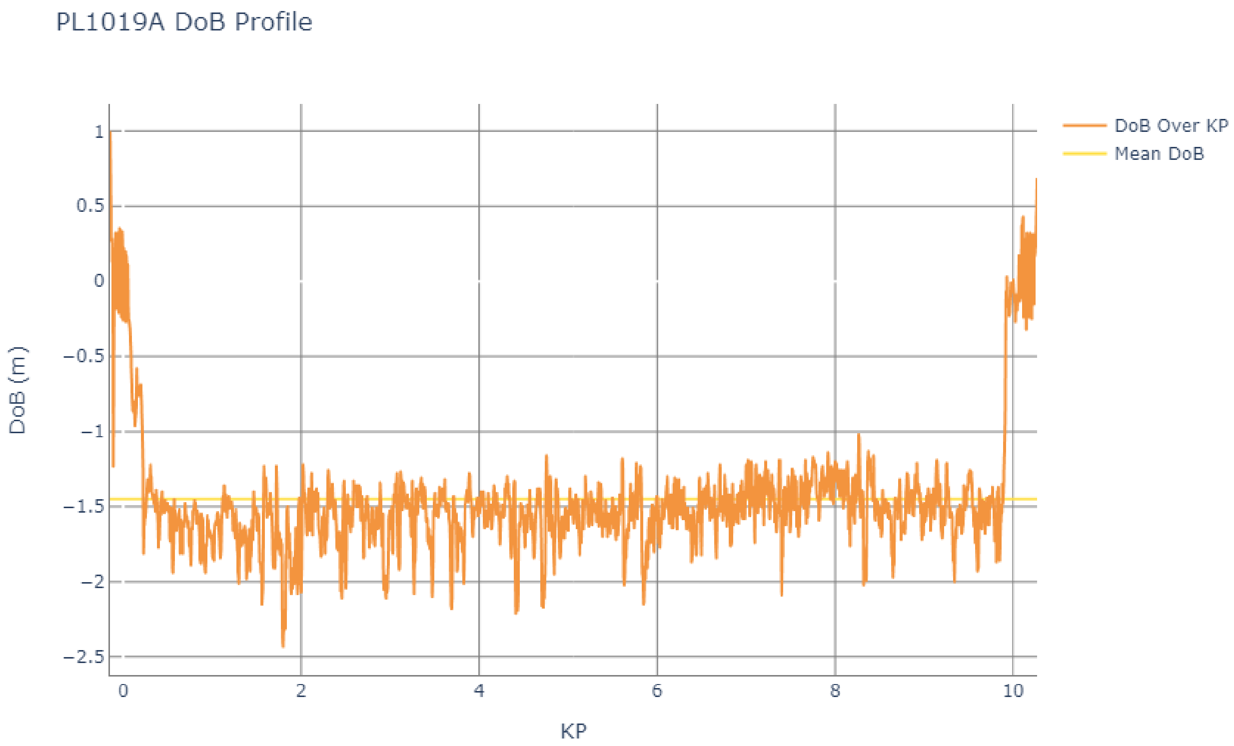

PLU3575 Depth of Lowering
Depth (m)
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
Seabed
Depth of Lowering
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
KP

Hudson

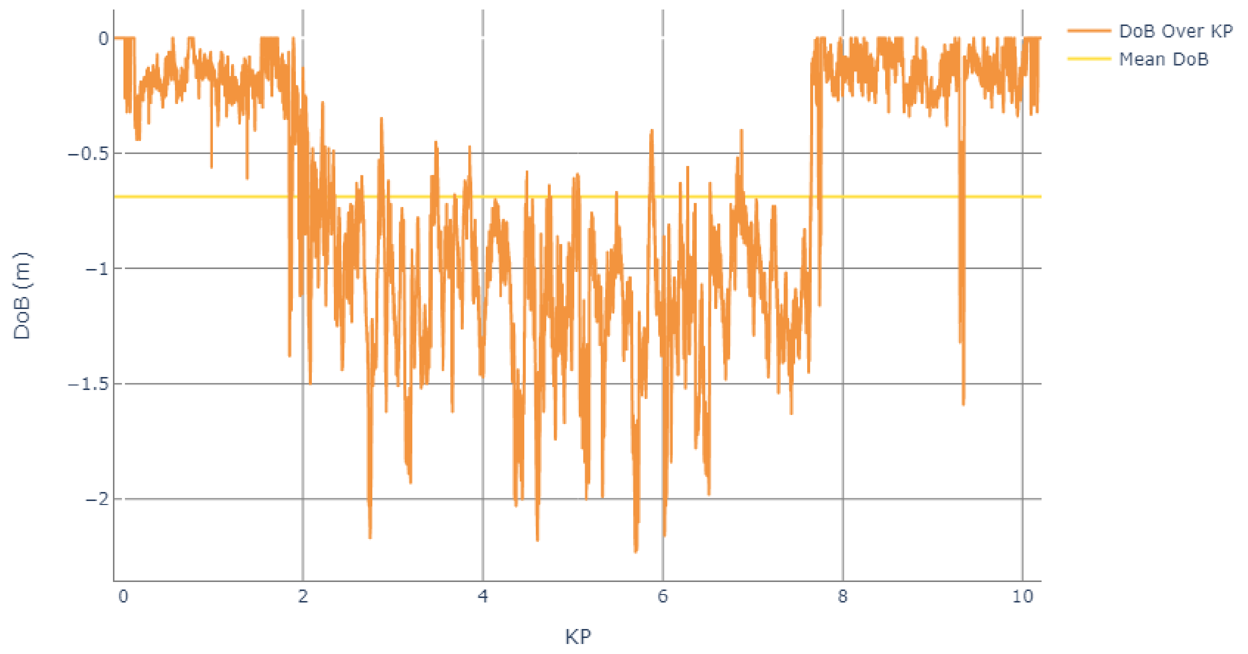

PL1018 DoB Profile
DoB Over KP
Mean DoB
DoB (m)
0
−0.5
−1
−1.5
−2
0
2
4
6
8
10
KP


PL1018A DoB Profile
DoB Over KP
Mean DoB
DoB (m)
0.5
0
−0.5
−1
−1.5
−2
0
2
4
6
8
10
KP

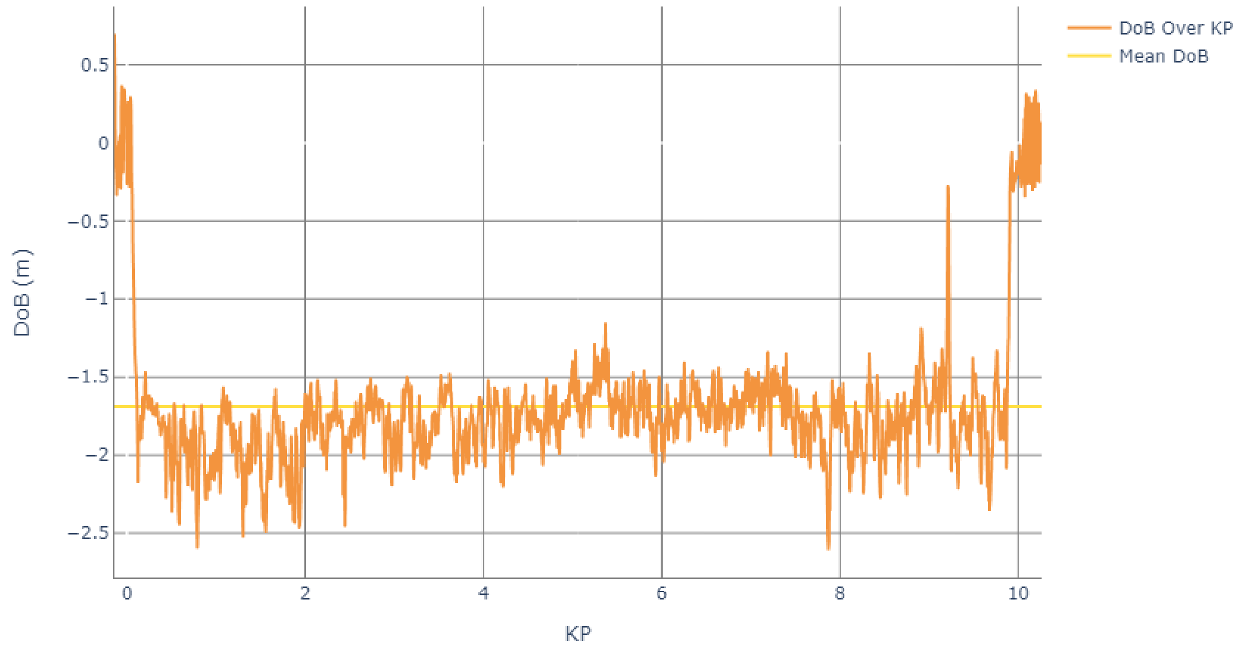

PL1019 DoB Profile
DoB Over KP
Mean DoB
DoB (m)
KP
0
−0.5
−1
−1.5
−2
−2.5
−3
0
2
4
6
8
10


PL1019A DoB Profile
DoB Over KP
Mean DoB
DoB (m)
KP
1
0.5
0
−0.5
−1
−1.5
−2
−2.5
0
2
4
6
8
10

