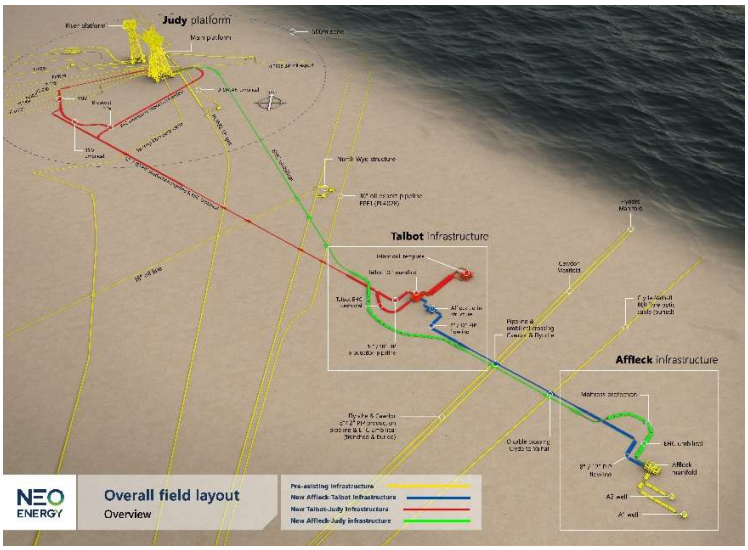
Affleck Re-development

Environmental Statement

D/4272/2021



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B1	Issued for Comment	10/06/2022	[redacted]	[redacted]	[redacted]
			Author	Environmental Specialist	Project Manager

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ENVIRONMENTAL STATEMENT DETAILS

Section A: Administrative Information

A1 – Project Reference Number

Please confirm the unique ES identification number for the project.

Number: D/4272/2021

A2 - Applicant Contact Details

Company name: NEO Energy

Contact name: [redacted]

Contact title: [redacted]

A3 - ES Contact Details (if different from above)

Company name: NEO Energy

Contact name: [redacted]

Contact title: [redacted]

A4 - ES Preparation

Please confirm the key expert staff involved in the preparation of the ES:

Name	Company	Title	Relevant Qualifications/ Experience
[redacted]	Xodus Group	[redacted]	[redacted]
[redacted]	Xodus Group	[redacted]	[redacted]

A5 - Licence Details

a) Please confirm licence(s) covering proposed activity or activities

Licence number(s): P255

b) Please confirm licensees and current equity

Licensee	Percentage Equity
NEO Energy Production UK Limited	100%

Section B: Project Information

B1 - Nature of Project

a) Please specify the name of the project.

Name: Affleck Development

b) Please specify the name of the ES (if different from the project name).

Name: Affleck Re-development Environmental Statement

c) Please provide a brief description of the project.

The Affleck Re-development comprises the redevelopment of the Affleck field (Licence P255) in United Kingdom Continental Shelf (UKCS) Blocks 30/19a in the central North Sea. NEO Energy plans to redevelop the Affleck oil field by reusing the existing Affleck wells, A1 and A2 and the Affleck Manifold. The two wells will be tied back to the existing Judy platform, routed via the proposed Talbot manifold (Harbour Energy (HE) - operator), where production fluids will be comingled.

B2 - Project Location

a) Offshore location(s) of the main project elements (r both the start and end locations).

Quadrant number(s): 30

Block number(s): 30/19, 30/14, 30/13, 30/12 and 30/7. Affleck pipeline start: 30/19, end: 30/13, Affleck umbilical start:

A1 well: Latitude: 56° 26' 36" N Longitude: 02° 42' 05" E

A2 well: Latitude: 56° 26' 37" N Longitude: 02° 42' 05" E

Distance to nearest United Kingdom (UK) coastline: 263 km

Distance to nearest international median line: 5 km to UK/Norway median line.

B3 - Previous Applications

Details of the original project.

Name of project: Affleck Development

Date of submission of ES: 8th Feb 2006

Identification number of ES: D/3010/2006

DEFINITIONS & ABBREVIATIONS

Abbreviation	Description
“	Inches
µPa	Micropascal
AA	Appropriate Assessment
ACA	Action Co-ordinating Authority
AET	Apparent Effects Threshold
API	American Petroleum Institute
AR6	Sixth Assessment Report
BAC	Background Assessment Criteria
BAT	Best Available Technique
BC	Background Concentration
BEIS	Department for Business, Energy and Industrial Strategy
BEP	Best Environmental Practice
BFP	Back-Fill Plough
BOCC	Birds of Conservation Concern
boe	Barrel of oil equivalent
BOP	Blow out preventer
bopd	Barrels of oil per day
BRC	Background Reference Concentration
Bwpd	Barrels of water per day
CAPEX	Capital Expenditure
CATS	Central Area Transmission System
CCC	Climate Change Committee
CCS	Carbon, Capture and Storage
CEFAS	Centre for Environment, Fisheries and Aquaculture Science
CFU	Compact Flotation Unit
CH_4	Methane
CNS	Central North Sea
CNSE	Central North Sea Electrification
CO	Carbon monoxide
CO_2	Carbon dioxide
CO_{2e}	Carbon dioxide equivalent
CoP	Cessation of Production
cp	centiPoise
CPI	Carbon Preference Index
CPT	Cone Penotrometer Test
CSV	Construction Support Vessel
dB	Decibels
DEFRA	Department of Environment, Food and Rural Affairs
DMA	Dead Man Anchor
DP	Dynamic Positioning

Abbreviation	Description
DSV	Dive Support Vessel
ECA	Emissions Control Areas
EEA	European Environment Agency
EEZ	Exclusive Economic Zone
EHC	Electro-hydraulic Control
EIA	Environmental Impact Assessment
EIAPP	Engine International Air Pollution Prevention
EMS	Environmental Management System
EMSA	European Maritime Safety Agency
ENE	East northeast
ENVID	Environmental Impact Identification
EPS	European Protected Species
ERL	Effects Low Range
ES	Environmental Statement
ESOS	Energy Savings Opportunity Scheme
EU	European Union
EUNIS	European Union Nature Information System
FDP	Field Development Plan
FEED	Front End Engineering Design
FGC	Flash Gas Compressor
FOCI	Feature of Conservation Interest
FPSO	Floating Producing Storage and Offloading
FPU	Floating Production Unit
ft	feet
GES	Good Environmental Status
GHG	Greenhouse Gas
GOR	Gas – Oil Ratio
GWP	Global Warming Potential
HE	Harbour Energy
Hf	High frequency
HRA	Habitat Regulations Assessment
HS&E	Health and Safety Executive
HSE	Health, Safety and Environment
IAMMWG	Inter-Agency Marine Mammal Working Group
IAPP	International Air Pollution Prevention Certificate
ICCI	In-combination climate impact
ICES	International Council for the Exploration of the Sea
ICOP	Code of Practice on Access to Upstream Oil and Gas Infrastructure on the UK Continental Shelf (or Infrastructure Code of Practice)
IEEM	Institute of Ecology and Environmental Management
IEMA	Institute of Environmental Management and Assessment
IGOP	International Association of Oil and Gas Producers

Abbreviation	Description
INTOG	Innovation and Targeted Oil and Gas
IPCC	Intergovernmental Panel on Climate Change
ITOPF	International Tankers Owners Pollution Federation
IUCN	International Union for Conservation of Nature
JNCC	Joint Nature Conservation Committee
JRP	Judy Riser Platform
kHz	Kilo-hertz
Km	Kilometre
kt	Kiloton
kWh	Kilowatt Hour
LAT	Lowest Astronomical Tide
LCTP	Low Carbon Transition Plan
LF	Low Frequency
LOD	Limit of Detection
LOLER	Lifting Operations and Lifting Equipment Regulations
LP	Low Pressure
LSE	Likely Significant Effect
m	Metre
m^3	Cubic Metre
MA	Major Accident
MAH	Major Accident Hazard
MarLIN	Marine Life Information Network
MAT	Master Application Template
mbbl/d	Thousand Barrels Per Day
MCAA	Marine and Coastal Access Act
MCCIP	Marine Climate Change Impacts Partnership
MCZ	Marine Conservation Zone
MDAC	Methane-Derived Authigenic Carbonate
MEG	Mono-ethylene glycol
MEI	Major Environmental Incident
MEI	Major environmental impact
MF	Mid-Frequency
mg/l	Milligrams per Liter
MIS	Marine Information System
Mmbbl/d	Million Barrels Per Day
mmboe	Million barrels of oil equivalent
MMMU	Marine Mammal Management Unit
MMO	Marine Management Organisation
mmstb	Million stock tank barrels
MOL	Main Line Oil
MPA	Marine Protected Area
MPFM	Multi-phase flow meter

Abbreviation	Description
MPP	Multi-Pass Plough
MtC	Megatonnes of Carbon
Mw	Molecular weight
MW	Megawatt
N_2	Nitrogen
N_2O	Nitrous Oxide
NCMPA	Nature Conservation Marine Protected Area
NCP	National Contingency Plan
NDC	Nationally Determined Contribution
NEC	No Effect Concentration
NECA	Nitrogen Oxides Emissions
NEO	NEO Energy
NERC	Natural Environment and Rural Communities
NM	Nautical Miles
NMFS	National Marine Fisheries Service
nmVOC	Non-Methane Volatile Organic Compounds
NNS	Northern North Sea
NNW	North northwest
NORBRIT	Norwegian / British Oil Response
NORM	Naturally Occurring Radioactive Material
NO_X	Nitrogen Oxides
NPD	Naphthalenes, Phenantherenes and Dibenzothiophenes
NSTA	North Sea Transition Authority
O_3	Ozone
OAA	Option Agreement Area
OCR	Offshore Chemicals Regulation
OESEA	Offshore Energy Strategic Environmental Assessment
OEUK	Offshore Energies UK
OGA	Oil and Gas Authority
OGUK	Oil and Gas UK
OIW	Oil in Water
OOS	Out of Straightness
OPEP	Oil Pollution Emergency Plan
OPEX	Operating Expenses
OPPC	Oil Pollution Prevention and Control
OPRC	Oil Pollution, Preparedness, Response and Cooperation
OPRED	Offshore Petroleum Regulator for Environment and Decommissioning
OSCAR	Oil Spill Contingency and Response
OSPAR	The Convention for the Protection of the Marine Environment of the North-East Atlantic
P	Pressure
Pa	Pascal
PAH	Polycyclic Aromatic Hydrocarbon

Abbreviation	Description
PAM	Passive Acoustic Monitoring
PCO	Precipitated carbonates
PiP	Pipe in Pipe
PMF	Priority Marine Feature
POC	Particulate organic carbon
PON1	Petroleum Operations Notices 1
ppb	Parts per billion
PPC	Pollution Prevention and Control
ppm	Parts Per Million
ppt	Parts per thousand
PSA	Particle Size Analysis
Psu	Practical Salinity Unit
PTS	Permanent Threshold Shift
PW	Phocids in Water
PWRI	Produced Water Reinjection
QSR	Quality Status Report
RCP	Representative Concentration Pathway
RLV	Reel Lay Vessel
RMS	Root Mean Square
RMS	Root Mean Square
ROV	Remotely Operated Vehicle
SAC	Special Areas of Conservation
SAT	Subsidiary Application Template
SCANS-III	Small Cetaceans in the European Atlantic North Sea
Scf	Standard cubic feet
scf	Standard cubic feet
SCM	Subsea Control Module
SCSSV	Subsurface Safety Valve
SDU	Subsea Distribution Unit
SECA	Sulfur Oxides Emission Control
SECE	Safety and Environmental Critical Elements
SEEMP	Shipboard Energy Efficiency Management Plan
SEL	Sound Exposure Level
SFF	Scottish Fishermen's Federation
SMP	Sectoral Marine Plan
SNCBs	Statutory Nature Conservation Bodies
SNH	Scottish Natural Heritage
SNS	Southern North Sea
SOPEP	Shipboard Oil Pollution Emergency Plan
SOSI	Seabird Oil Sensitivity Index
SOx	Sulphur oxides
SPA	Special Protection Area

Abbreviation	Description
SPL	Peak Sound Pressure Level
SPLrms	Root Mean Square Sound Pressure Level
SR	Social Responsibility
SRE	Special Report Emissions
SSE	South southeast
SSS	Side Scan Sonar
SSSV	Subsurface Safety Valve
SSW	South southwest
stb	Stock tank barrel
STOIIP	Stock Tank Oil Initially in Place
SUV	Support Operation Vessel
TCFD	Taskforce for climate related financial disclosure
tCO_{2e}	Tonnes of Carbon Dioxide Equivalent
Te	Tonnes
THC	Total Hydrocarbon Content
TOC	Total Organic Carbon
TOM	Total Organic Matter
TSV	Trenching Support Vessel
TTS	Temporary Threshold Shift
TUTU	Topsides Umbilical Termination Unit
TVDSS	True Vertical Depth SS
UCM	Unresolved Complex Mixture
UHB	Upheaval Buckling
UK	United Kingdom
UKAPP	UK Air Pollution Prevention Certificate
UKBAP	UK Biodiversity Action Plan
UKCS	United Kingdom Continental Shelf
UKETS	UK Emissions Trading Scheme
UKOOA	UK Offshore Operators Association
UNESCO	United Nations Educations, Scientific and Cultural Organisation
UNFCCC	United Nations Framework Convention on Climate Change
US	United States
UTA	Umbilical Termination Assembly
VHF	Very High Frequency
VMS	Vessel Monitoring System
VOC	Volatile Organic Compounds
WFD	Water Framework Directive
WHP	Wellhead Pressure
WHS	World Heritage Site
WNW	West northwest
WSW	West southwest
XT's	Xmas Tree