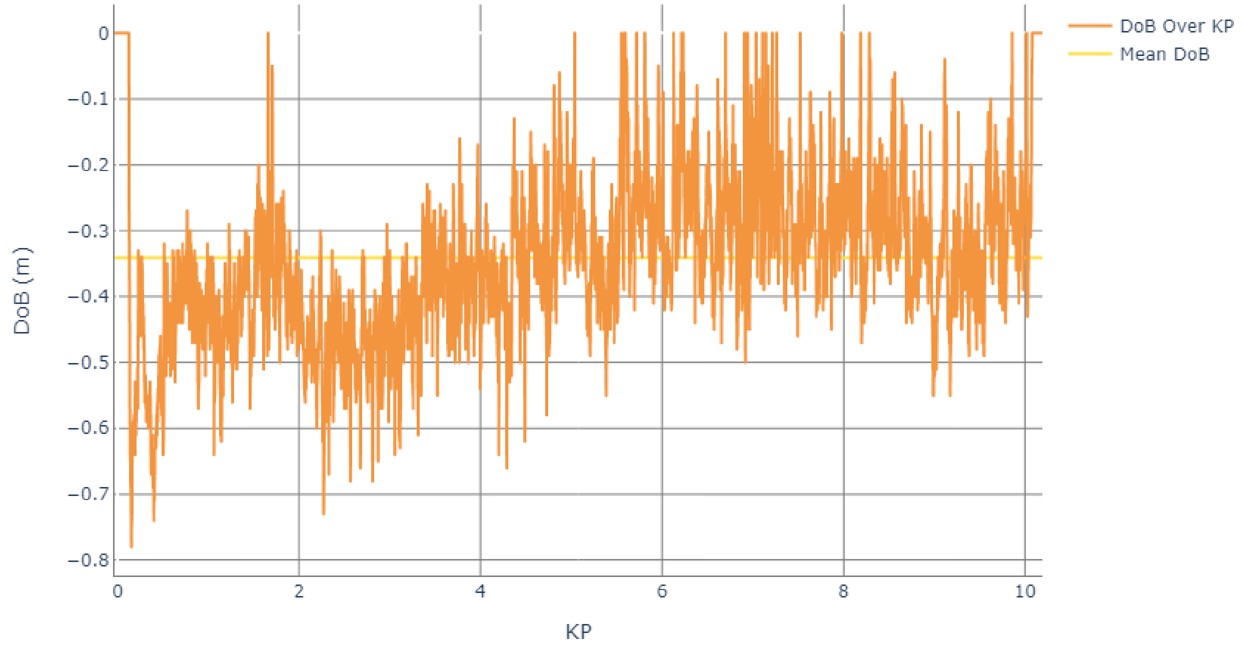
PL1020 DoB Profile



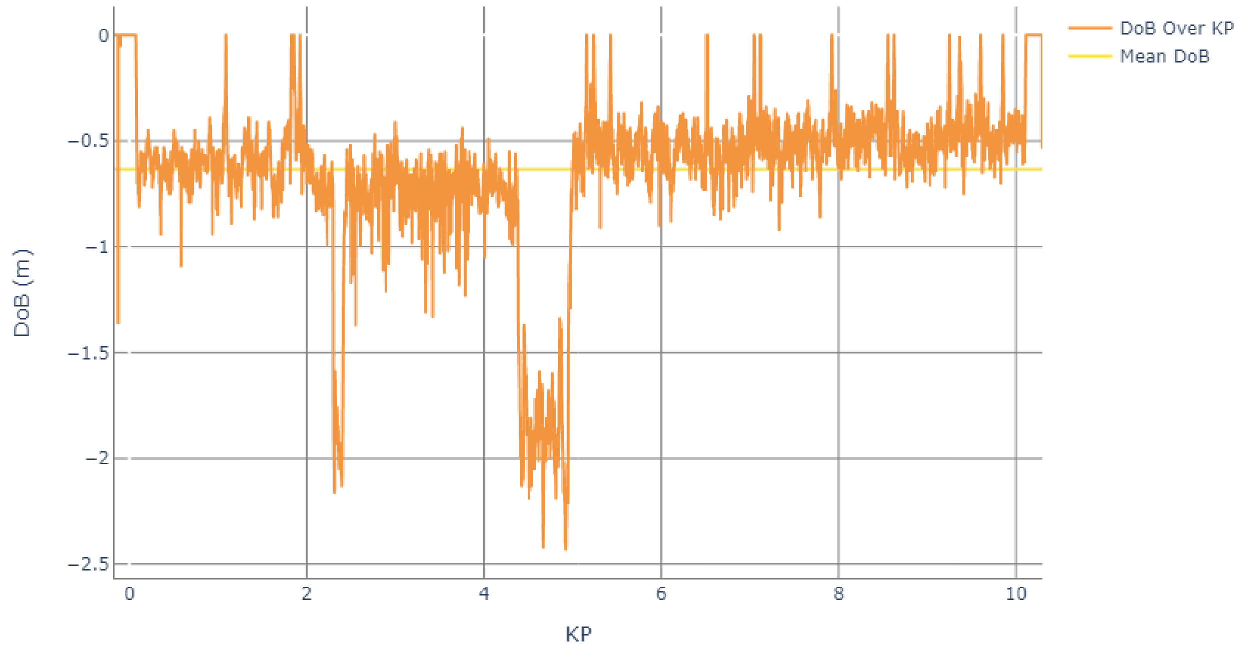
PL1020A DoB Profile

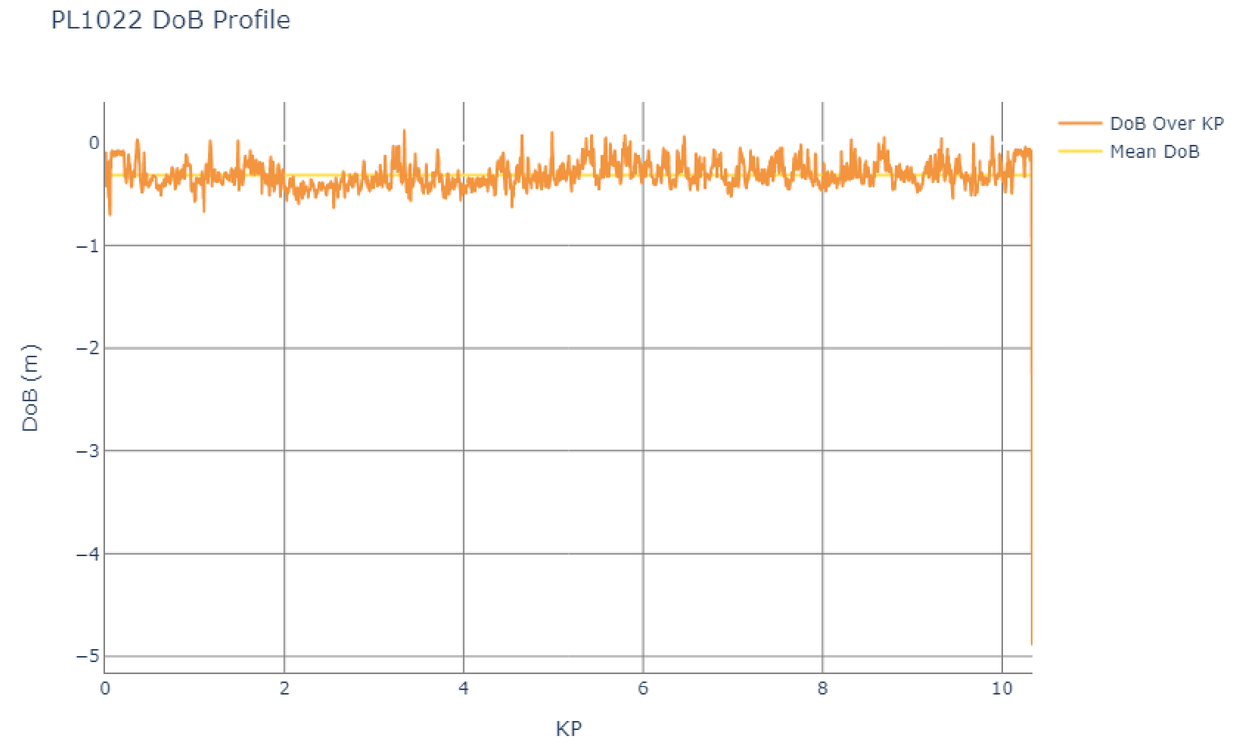


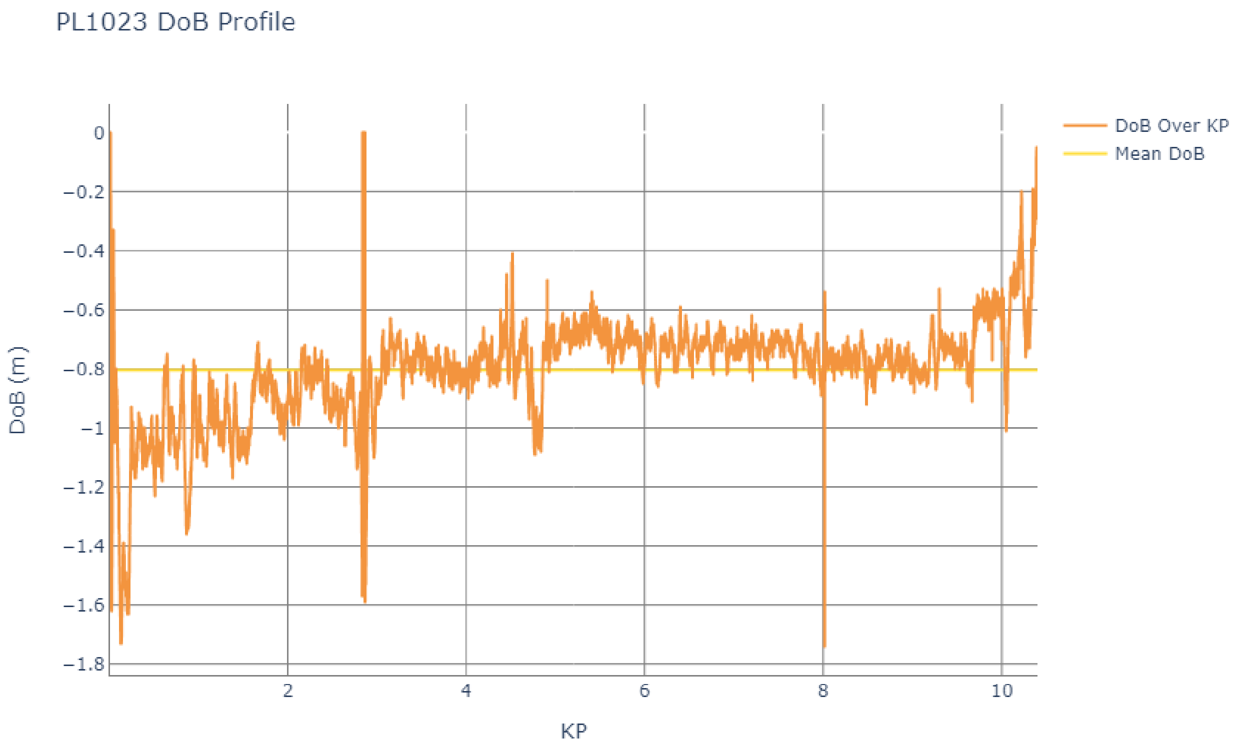
PL1021 DoB Profile



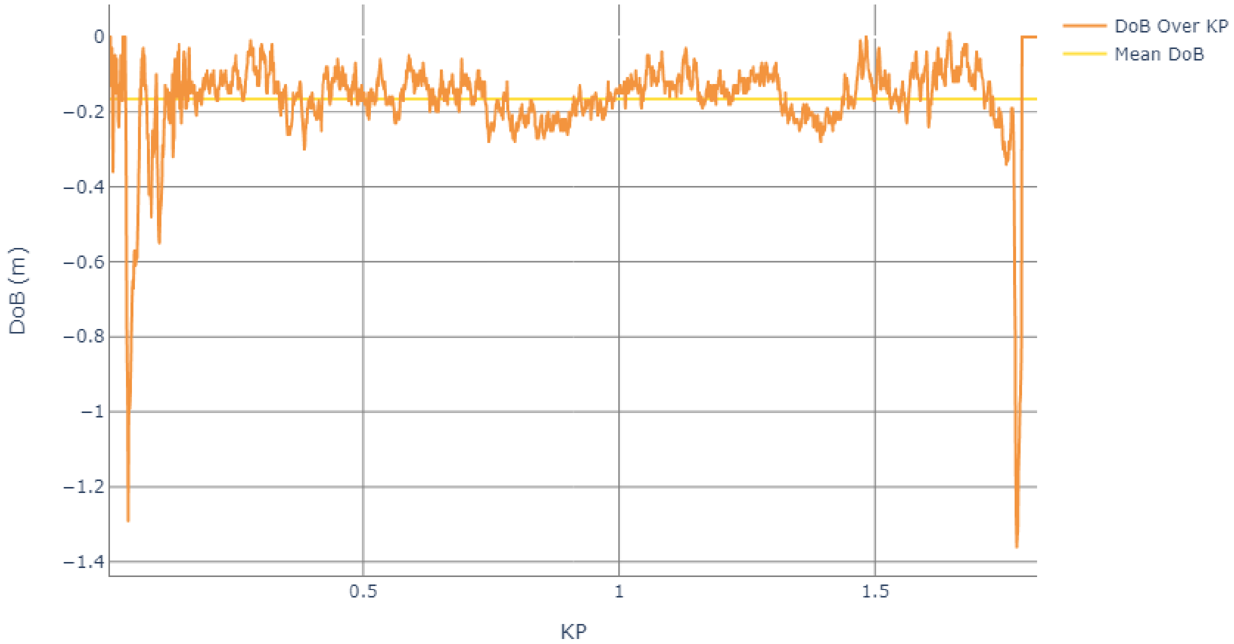
PL1021A DoB Profile