NON-TECHNICAL SUMMARY

INTRODUCTION

This non-technical summary provides an overview of the finding of the Environmental Impact Assessment (EIA) conducted to date by NEO Energy ('NEO') for the re-development of the Affleck field (the 'Development'). The Affleck field is located in the central North Sea (CNS), in Block 30/19a of the United Kingdom Continental Shelf (UKCS), approximately 5 km from the UK/Norway median line (Figure NTS-1).

In early 2022, NEO acquired 100% ownership of the Affleck field, and are proposing to re-develop the field via two existing production wells (A1 and A2). The re-development will entail a subsea tie-back to the Judy platform via the Talbot field (proposed by Harbour Energy). Installation of new risers, flowlines, umbilical and tie-in structures will be required as part of this development. On the Judy platform, produced fluids from Affleck and Talbot will be commingled with production from other nearby fields that are already operating, and separated into gas and liquids streams for export.

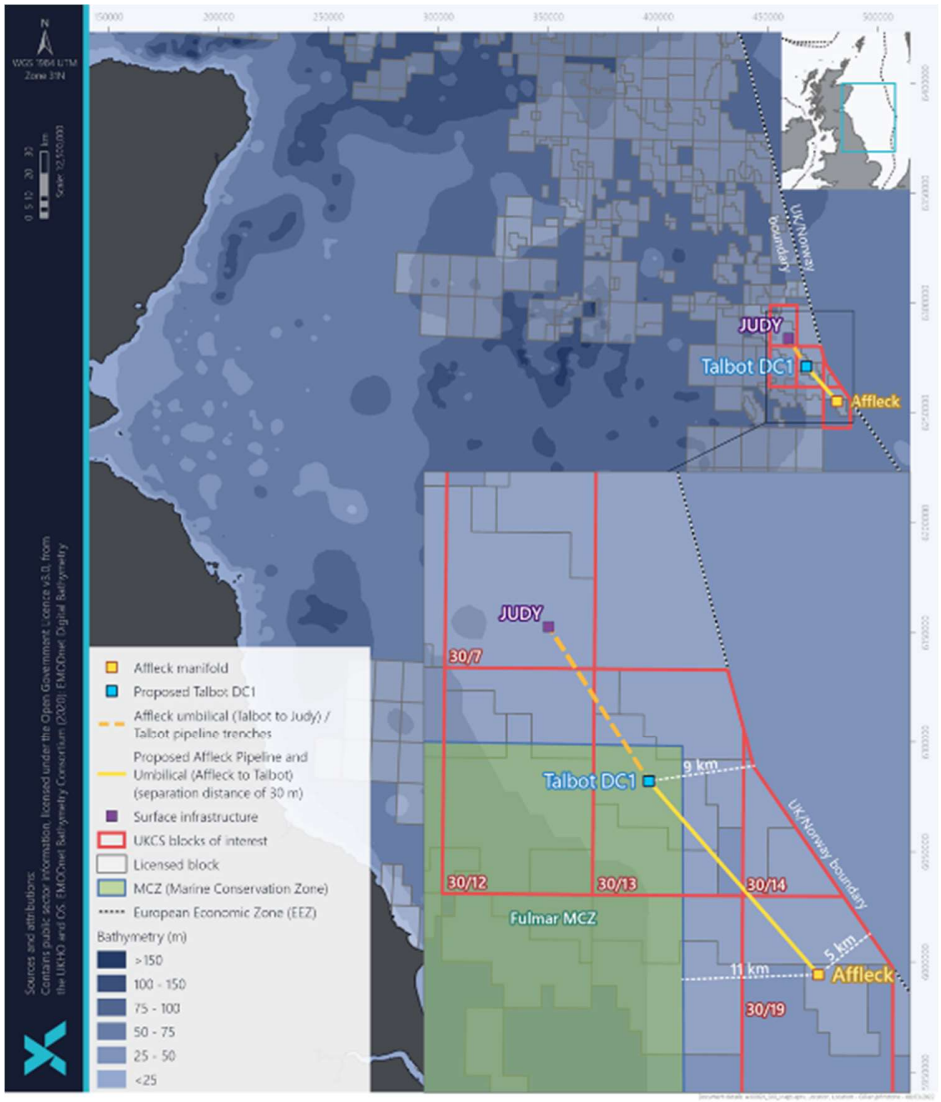


Figure NTS-1 Location of the Affleck Development

ALTERNATIVES

INITIAL CONCEPT SCREENING

A high-level screening study of the Affleck field redevelopment options was undertaken. The re-development options under consideration included:

- A new standalone facility;
- A subsea processing option;
- A subsea tie-back to other facilities;
- A joint development with other fields/discoveries; and
- Not to re-develop the Affleck field (do-nothing option).

The do-nothing option for the redevelopment of the Affleck field was scope out due to the need for secure energy supply during the UK energy transition and the replacement of imports with national hydrocarbon supply.

This broad suite of re-development options was primarily screened for their technical feasibility, commercial viability and environmental impact. The outcome of the initial high-level screening identified that a subsea tie-back, potentially in combination with a joint development, was the most technically feasible and commercially viable option for re-development of the Affleck field. Furthermore, it was estimated that the social benefits would override the anticipated small environmental impacts that such a redevelopment may incur, and therefore the redevelopment was worth pursuing.

HOST SELECTION

As part of the concept select process, screening of seven potential tie-back/host options was undertaken which considered key technical constraints and opportunities. The viable options for the re-development was narrowed down to three options:

- routing fluids to Judy via Talbot;
- routing fluids to Judy direct; and
- routing fluids to Clyde via Cawdor.

As part of the host installation decision-making process, an assessment was carried out of the comparative atmospheric emissions between the two potential hosts, Clyde versus a tie-back to Judy, from 2024 to 2030. The cessation of production (CoP) of Affleck extends up to 2035, however this date was used for comparative purposes only as there was uncertainty around the emissions data after 2030 at the time the study was conducted. The Judy host option included both the direct tie-back to the installation and a tie-back via the Talbot subsea infrastructure. NEO is committed to minimise its greenhouse gas emissions and complies with the North Sea Transition Authority (NTSA) Stewardship Expectations 11 as part of the UK Government's strategy to meet the Net Zero target by 2050.

This assessment identified that the subsea tie-back to the Judy Platform, particularly the tie-back via the Talbot development, would result in significantly lower atmospheric emissions. This concept also represented the most technically feasible option in that no additional export pipeline from Judy is required to accommodate the Affleck production. Finally, the Judy via Talbot option is associated with the greatest potential economic recovery. For these reasons, the Judy via Talbot concept offered the most attractive prospect and was selected as the re-development concept.

OVERVIEW OF THE DEVELOPMENT

NEO propose to tie-back the two existing Affleck wells (A1 and A2) to the existing Judy platform via the Talbot DC1 manifold, where production fluids will be comingled. NEO will reconnect to the existing Affleck manifold and link to the Talbot DC1 manifold via a new tie-in structure.

New infrastructure proposed by NEO include the following:

- A new tie-in structure connecting to the Talbot DC1 manifold;
- A new 21 km pipeline between the Affleck manifold and the tie-in structure (trenched and buried);
- A new 37 km umbilical between the Affleck manifold and the Judy Platform (trenched and buried); and
- Associated crossings/trenching and protection.

It is anticipated that produced water volumes would be low in the first five years of production and gradually increase to remain above 1700 bbl/d for the remaining life of the field in the high production scenario.

There is no produced water reinjection system on the Judy platform, therefore produced water from the Affleck Development will be treated via the existing produced water treatment system at the Judy platform to meet the 30 mg/L oil-in-water concentration threshold and then discharged to sea via the caisson at the Judy riser platform, and occasionally from the sea surface at the Judy platform.

The only required modifications to the existing facilities will be internal modifications to the Judy platform to increase the produced water handling capacity, which will accommodate both Affleck and Talbot produced water.

There is no requirement for a well flowback or test or a full function test as the wells have previously been in production; therefore, there is no planned routine flaring.

The Affleck field layout is provided in Figure NTS- 2.

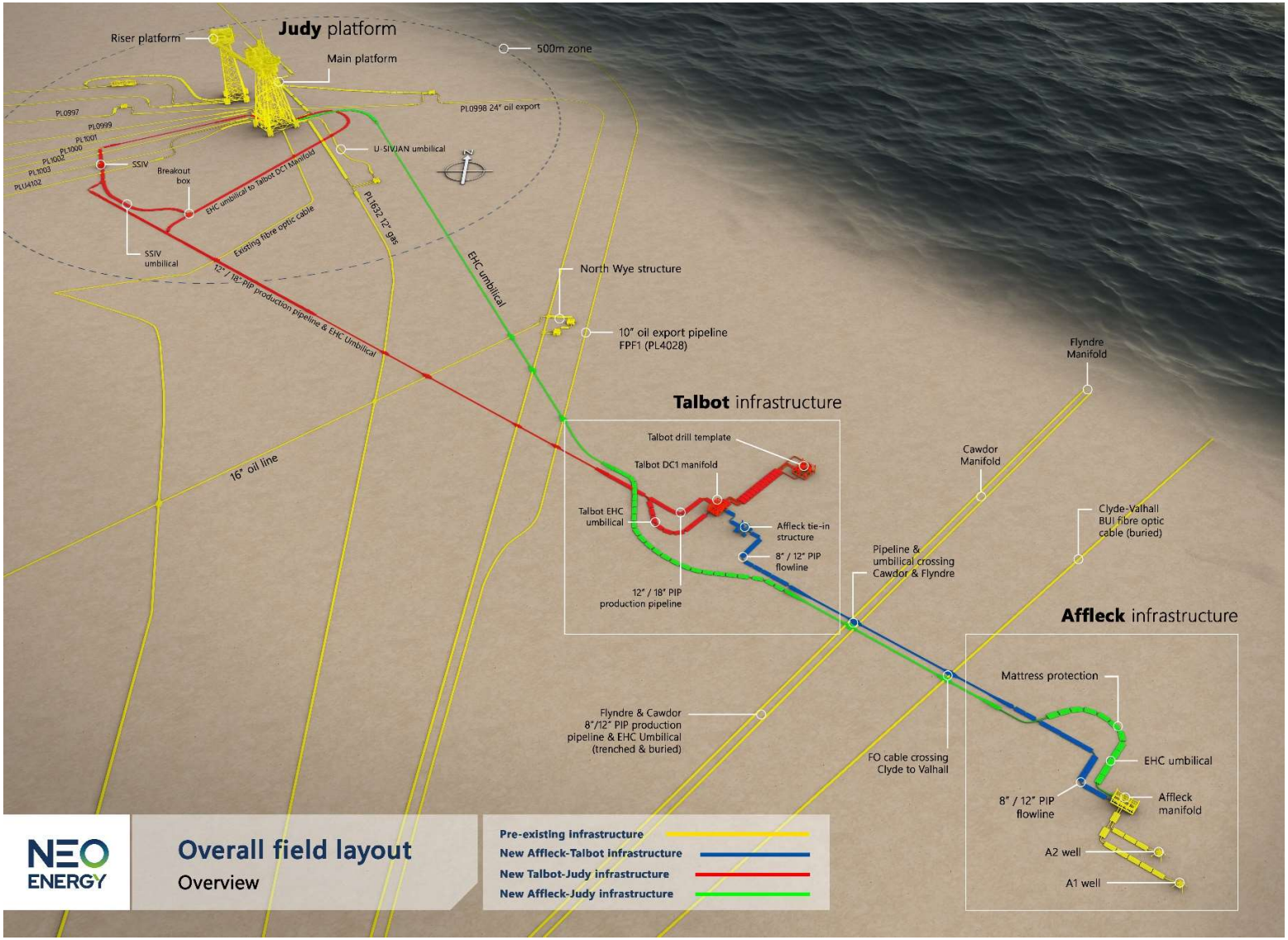


Figure NTS- 2 Affleck Development layout

RECEIVING ENVIRONMENT

The table below provides an overview of the baseline environment in the Affleck Development area. Figure NTS- 3 shows the distribution of key environmental sensitivities around Affleck.