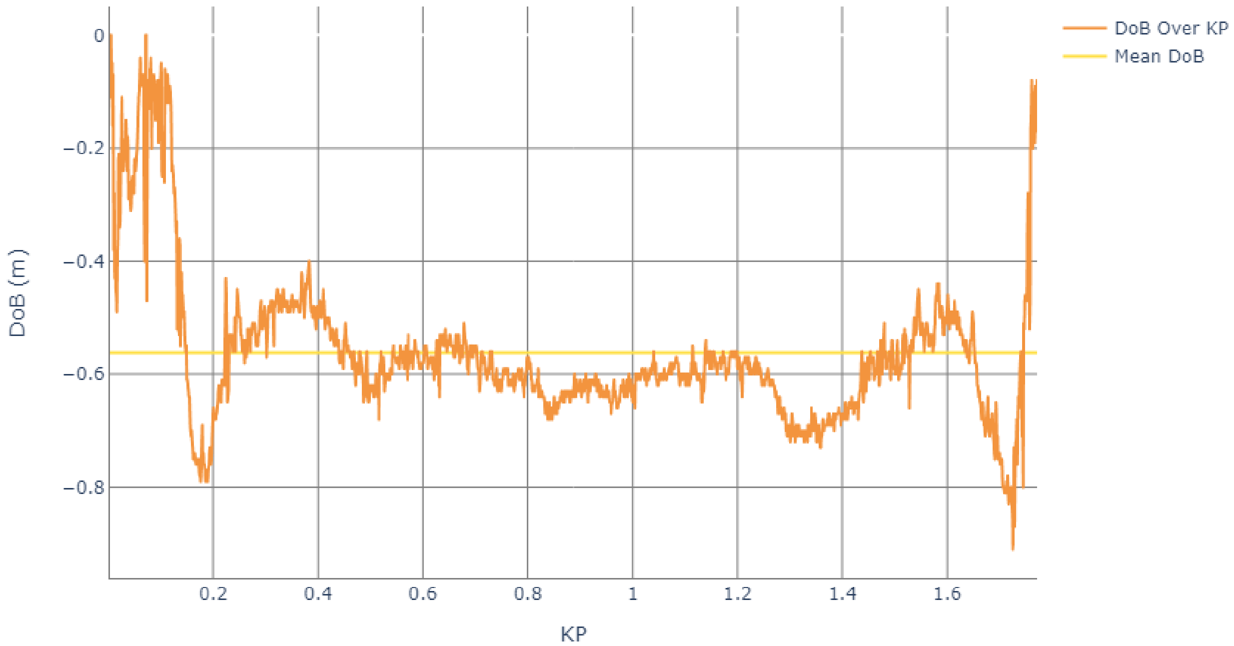

PL1022 DoB Profile
DoB Over KP
Mean DoB
DoB (m)
0
−1
−2
−3
−4
−5
0
2
4
6
8
10
KP

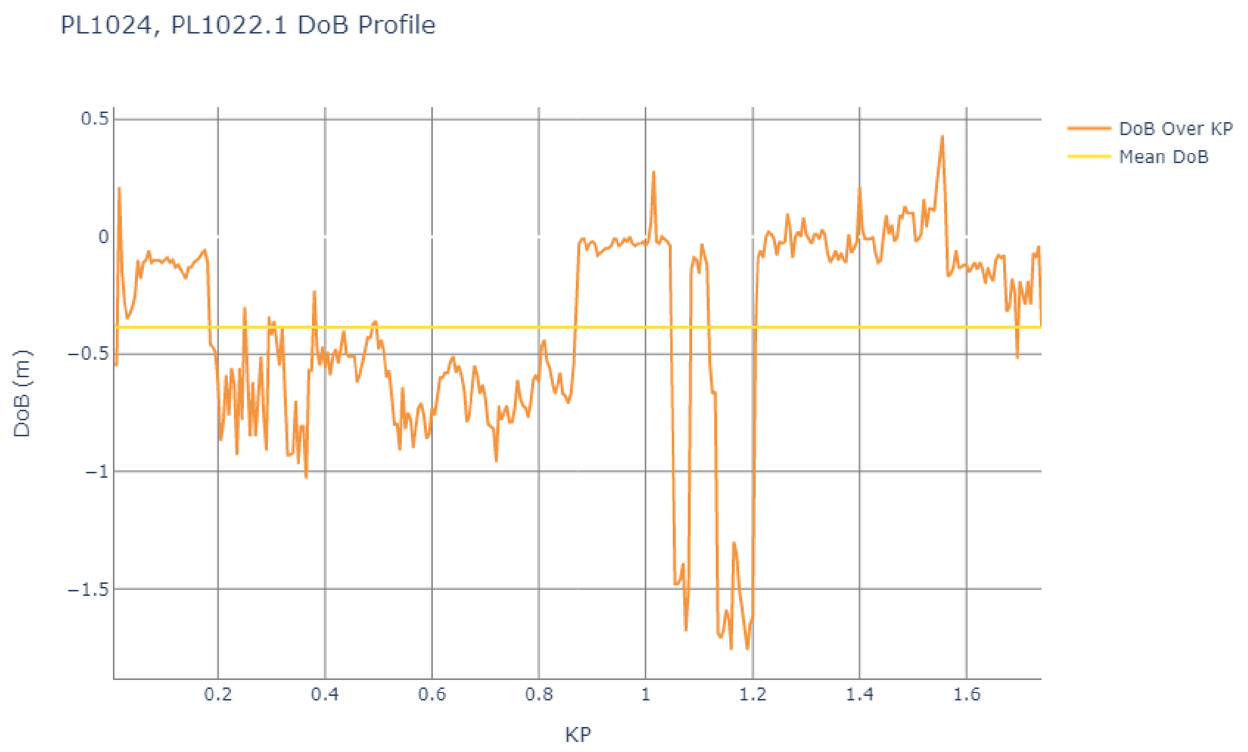

PL1023 DoB Profile
DoB Over KP
Mean DoB
DoB (m)
0
−0.2
−0.4
−0.6
−0.8
−1
−1.2
−1.4
−1.6
−1.8
2
4
6
8
10
KP