Environmental Receptor	Baseline Description
Bathymetry and seabed conditions	▪ Water depths ranged from 70 to 75.4 m in the Affleck Development area. ▪ Seabed generally flat. The only features of interest include existing pipelines, wells, boulders, spudcan depressions and buried debris. ▪ Seabed sediments were generally classified as fine sand with occasional shell fragments.
Benthic fauna	Notable fauna in the Affleck pipeline survey area include: ▪ Fauna is typical of fine sandy sediments, dominated by annelids, echinoderms and molluscs, including the bivalve of conservation importance *Artica islandica* (ocean quahog) observed in low numbers within the Affleck pipeline survey area. ▪ Evidence of seapen burrows and live seapen, however the burrows did not meet the criteria of the OSPAR (2009) threatened and/or declining habitat 'seapen and burrowing megafauna communities. Notable fauna in the Talbot survey area include: ▪ The fauna observed at Talbot was similar to that observed at Affleck. ▪ Faunal burrows were observed across almost all sampling locations although no seapens were observed, however it did not meet all criteria of the OSPAR (2008) declining and/or threatened habitat 'seapen and burrowing megafauna communities. ▪ Horse mussels (*Modiolus modiolus*) were recorded; however, the biotope was not classified as Annex I biogenic reef. ▪ Rare occurrences of deep-sea sponges. ▪ Ocean quahog siphons and dead shells were observed at almost all stations but no live individuals.
Fish and fisheries	▪ The Development is located within areas that may be used as spawning and nursery grounds for a number of commercially important species, including sandeel spawning grounds (species that depends on specific seabed conditions for spawning). ▪ Commercial landings are dominated by demersal fish with species of importance in terms of landed value and weight being plaice and lemon sole. Fishing effort in the Development area is very low.
Seabirds	▪ The JNCC's Seabird Oil Sensitivity Index (SOSI) in the vicinity of the Development is generally low in winter and early spring, and very high in early summer.
Marine mammals	▪ The density of cetaceans in the Development area is estimated to be low and is not considered to be significant for feeding, breeding, nursing or for migrating cetaceans. ▪ Harbour porpoise is the most abundant cetacean species in the Development area, followed by minke whale. Other species that may be present in the Development area include white-beaked dolphin and white-sided dolphin.
Protected sites	▪ The Affleck pipeline and umbilical are partially located within the Fulmar MCZ, designated for subtidal sand, subtidal mud, subtidal mixed sediments, and ocean quahog. No other protected sites are located within 50 km of the Development.

Environmental Receptor	Baseline Description
Other sea users	▪ The Development is located in an area that experiences very low to low shipping intensity with cargo ships and tankers the dominant vessel type. ▪ The nearest proposed oil and gas platform to the Affleck Development is Jackdaw which location is 22.8 km west-north-west of the Affleck umbilical. ▪ The proposed Affleck pipeline will cross a number of existing pipelines and umbilical.

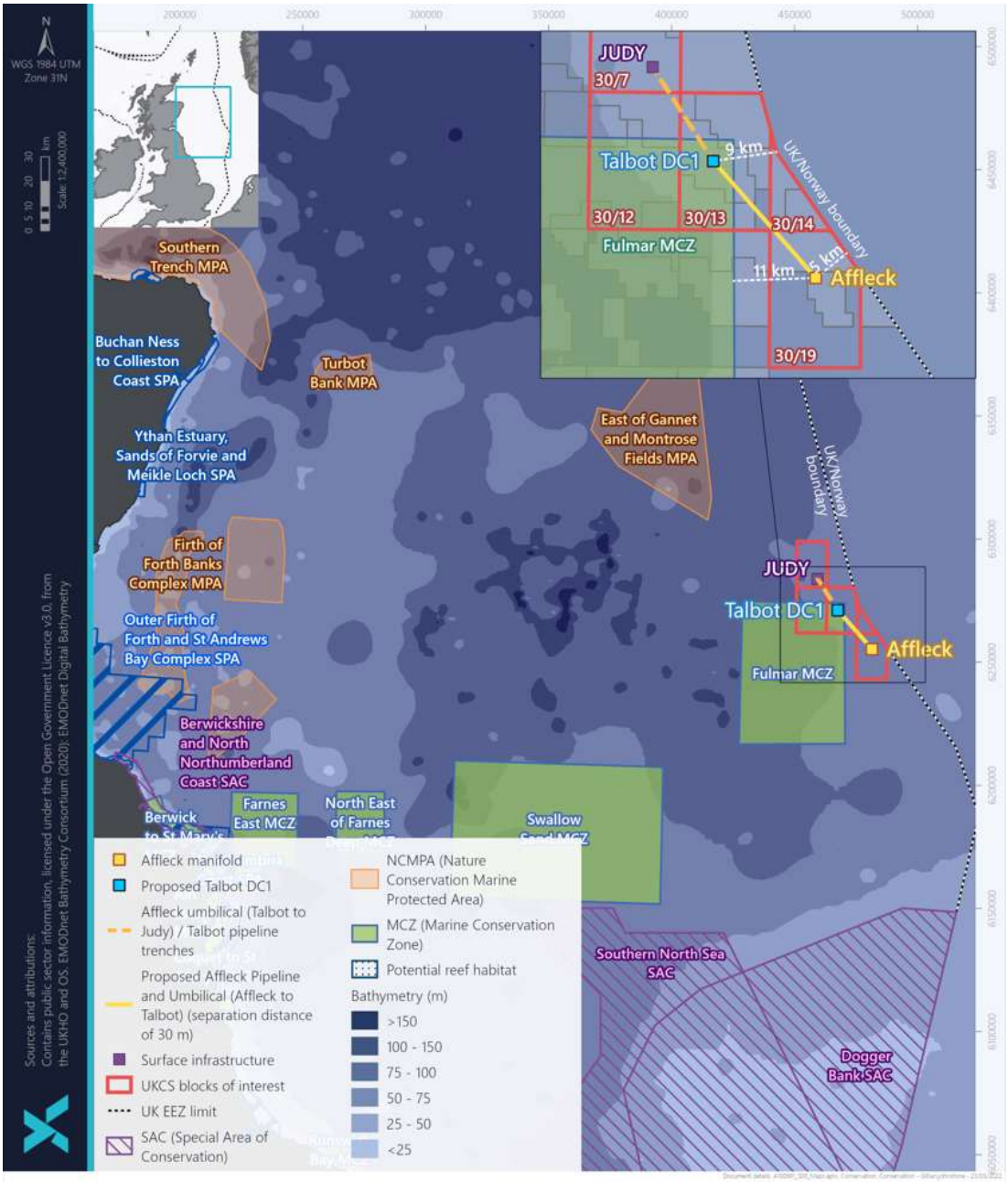


Figure NTS- 3 Key environmental sensitivities around the Affleck Development

EIA METHODOLOGY

The objectives of the EIA process are to incorporate environmental considerations into the planning phase of the Development, to ensure that best environmental practices are followed. The process also allows for potential concerns raised by relevant stakeholders to be addressed appropriately. The EIA process ensures that the Development complies with environmental legislation and NEO's Health, Safety, Environment and Social Responsibility policies.