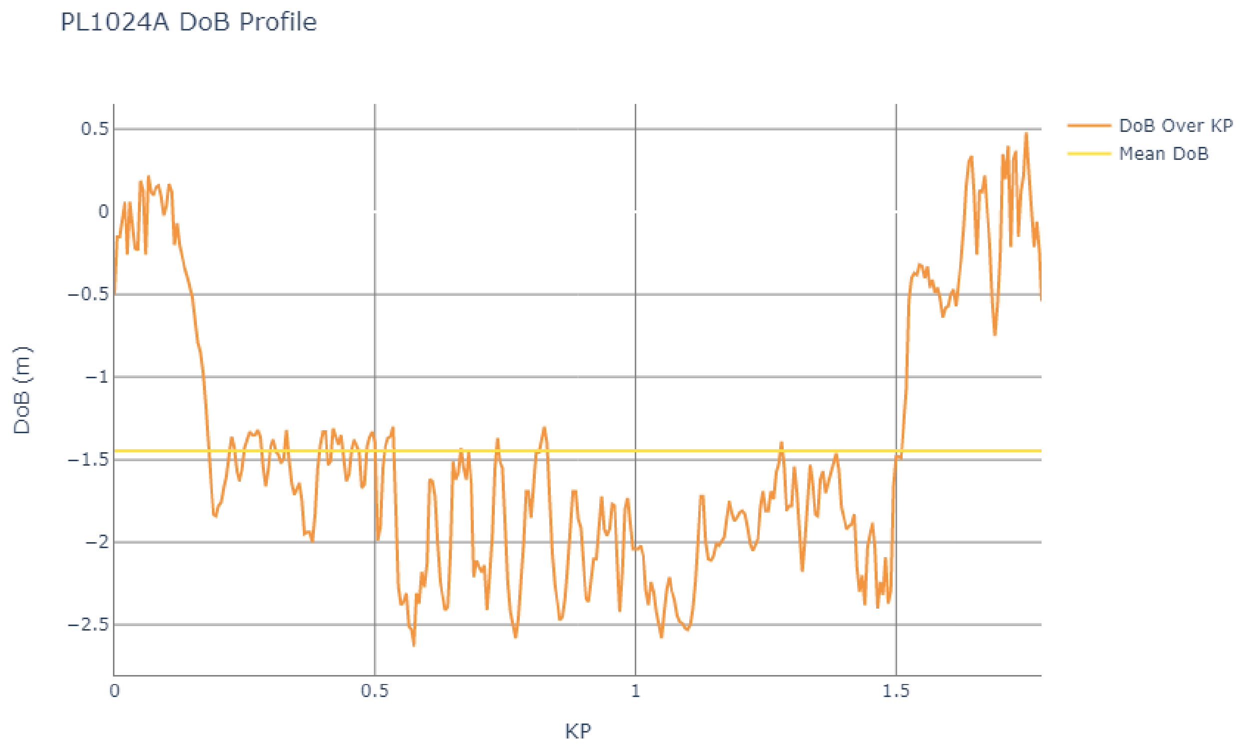
PL1023.26 DoB Profile



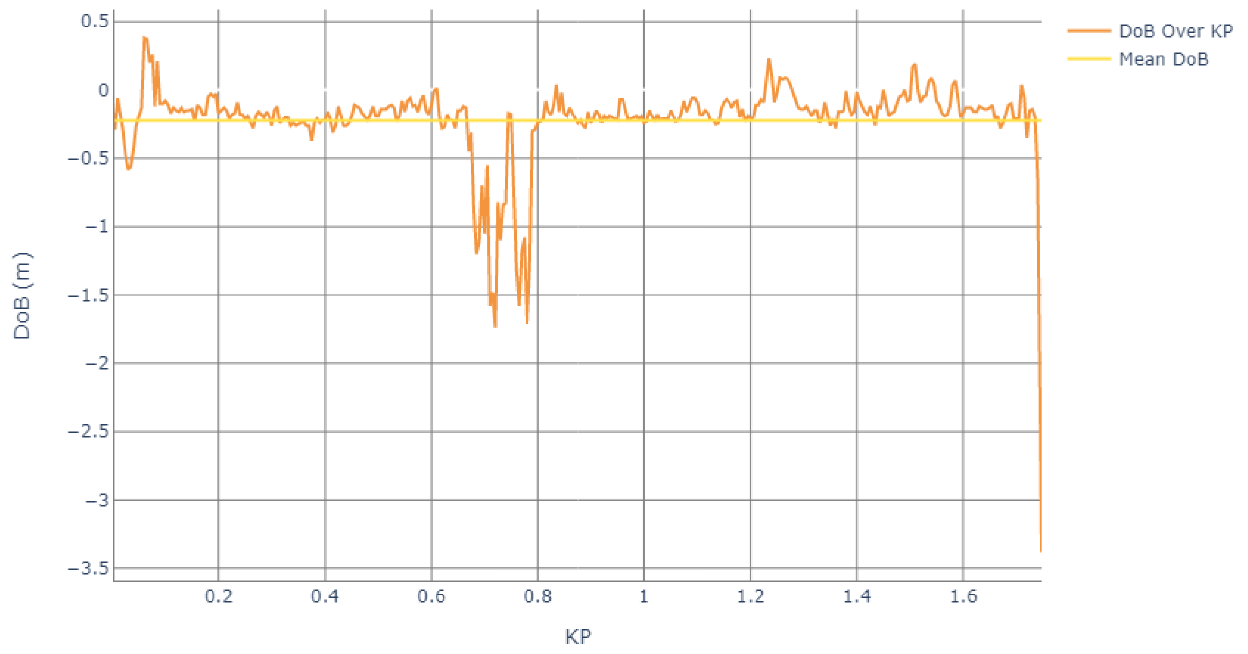
PL1023.27 DoB Profile



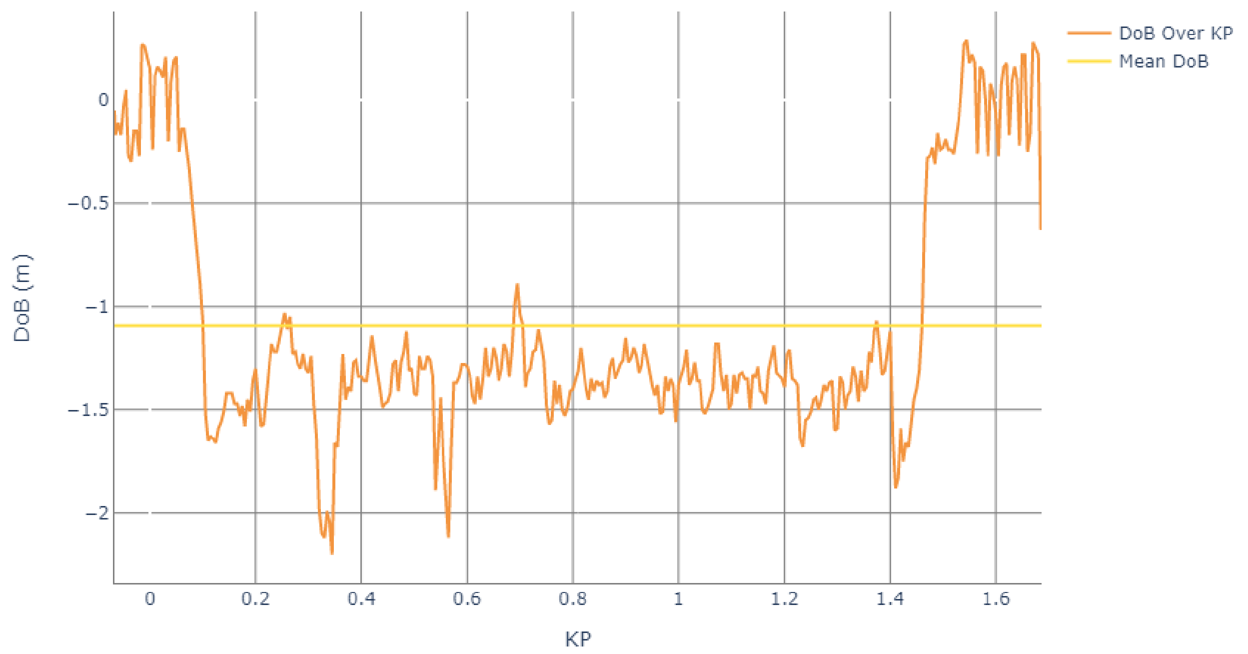

PL1024, PL1022.1 DoB Profile
0.5
0
−0.5
−1
−1.5
DoB (m)
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
KP
DoB Over KP
Mean DoB


PL1024A DoB Profile
0.5
0
−0.5
−1
−1.5
−2
−2.5
DoB (m)
0
0.5
1
1.5
KP
DoB Over KP
Mean DoB

PL1025, PL1022.2 DoB Profile

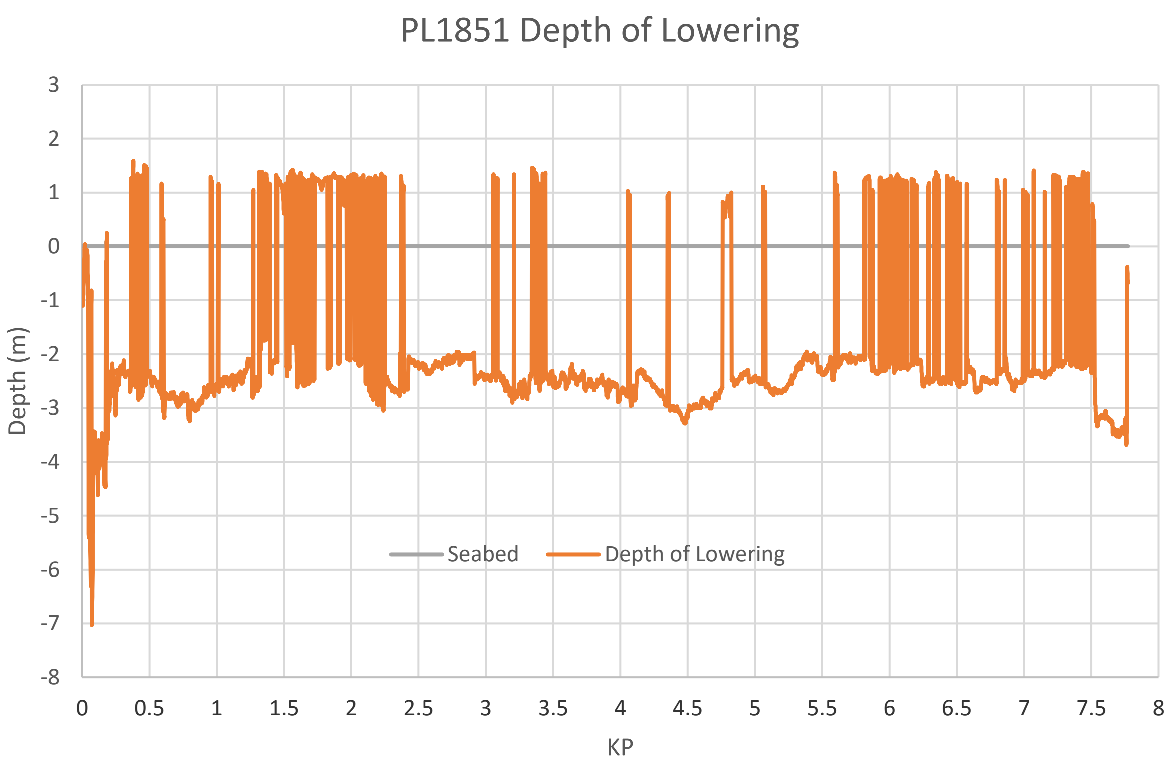


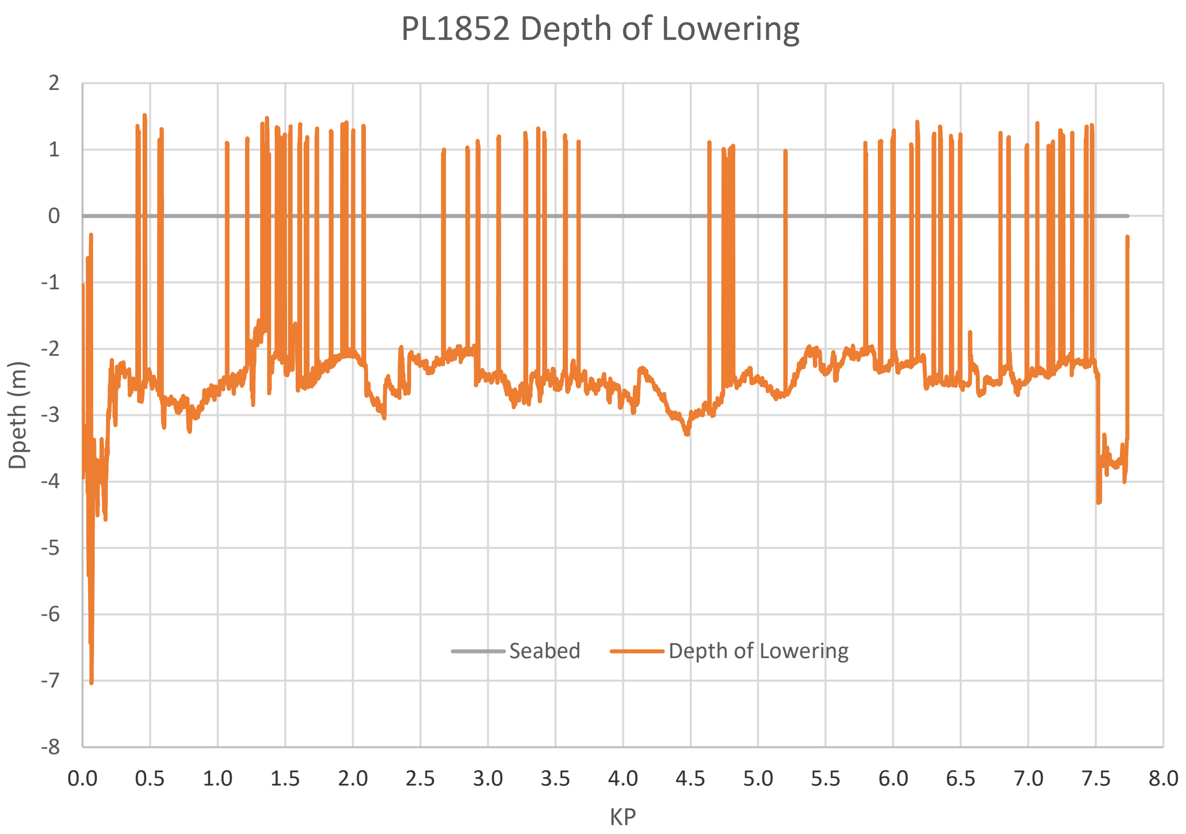
PL1025A DoB Profile

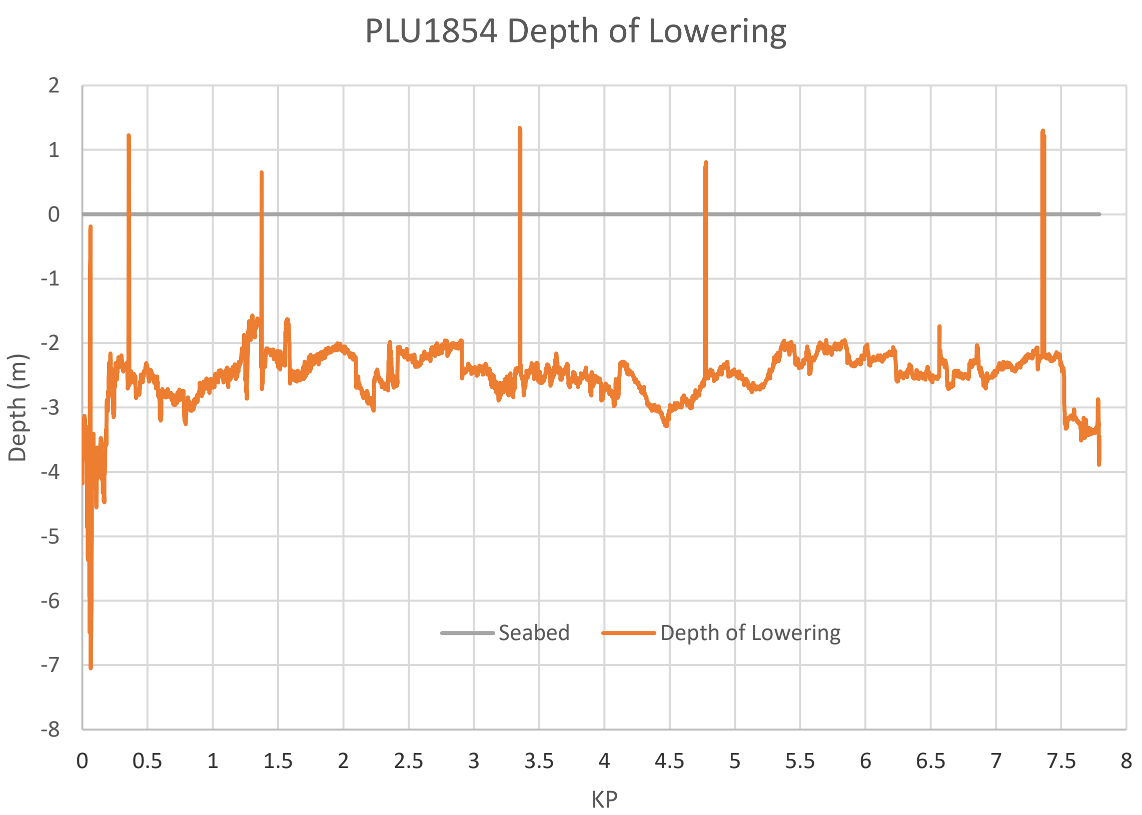


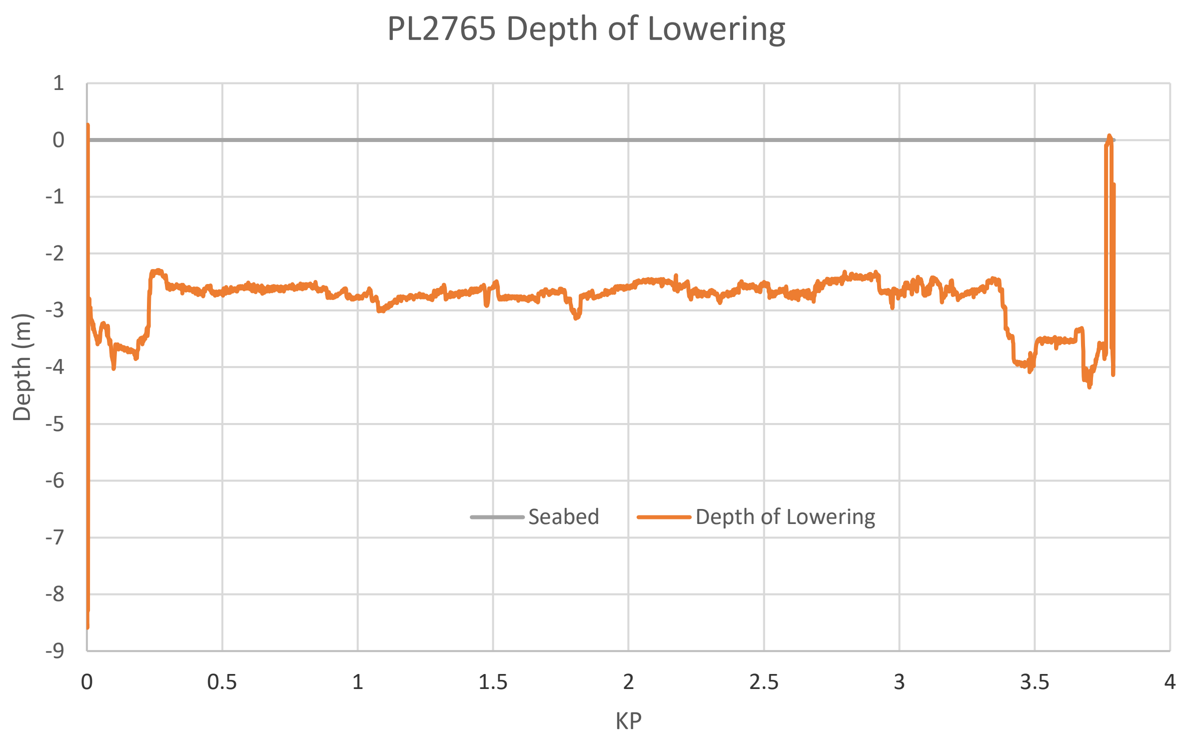
Kestrel and Falcon Depth of Lowering

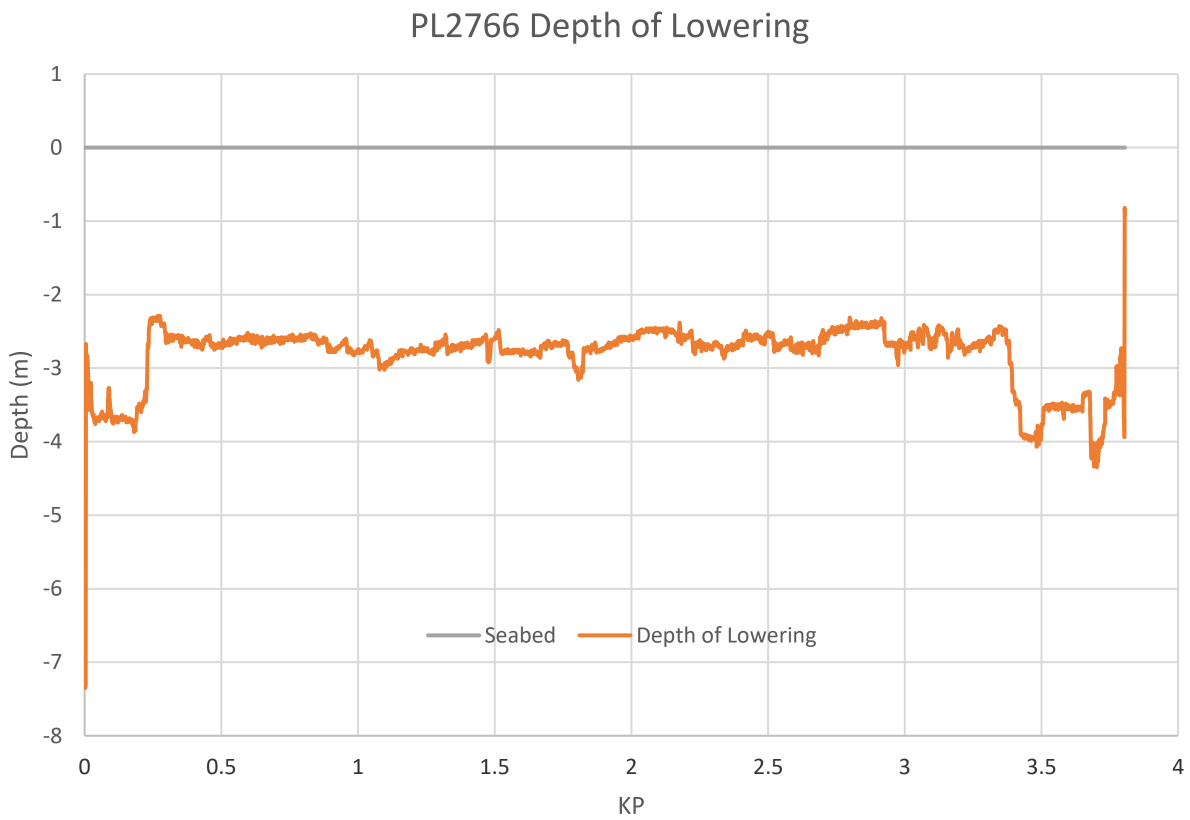
Depth of burial surveys data are incomplete, therefore the depth of lowering pipeline burial data for the Kestrel and Falcon fields are presented below where data is available, based on current understanding. Depth of lowering data for PL2765, PL2766 and PL2767 indicates that those pipelines were laid within a seabed trench between over 2 m below seabed level. Data for PL1851 and PL1852 in particular seems spurious with numerous false data points, perhaps reflections of the trench edges rather than the pipeline itself. Burial depth will be confirmed using pipe-tracker survey techniques prior to the commencement of decommissioning activities, to provide an accurate and current picture of the situation for each of the pipelines proposed to be decommissioned *in situ*. Should remediation of these pipelines be required following the pre-decommissioning surveys, this will be carried out via the permitting process.

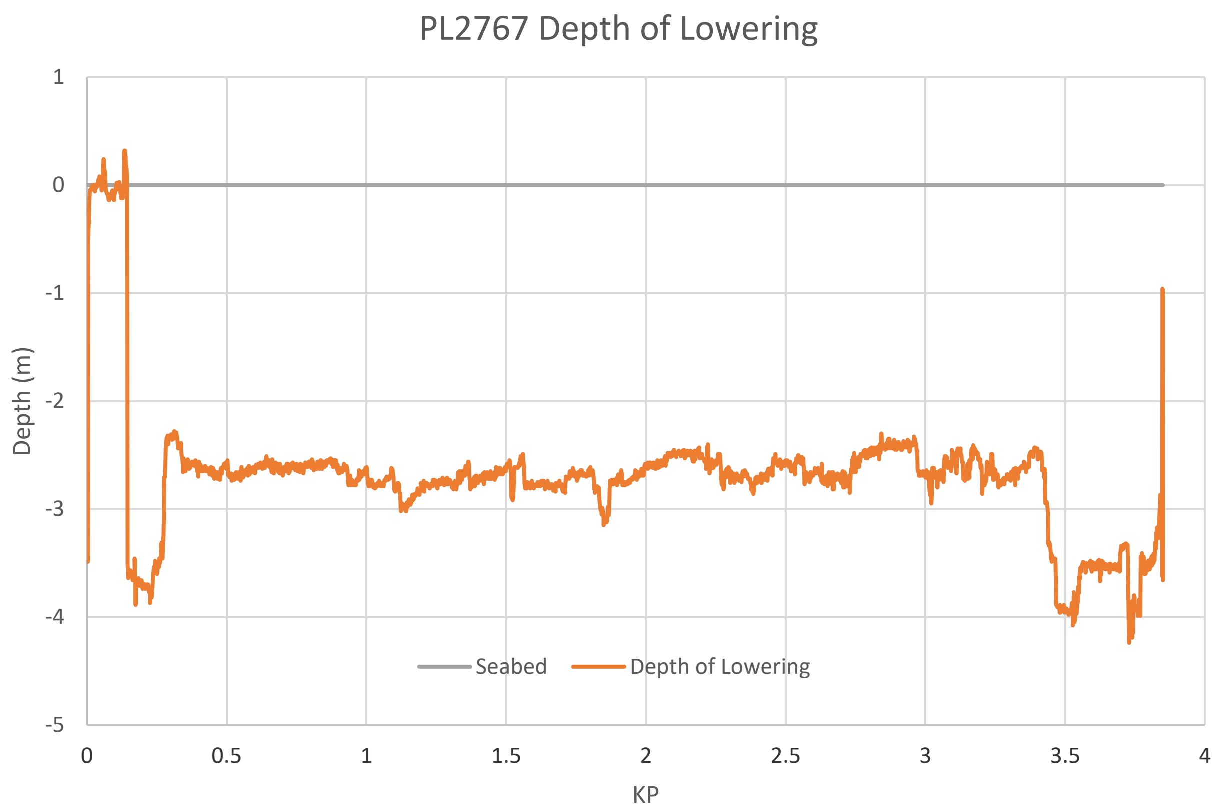



PL1852 Depth of Lowering
Dpeth (m)
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
8.0
KP
Seabed
Depth of Lowering


PLU1854 Depth of Lowering
Depth (m)
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
KP
Seabed
Depth of Lowering


PL2765 Depth of Lowering
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
Depth (m)
0
0.5
1
1.5
2
2.5
3
3.5
4
KP
Seabed
Depth of Lowering


PL2766 Depth of Lowering
1
0
-1
-2
-3
-4
-5
-6
-7
-8
Depth (m)
0
0.5
1
1.5
2
2.5
3
3.5
4
KP
Seabed
Depth of Lowering


PL2767 Depth of Lowering
Depth (m)
1
0
-1
-2