Key drivers of environmental impact were identified through an 'Environmental issues identification' workshop, drawing on the accumulated experience of relevant engineers and environmental specialists. Scoping and consultation with the main offshore regulator, the Offshore Petroleum Regulator for Environment and Decommissioning (OPRED), and its advisors: the Joint Nature Conservation Committee (JNCC) and Marine Scotland further refined the scope and scale of the impact assessment. Key impact drivers identified for assessment were: - discharges to sea, seabed disturbance, physical presence of the Development infrastructure and associated vessels, atmospheric emissions, underwater noise and accidental events. To inform the assessment of impacts from these key drivers, several specialist survey and modelling studies were completed.

The EIA methodology followed a systematic process by which the sensitivity, vulnerability and value of receptor are combined with magnitude (and likelihood, where appropriate) of impact using expert judgement to arrive at a consequence for each impact. The significance of impact was derived directly from the assigned consequence ranking.

This ES will be subject to a statutory public consultation during which will allow stakeholders and members of the public to raise any concerns or provide comments on the proposed Development.

DISCHARGES TO SEA

The primary sources of discharges to sea come from the proposed Development include dewatering of the Affleck pipeline and umbilical as part of pre-commissioning operations and produced water discharges in the operational phase. The associated discharges in the water column have been assessed. There are no discharges at the seabed associated with the Development activities, therefore no potential seabed impacts were assessed in this chapter.

Produced water will be discharged either at the Judy riser approximately 41.9 m below sea level or at the sea surface at Judy. Produced water may contain residues of reservoir hydrocarbons (oil), dissolved organic and inorganic compounds present in the geological formation and chemicals added during the production process. The produced water system is designed to reduce the oil content in the produced water to a target of less than or equal to 30 mg/l oil in water or less. NEO will conduct chemical risk assessment and commits to the use of non-substitution chemicals.

Pipeline dewatering operations incur some of the largest discrete discharges of fluids including inhibited seawater. However, these discharges will be limited in quantity and occur only intermittently. Therefore, these are expected to disperse rapidly in the environment to non-toxic concentrations.

With regard to discharges to the water column, plankton are particularly susceptible to impacts chemicals because they are generally non-motile and cannot move away from an affected area. However, they occur in huge numbers, are borne in large moving water masses, and have extremely high natural mortality rates. Therefore, due to the regulated conditions of chemical use and produced water treatment, the small discharge volumes in relation to the receiving environment, and the large dilution and dispersion available, impacts are expected to be largely non-measurable. Thus, sensitivity and vulnerability are considered to be low and the impact not significant.

Overall, the risk assessment concluded that the consequence of discharges to sea were low and that the overall impact impacts was **not significant**.

SEABED DISTURBANCE

The Development activities that will interact with the seabed include installation of the Affleck pipeline and umbilical via a trenching and burial method, tie-in structure and spools at Affleck and Talbot, and placement of subsea infrastructure protection and stabilisation material (concrete mattresses and rock).

Within the immediate footprint of installation activities, which represents a seabed area of approximately 0.26 km^2, there will be a physical loss and abrasion of benthic habitats and species. In the surrounding area, where the disturbed sediments will resettle, benthic species and habitats will undergo a smothering effect. The seabed surrounding the Development predominantly consisting of fine sand, sediments have the potential to remain suspended in the water column for a longer period and thus resettle over a wider area.

The impact from subsea infrastructure installation will result in a one-off event, resulting in a localised loss of seabed habitat and fauna. A fall pipe vessel will be used to install rock protection around structures in order to optimise the use of deposits and thus reduce the seabed footprint of installation activities. Additionally, the number of concrete mattresses and sandbags will be refined during the design phase of the project in order to limit the extent of seabed disturbance. The seabed disturbance generated by the installation of seabed infrastructure will not affect long-term function of ocean quahog and seapens populations that may occur in the Development area, as these are widely distributed in this region of the North Sea. Deep-sea sponges were observed as a rare occurrence in the environmental baseline and habitat assessment survey conducted at Affleck in 2019, and there was not sufficient evidence to classify the observed horse mussels population as biogenic reefs.

Approximately 4 km of the proposed Affleck pipeline and 7 km of the umbilical will be placed within the Fulmar MCZ, which qualifying features include mud, sand, mixed sediments habitats and ocean quahog. Given the low footprint of the Development in the MCZ, together with the low number of ocean quahog individuals observed within the Affleck pipeline survey area and the recoverability of the habitats observed, the Affleck Development activities are not expected to compromise the conservation objectives of the Fulmar MCZ.

The sediment type in the Affleck Development area is considered to have a low capacity to assimilate and store carbon and therefore the sediment disturbance planned as part of the Affleck Development is not expected to result in a significant release of carbon that may be stored in the sediments, thus resulting in a non-significant contribution to climate change.

Overall, it was concluded that the residual impact to the seabed is **not significant**.

UNDERWATER NOISE

Noise sources that have been identified as likely to cause injury or disturbance to marine mammals and fish include pipeline installation, dredging and presence of vessels, and short-term impulsive noise from piling of the new Affleck subsea tie-in structure. However, of these activities, only piling noise is considered to have the potential to impact on the hearing of sensitive marine species because it forms the greatest noise source in both power and character (impulsive noise).

Noise propagation modelling was used to characterise the potential impacts of piling on marine mammals hearing capacities. The outputs suggested that the potential for injury from impulsive noise could only arise within very close proximity of the noise source. The employment of a marine mammal observer (MMO) or the use of Passive Active Monitoring (PAM) onboard the installation vessel will ensure that no marine mammals are within the vicinity of the works prior to starting the piling operations. Additionally, a soft-start

will be performed on the hammer used for piling, which means that the power level will be increased progressively to provide any animals in the vicinity to leave the area prior to the works commencing. Therefore, it was concluded that following implementation of mitigation measures, injury from the piling operations was considered as extremely unlikely.

Any possible impact on marine mammals is therefore expected to be limited to **minor** disturbance to cetaceans and **negligible** disturbance to pinnipeds.

PHYSICAL PRESENCE

The use of vessels for subsea installation, supply and offloading for developing the Affleck field has the potential to interfere with the activities of other users of the marine space, including commercial fisheries, other oil and gas activities and commercial shipping.

The key potential impacts on other sea users from the Affleck Development include temporary exclusion of other sea users from the area during the subsea installation phase, increased risk of vessel collisions due to higher third-party vessel traffic, and introduction of snagging risk for commercial fishing gear.