-3
-4
-5
0
0.5
1
1.5
2
2.5
3
3.5
4
KP
Seabed
Depth of Lowering

APPENDIX B - PIPELINE EXPOSURES AND FREE SPANS SUMMARY

Note: The heights of free spans that are >10 m in length don't exceed heights of 0.8 m and therefore none of the spans presented in Table B-1 are FishSAFE reportable. Spans adjacent to pipeline ends will also be removed as part of decommissioning operations. Midline sections decommissioned *in situ* are buried to >0.6m deep.

Table B-1 Exposures and Free Spans Located on The Tern Area Pipelines and Umbilicals

Location	Pipeline Status	Easting	Northing	Length (m)
PL1018/A	Freespan	388446.10	6795525.30	4.76
	Freespan	388412.40	6795621.70	7.36
	Freespan	388326.30	6795650.10	2.91
	Freespan	379161.80	6793634.50	3.78
	Freespan	379147.60	6793628.30	2.79
	Freespan	378559.40	6793232.10	12.97
	Freespan	378560.20	6793205.80	1.23
	Freespan	378542.90	6793195.70	4.58
	Freespan	378524.70	6793186.00	14.51
PL1019/A	Freespan	388447.90	6795513.50	18.64
	Freespan	388425.30	6795572.80	1.55
	Freespan	388408.10	6795617.30	3.08
	Freespan	388405.20	6795625.40	1.72
	Freespan	378612.80	6793277.80	5.87
	Freespan	378602.10	6793270.60	8.74
	Freespan	378572.00	6793218.90	2.84
	Freespan	378548.90	6793195.90	1.98
	Freespan	388414.10	6795588.10	9.59
	Freespan	388403.70	6795615.00	3.51
	Freespan	388402.50	6795618.50	1.55
	Freespan	388399.50	6795626.60	1.95
	Freespan	388343.80	6795627.20	1.37
	Freespan	378559.30	6793198.80	1.51
PL1022.1 Piggybacked to PL1024	Exposure	378504.20	6793206.90	0.98
	Exposure	378371.20	6793264.30	1.03
	Freespan	377708.90	6793776.90	2.2
	Freespan	377288.90	6794101.10	14.91
	Exposure	377285.80	6794103.20	11.42
PL1022.2 Piggybacked to PL1025	Freespan	378466.00	6793180.30	11.61
	Freespan	378456.50	6793187.80	2.84
	Freespan	378454.10	6793189.50	2.13
	Freespan	377524.60	6793882.20	4.88

Location	Pipeline Status	Easting	Northing	Length (m)
	Freespan	377307.60	6794047.00	3.52
	Freespan	377146.00	6794160.00	1.39
PL1022	Exposure	388438.30	6795509.10	1.21
	Exposure	388142.20	6795460.10	13.69
	Exposure	387352.00	6795246.00	0.49
	Exposure	387346.70	6795244.80	1.27
	Exposure	387050.30	6795182.50	1.78
	Exposure	385244.70	6794788.20	9
	Exposure	383959.40	6794503.10	1.72
	Exposure	383632.30	6794432.20	4.2
	Exposure	383260.10	6794352.00	2.37
	Exposure	383202.00	6794340.10	1.5
	Exposure	383184.90	6794336.60	2.06
	Exposure	383055.60	6794307.80	1.08
	Exposure	383046.10	6794305.70	3.41
	Exposure	382995.80	6794294.20	1.9
	Exposure	382985.80	6794292.00	0.82
	Exposure	382974.80	6794289.50	1.18
	Exposure	382857.90	6794262.70	2.04
	Exposure	382849.50	6794260.70	2.29
	Exposure	382841.50	6794258.90	3.89
	Exposure	382800.00	6794250.10	2.31
	Exposure	382783.30	6794246.60	2.45
	Exposure	382208.20	6794122.10	2.21
	Exposure	382196.90	6794119.70	2.15
	Exposure	382190.10	6794118.20	1.79
	Exposure	381144.80	6793888.00	2.78
	Exposure	380923.10	6793838.80	0.16
	Exposure	380762.70	6793804.50	0.39
	Exposure	380374.40	6793720.20	1.6
	Exposure	380078.30	6793654.40	1.5
	Exposure	380018.90	6793641.10	1.31
	Exposure	379459.10	6793519.90	1
	Exposure	379420.30	6793511.20	1.31
	Exposure	379392.30	6793504.20	1.97
	Exposure	379385.10	6793502.20	0.19
	Exposure	379332.70	6793485.60	0.41
	Exposure	379063.60	6793369.80	0.59
	Exposure	378873.00	6793283.80	7.23
	Exposure	378513.80	6793199.90	1.65
PL1024/A	Freespan	377165.30	6794201.60	1.11

Location	Pipeline Status	Easting	Northing	Length (m)
	Freespan	378422.30	6793274.60	1.54
	Freespan	378424.40	6793272.80	9.34
	Freespan	378471.30	6793227.50	3.39
	Freespan	378469.90	6793223.10	2.06
	Freespan	378461.70	6793212.70	7.32
	Freespan	378471.90	6793199.10	7.79
	Freespan	378480.70	6793201.70	1.92
PL2025/A	Freespan	378409.50	6793269.70	1.84
	Freespan	378413.00	6793267.10	2.55
	Freespan	378415.80	6793264.80	1.89
	Freespan	378466.90	6793196.40	2.78
PL1851	Freespan	549275.08	6794077.32	1.6
	Freespan	549259.86	6794093.64	1.0
	Freespan	549256.96	6794112.52	2.8
	Freespan	550500.85	6794564.56	7.7
	Exposure	549275.08	6794077.32	45.6
	Exposure	549277.75	6794127.75	5.8
	Exposure	549385.67	6794117.05	0.5
	Exposure	549391.89	6794117.12	0.2
	Exposure	549557.09	6794183.85	19.4
	Exposure	549602.04	6794201.93	2.2
	Exposure	549606.42	6794203.69	4.3
	Exposure	549612.54	6794206.24	0.5
	Exposure	549619.35	6794208.97	1.5
	Exposure	549649.46	6794221.04	8.8
	Exposure	549663.52	6794226.86	2.2
	Exposure	549753.59	6794262.97	3.8
	Exposure	549768.90	6794269.18	1.5
	Exposure	549780.93	6794276.14	0.3
	Exposure	549787.05	6794277.02	0.6
	Exposure	550106.53	6794407.03	9.8
	Exposure	550117.12	6794411.18	1.0
	Exposure	550387.94	6794521.61	0.2
	Exposure	550393.07	6794524.47	0.3
	Exposure	550399.85	6794525.22	0.7
	Exposure	550441.44	6794541.43	1.3
	Exposure	550459.53	6794548.39	3.5
	Exposure	550471.75	6794552.99	2.0
	Exposure	550485.05	6794558.38	0.2
	Exposure	550489.27	6794560.04	27.0
	Exposure	550558.44	6794588.79	1.4

Location	Pipeline Status	Easting	Northing	Length (m)
	Exposure	550566.67	6794592.26	65.5
	Exposure	550637.78	6794621.14	3.9
	Exposure	550643.49	6794623.40	2.6
	Exposure	550652.70	6794627.20	20.6
	Exposure	550679.57	6794638.18	5.0
	Exposure	550685.09	6794640.41	2.8
	Exposure	550717.38	6794653.59	10.7
	Exposure	550728.20	6794658.19	7.2
	Exposure	550739.97	6794662.99	1.4
	Exposure	550746.79	6794665.78	1.4
	Exposure	550768.61	6794674.47	4.6
	Exposure	550774.82	6794677.04	1.2
	Exposure	550777.06	6794677.88	3.0
	Exposure	550799.04	6794686.53	1.3
	Exposure	550804.90	6794688.80	5.3
	Exposure	550812.09	6794691.65	0.9
	Exposure	550820.23	6794694.93	0.4
	Exposure	550825.47	6794697.03	7.3
	Exposure	550833.45	6794700.32	61.0
	Exposure	550894.04	6794724.65	17.3
	Exposure	550915.62	6794733.19	3.6
	Exposure	550931.94	6794739.92	4.9
	Exposure	550942.49	6794743.75	22.4
	Exposure	550963.92	6794752.03	7.6
	Exposure	550974.27	6794756.18	5.4
	Exposure	550980.68	6794758.73	4.4
	Exposure	550998.17	6794765.70	47.6
	Exposure	551075.48	6794796.59	0.5
	Exposure	551086.50	6794800.93	5.0
	Exposure	551139.23	6794822.03	0.5
	Exposure	551142.98	6794823.54	3.7
	Exposure	551149.12	6794825.94	12.9
	Exposure	551165.59	6794834.98	0.3
	Exposure	551172.21	6794837.19	0.2
	Exposure	551178.10	6794837.79	10.2
	Exposure	551191.15	6794842.99	7.9
	Exposure	551204.42	6794848.31	5.3
	Exposure	551220.51	6794854.74	0.9
	Exposure	551282.09	6794878.81	2.3
	Exposure	551419.19	6794934.09	20.4
	Exposure	552079.88	6795212.67	1.4

Location	Pipeline Status	Easting	Northing	Length (m)
	Exposure	552186.46	6795273.04	1.4
	Exposure	552298.85	6795352.26	1.4
	Exposure	552321.06	6795368.92	20.8
	Exposure	552867.20	6795778.56	13.3
	Exposure	553098.69	6795958.13	11.8
	Exposure	553416.56	6796198.34	2.4
	Exposure	553428.90	6796208.33	31.8
	Exposure	553458.91	6796230.42	21.9
	Exposure	553663.50	6796388.16	15.6
	Exposure	553834.92	6796520.18	0.3
	Exposure	554099.37	6796719.34	7.5
	Exposure	554263.94	6796844.44	0.9
	Exposure	554270.86	6796849.68	3.2
	Exposure	554275.35	6796852.98	15.2
	Exposure	554292.97	6796866.46	2.8
	Exposure	554305.95	6796876.00	0.4
	Exposure	554311.05	6796879.97	0.2
	Exposure	554336.88	6796899.80	2.4
	Exposure	554396.32	6796946.93	0.9
	Exposure	554417.50	6796963.34	0.5
	Exposure	554454.98	6796993.80	2.9
	Exposure	554467.42	6797003.47	1.1
	Exposure	554469.94	6797005.40	2.3
	Exposure	554509.41	6797035.66	1.6
	Exposure	554540.70	6797059.42	2.4
	Exposure	554553.57	6797068.80	21.7
	Exposure	554643.05	6797134.64	1.5
	Exposure	554679.17	6797160.58	1.8
	Exposure	554686.21	6797165.56	14.8
	Exposure	554701.95	6797177.15	0.7
	Exposure	554751.53	6797214.24	2.0
	Exposure	554754.51	6797216.60	4.5
	Exposure	554779.73	6797236.29	7.4
	Exposure	554787.99	6797242.72	1.0
	Exposure	554810.44	6797260.30	3.2
	Exposure	554828.89	6797274.40	0.6
	Exposure	554866.62	6797304.80	1.4
	Exposure	555045.13	6797445.75	13.9
	Exposure	555089.83	6797480.06	1.8
	Exposure	555198.11	6797563.42	1.2
	Exposure	555212.80	6797575.09	15.2

Location	Pipeline Status	Easting	Northing	Length (m)
	Exposure	555259.41	6797610.52	1.7
	Exposure	555348.27	6797677.44	6.1
	Exposure	555377.88	6797700.22	0.5
	Exposure	555389.84	6797709.36	9.3
	Exposure	555397.92	6797715.57	1.1
	Exposure	555400.05	6797717.18	2.2
	Exposure	555407.26	6797722.67	1.9
	Exposure	555416.86	6797730.40	0.4
	Exposure	555451.74	6797756.67	22.2
	Exposure	555469.81	6797770.73	1.2
	Exposure	555471.24	6797771.83	4.8
	Exposure	555478.04	6797777.09	0.2
	Exposure	555487.54	6797784.43	16.5
	Exposure	555503.25	6797796.57	4.7
	Exposure	555507.88	6797800.28	1.4
	Exposure	555521.14	6797810.35	0.8
	Exposure	555533.59	6797819.90	0.5
	Exposure	555548.52	6797830.93	1.7
	Exposure	555555.46	6797836.61	0.5
	Exposure	555580.39	6797855.91	0.2
	Exposure	555581.74	6797856.97	1.7
	Exposure	555607.09	6797876.60	15.1
	Exposure	555759.42	6797941.80	0.1
	Exposure	555776.50	6797924.45	0.1
	Exposure	555780.66	6797920.03	0.3
	Exposure	555792.99	6797906.52	0.3
	Exposure	555799.51	6797882.98	5.8
PL1852	Exposure	555821.72	6797906.21	0.5
PL2765	Exposure	549278.12	6794078.60	1.0
	Exposure	549261.03	6794113.45	3.7
	Exposure	549278.31	6794125.99	5.4
	Exposure	549385.66	6794117.04	0.5
	Exposure	549606.68	6794203.78	4.2
	Exposure	550467.22	6794551.23	1.6
	Exposure	550494.01	6794562.06	11.7
	Exposure	550560.27	6794590.07	11.4
	Exposure	550588.62	6794601.36	2.7
	Exposure	550607.32	6794608.58	9.6
	Exposure	550649.51	6794626.32	5.2
	Exposure	550713.19	6794652.38	7.9
	Exposure	550759.03	6794670.71	12.0