The Development is located approximately 263 km from the east coast of Scotland and England where shipping and commercial fishing activity are low. No additional safety zones are planned for the Affleck Development, beyond those that are already in place at Affleck and Judy and is proposed to be in place at Talbot DC1 manifold as part of the Talbot development. No anchored or moored vessels are anticipated to be used. Information on the location of subsea infrastructure, safety zones and vessel operations will be communicated through the standard communication channels and marked on admiralty charts when appropriate. Additionally, a guard vessel will be on site in the interim period between pipeline/umbilical laying and arrival of the trenching vessel. Therefore, there will be a minimal disturbance to shipping and commercial fishing activities.

The Development is expected to be constructed over a nine-month period, during which these vessels will be present, however it is unlikely that all vessels will be on site at the same time during the construction phase. The Affleck installation campaign will be a temporary, short-term activity, and thus, the increase in vessel traffic will be minimal. Overall, the impact magnitude on shipping due to increased collision risk is considered low.

The physical presence of subsea infrastructure also represents a snagging risk for fishing gear. Commercial fishing in the Development area predominantly targets demersal fish, which involves towing nets along the seabed, thus posing a risk to subsea infrastructure, and in extreme cases, a potential risk to life if snagging occurs. However, the pipeline and umbilical will be buried for the majority of the routes, with a target depth of cover of >0.6m. External protection, including concrete mattresses and rock placement will be installed at trench transitions, crossing points, tie-in spools and at spot locations along the pipeline and umbilical. These external protections will be designed to be overtrawlable. Given that fishing effort in the Development area is very low, together with the selected seabed infrastructure protection methods, the resulting magnitude of impact to fisheries is considered as minor.

When taking into consideration the temporary activities of vessels during construction phase and the longer-term physical presence of the Affleck platform, the overall the assessment has found that these associated impacts of physical presence are not significant.

ATMOSPHERIC EMISSIONS

Greenhouse gas emissions from the Development will arise during all phases of the lifecycle, from fabrication of the new infrastructure to be installed, installation and commissioning, operation and decommissioning. An inventory of sources of emissions has been prepared and emissions quantified in order to assess the impact of the Development on local and global air quality and on climate change. This assessment was conducted to align with the NSTA Net Zero Stewardship Expectation 11 by ensuring that greenhouse gas emissions reduction is considered throughout lifecycle of the Development. The anticipated sources of atmospheric emissions from the Affleck Development include:

- New subsea infrastructure materials and fabrication.
- Vessel and helicopter fuel combustion during the installation phase.
- Judy facility emissions during production and maintenance, with no routine flaring and venting. Increased power generation will be required at Judy as a result of Affleck coming online.
- Decommissioning of Affleck infrastructure.

The carbon assessment showed that the embodied carbon in the subsea infrastructure makes the largest contribution to Development emissions.

The annual operational emissions of Affleck represent approximately 0.052% of the annual sector emissions. The magnitude of the Development emissions is therefore considered to have a negligible cumulative impact on global climate change.

ACCIDENTAL EVENTS

Accidental hydrocarbon releases can have serious impacts on wildlife, particularly birds and sensitive coastal habitats and are therefore a primary concern.

Modelling indicated that a worst-case release resulting from a well blow out at Affleck would result in oil on the sea surface crossing the Norwegian, Danish, Swedish, German, and Dutch median lines in all seasons. In addition, the probability of oil beaching in Norway, Denmark and Sweden in summertime was 100%. Beaching was also predicted to occur on the east coast of the UK from Shetland to East of England and on other European coastlines.

Under the Offshore Safety Directive (2013/30/EC) and the implementing UK regulations, the Offshore Installations (Offshore Safety Directive) (Safety Case) Regulations 2015 (OSCR), operators are required to identify in their well notifications where any Major Accident Hazards (MAHs) associated with the operations has the potential to cause a Major Environmental Incident (MEI). NEO undertook an MEI assessment as part of this EIA and it was found that in the event of a release, there was not considered to be significant risk to the qualifying features of protected sites in the region. Furthermore, the quantity of oil that would contaminate the sediment is not sufficient to pass a threshold where it would be detrimental to protected habitats or species.

It is recognised that a hydrocarbon release could result in demonstrable change in receptors. However, for this type of accidental event, it is especially important to assess the likelihood of the impact occurring. A review of UKCS historical data relating to hydrocarbon release events confirm that the likelihood of an event like this is remote. Given the mitigation measures that are in place and the remote likelihood of the release happening, the impact is considered **not significant**.

ENVIRONMENTAL MANAGEMENT SYSTEM

NEO's commitment to responsible environmental stewardship is embodied in its *Health, Safety, Environment and Social Responsibility* and *Corporate Major Accident Prevention* policies. NEO have an integrated management system that governs its operations and ensures that the policy commitments are delivered. The environmental components of the management system are routinely assessed to verify that it continues to meet the requirements of the ISO 14001:2015 standard. All operations are required to adhere to the management system to ensure legal compliance, delivery of commitments, and to remain an environmentally responsible operator.

NEO is also committed to supporting the achievement of the Net Zero targets and the OEUK 2035 Roadmap. The scope of the NEO Low Carbon Transition Plan (LCTP) is in alignment with the NSTA (2020) (Stewardship Expectations 11: Net Zero) and covers the organisation and assets.

CONCLUSION

Impacts on the majority of receptors are predicted to be short-term in nature and negligible or minor in magnitude. A worst-case accidental hydrocarbon release may result in an impact of moderate magnitude on seabirds and their associated protected sites.

All activities will be subject to measures to reduce impact either through avoiding impacts occurring, minimising the scale of impacts or mitigation of impacts that are unavoidable.

NEO will ensure that all the measures described in the Affleck Development EIA to minimise and mitigate against environmental impacts are delivered.

Based on the available information to date, it is anticipated that that the proposed Affleck Development will not result in any significant prolonged environmental impacts.

1 INTRODUCTION

1.1 NEO ENERGY

NEO Energy ('NEO') is an independent oil and gas exploration and production company. NEO is the licence operator of P255 which covers UKCS Block 30/19a. NEO holds a 100% operated interest in Block 30/19a.

1.2 OVERVIEW OF THE AFFLECK DEVELOPMENT

NEO is proposing to re-develop the Affleck field via two existing horizontal production wells ('the Development'). While there is the potential for more wells in a future phase of the Development, the scope of this ES does not include the drilling of any wells. Consideration of any additional wells is dependent on the reservoir production performance of the two existing production wells. The existing subsea wells will tie-back to the Judy platform via the proposed Talbot subsea infrastructure, through the use of existing riser, flowlines, umbilical and tie-in structures. On Judy, produced fluids (Affleck/Talbot) will be commingled with other J-Block area fields' (Jade, Jasmine, Joanne and Judy) production and separated into gas and liquids streams.