Location	Pipeline Status	Easting	Northing	Length (m)
	Exposure	550832.29	6794700.50	4.6
	Exposure	550931.82	6794740.06	4.5
	Exposure	551026.17	6794776.80	1.5
	Exposure	551030.94	6794778.73	2.1
	Exposure	551037.32	6794781.41	1.9
	Exposure	551701.17	6795049.64	5.2
	Exposure	551867.55	6795118.96	2.7
	Exposure	552076.04	6795211.40	5.5
	Exposure	553427.63	6796206.70	4.8
	Exposure	553453.29	6796225.92	1.5
	Exposure	553467.77	6796237.27	5.6
	Exposure	554251.49	6796836.08	3.9
	Exposure	554409.61	6796957.58	6.6
	Exposure	554558.20	6797072.24	1.5
	Exposure	554652.73	6797141.50	3.5
	Exposure	554691.77	6797170.04	5.9
	Exposure	554755.75	6797217.91	9.0
	Exposure	554810.03	6797259.98	2.1
	Exposure	555088.70	6797478.98	5.8
	Exposure	555397.91	6797715.59	0.9
	Exposure	555543.97	6797827.66	6.2
	Exposure	555581.25	6797856.56	2.8
	Exposure	555803.11	6797884.12	4.8
	Exposure	549278.12	6794078.60	1.0
	Exposure	549261.03	6794113.45	3.7
	Exposure	549278.31	6794125.99	5.4
	Exposure	549385.66	6794117.04	0.5
	Exposure	549606.68	6794203.78	4.2
	Exposure	550467.22	6794551.23	1.6
	Exposure	550494.01	6794562.06	11.7
	Exposure	550560.27	6794590.07	11.4
	Exposure	550588.62	6794601.36	2.7
	Exposure	550607.32	6794608.58	9.6
	Exposure	550649.51	6794626.32	5.2
	Exposure	550713.19	6794652.38	7.9
	Exposure	550759.03	6794670.71	12.0
	Exposure	550832.29	6794700.50	4.6
	Exposure	550931.82	6794740.06	4.5
	Exposure	551026.17	6794776.80	1.5
	Exposure	551030.94	6794778.73	2.1
	Exposure	551037.32	6794781.41	1.9

Location	Pipeline Status	Easting	Northing	Length (m)
	Exposure	551701.17	6795049.64	5.2
	Exposure	551867.55	6795118.96	2.7
	Exposure	552076.04	6795211.40	5.5
	Exposure	553427.63	6796206.70	4.8
	Exposure	553453.29	6796225.92	1.5
	Exposure	553467.77	6796237.27	5.6
	Exposure	554251.49	6796836.08	3.9
	Exposure	554409.61	6796957.58	6.6
	Exposure	554558.20	6797072.24	1.5
	Exposure	554652.73	6797141.50	3.5
	Exposure	554691.77	6797170.04	5.9
	Exposure	554755.75	6797217.91	9.0
	Exposure	554810.03	6797259.98	2.1
	Exposure	555088.70	6797478.98	5.8
	Exposure	555397.91	6797715.59	0.9
	Exposure	555543.97	6797827.66	6.2
	Exposure	555581.25	6797856.56	2.8
	Exposure	555803.11	6797884.12	4.8
	Freespan	549261.43	6794114.56	2.8
	Freespan	549278.48	6794126.09	3.6
PL2766	Freespan	555819.93	6797906.77	8.5
	Exposure	555821.69	6797907.28	8.0

APPENDIX C - TAQA HSSE POLICY

TAQA UK Health, Safety, Security and Environment Policy

The health, safety and security of our employees, contractors and the public is our highest priority; it is more important than any operational priority.

We must also:

- Ensure that our assets are operated safely
- Assure the integrity of our assets
- Respect, protect and understand the natural environment

HSSE = Health, Personal Safety, Major Accident Prevention, Security and Environment

We strongly believe that excellent business performance requires excellent HSSE performance – we recognise this as a core value.

Employees and contractors are required to focus on the four areas below:

Leadership

- Everyone within TAQA demonstrates commitment and accountability to implement this policy and to work in accordance with the TAQA Management System Elements and Expectations
- Everyone within TAQA understands their accountabilities for the management of HSSE
- The structure and resources necessary to achieve and measure HSSE accountabilities are provided
- Requirements of applicable legislation and standards are identified, understood and complied with
- Personnel have the required competencies and are fit for work
- Our workforce is aligned, involved and empowered in the identification and management of HSSE hazards and the achievement of our HSSE goals
- Key stakeholder groups are identified and a good working relationship is maintained with them (understanding and addressing their issues and concerns)

Operational Risk Identification and Assessment

- Risks are identified, assessed and appropriately managed
- Information required to support safe operation is identified, accurate, available and up to date

Operational Risk Management

- The standards, procedures and operating manuals required to support project, maintenance and operational activities are identified, developed, understood and consistently applied
- Process and operational status monitoring and handover requirements are defined, understood and carried out
- Operational interfaces with third parties are identified, assessed and appropriately managed

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TAQA UK Health, Safety, Security and Environment Policy

- Risks arising from any form of change are systematically identified, assessed and managed
- A systematic process is in place to verify the safe condition of plant and equipment and to ensure that personnel are appropriately prepared (before start-up or return to normal operations)
- We are appropriately prepared for all necessary actions which may be required for the protection of the public, personnel (including contractors), the environment, plant equipment and reputation in the event of an incident
- We aim to prevent pollution and protect the environment from the impact of our operations

Review and Improvement

- We routinely monitor our activities through internal/external audits and produce key performance indicators – we review these indicators and intervene as necessary
- Compliance with our expectations is routinely reviewed and audited to determine whether this policy remains appropriate and is being implemented effectively
- The management system is routinely reviewed for continual improvement and to enhance HSSE performance
- All incidents, near misses and opportunities for improvement are consistently reported and investigated, and that identified actions and learnings are implemented on a timely basis

We all have a personal responsibility to work safely and protect the environment. We are all safety leaders, irrespective of our role or location. Everyone is empowered to challenge and stop work if they are in any doubt regarding a job they are involved in or observing.

Sandy Hutchison, Managing Director

Brad Youngson,
HSSEQ & Assurance Director

Calum Riddell,
Operations Director

David Wilson,
Decommissioning, Projects & Engineering Director

Jeremy Kibble,
Finance Director

Corinne Kelt,
Human Resources Director

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APPENDIX D - ENERGY USE AND ATMOSPHERIC EMISSIONS

The emissions estimates for the recycling of waste materials, total vessel fuel consumption and the associated vessel emissions are based on IoP (2000) energy conversion factors, where available for specific GHG and specific materials.

Table D-1 Total Energy Use and Atmospheric Emissions by Project Activity

Planned Activity	Energy (GJ)	CO2 (Te)
Onshore transportation of materials	3,408	28
Onshore dismantling of materials	13,836	443
Onshore recycling of materials	38,104	11,230
New manufacture to replace recyclable materials	325,865	24,612
Offshore transport and operation of vessels offshore (See table below)	691,196	50,956
Total	**1,072,409**	**87,269**

Table D-2 Total Offshore Transport Energy Use and Atmospheric Emissions

Vessel Type	Duration (days)				Energy (GJ)	CO2 (Te)
	Mob/ Demob	Transit	Working	TOTAL		
DSV	14.25	15.85	69.36	99.47	67,789	4,998
CSV (includes WDP3 activity)	28.44	40.60	383.05	452.08	453,662	33,444
ROVSV	6.25	6.17	78.69	91.10	79,547	5,864
Rock vessel	12.00	5.00	30.08	47.08	22,586	1,665
Survey vessel	2.00	2.00	55.21	59.21	67,612	4,985
				Total	**691,196**	**50,956**

Table D-3 Cladhan Energy Use and Atmospheric Emissions by Project Activity

Planned Activity	Energy (GJ)	CO2 (Te)
Onshore transportation of materials	1,025	10
Onshore dismantling of materials	3,927	126
Onshore recycling of materials	8,555	3,242
New manufacture to replace recyclable materials	111,481	8,419
Offshore transport and operation of vessels offshore	170,280	12,553
Total	**295,268**	**24,350**

Table D-4 Hudson Energy Use and Atmospheric Emissions by Project Activity

Planned Activity	Energy (GJ)	CO2 (Te)
Onshore transportation of materials	1,418	4
Onshore dismantling of materials	4,934	158
Onshore recycling of materials	20,343	3,842
New manufacture to replace recyclable materials	166,600	12,586
Offshore transport and operation of vessels offshore	354,944	26,167
Total	**548,239**	**42,757**

Table D-5 Kestrel Energy Use and Atmospheric Emissions by Project Activity

Planned Activity	Energy (GJ)	CO_2 (Te)
Onshore transportation of materials	394	4
Onshore dismantling of materials	1,788	57
Onshore recycling of materials	6,007	1,497
New manufacture to replace recyclable materials	36,644	2,766
Offshore transport and operation of vessels offshore	91,654	6,757
Total	**136,487**	**11,081**

Table D-6 Falcon Energy Use and Atmospheric Emissions by Project Activity

Planned Activity	Energy (GJ)	CO_2 (Te)
Onshore transportation of materials	571	10
Onshore dismantling of materials	3,187	102
Onshore recycling of materials	3,199	2,649
New manufacture to replace recyclable materials	11,140	841
Offshore transport and operation of vessels offshore	74,319	5,479
Total	**92,416**	**9,081**