The produced water will be passed to the Judy produced water treatment system and discharged overboard. Liquids will be transported as part of a commingled stream from the Judy platform into the Norpipe liquids pipeline and thereon to the Norsea Terminal at Teesside, United Kingdom (UK) for processing. Affleck gas will be transported as part of a commingled stream from the Judy platform, into the Central Area Transmission System (CATS) pipeline system and thereon to Teesside, UK for processing.

The United Kingdom Continental Shelf (UKCS) blocks that the Development is situated in are presented in Table 1-1. The layout is shown on the map in.

Table 1-1 UKCS Blocks in which the Development is located

Field/infrastructure	Block
Affleck field	30/19
Affleck pipeline and umbilical	30/19, 30/14, 30/13 & 30/7

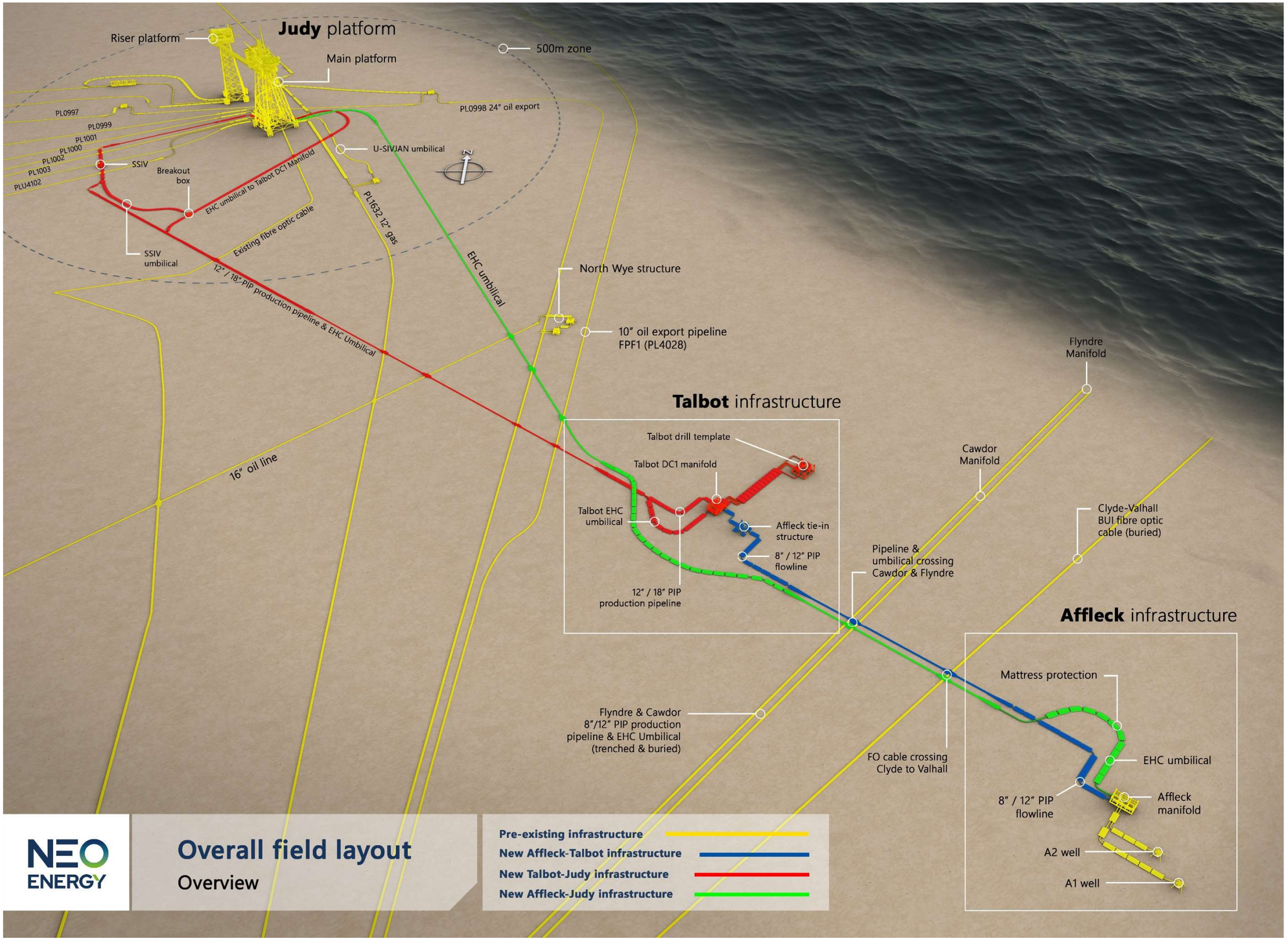


Figure 1-1 Overview of the proposed Development Infrastructure

An indicative schedule of works for the Development is shown in Table 1-2.

Table 1-2 Development Phase 1 Schedule

	2023				2024			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Integrity tests								
Subsea inspection and testing								
Tie-in								
First oil								

1.3 BACKGROUND AND PURPOSE OF THE AFFLECK FIELD DEVELOPMENT

The Affleck field is located in the UK sector of the North Sea, in Block 30/19a, at a depth of approximately 9150 ft True Vertical Depth SS (TVDSS). It was discovered by Shell in 1975 within Block 30/19a-2. Eight exploration and appraisal wells have been drilled on or around the structure, the most recent one being 30/19a-7z on the crest (2003), confirming the oil and gas columns and acquiring comprehensive data.

Two horizontal producer wells were planned in the Field Development Plan (FDP) (Maersk, 2006) and the successful drilling of wells A1 and A2 was achieved in 2007. These wells were tied back to the Janice Floating Production Unit (FPU) via a 28.5 km pipeline. Affleck came on production in mid-2009 and by the end of July 2016 had produced 4.3 million stock tank barrels (mmstb). The Janice FPU ceased production in May 2016 and has been fully decommissioned. Further to the Cessation of Production (CoP) of Janice and associated decommissioning work, the remaining subsea infrastructure at the Affleck drill centre consists of the two production wells (A1 and A2), the Affleck Manifold, and the associated 6" production spools and umbilical well sets. The spools and manifold were flushed as part of the pipeline disconnection scope and have been preserved with appropriate chemicals.

In October 2018 the previous Affleck Operator (TEPUK (now TotalEnergies)) kicked off a Screening Study assessing options available for the redevelopment of Affleck, the main conclusion being that this provides a value opportunity worthy of further analysis. Therefore, the recommendation was to mature Affleck further. The Select Stage study was kicked off in September 2019. Following the selection of Judy Platform as the preferred tie back option in November 2021, the Front End Engineering Design (FEED) study was kicked off to refine the technical work to allow the Final Investment Decision to be made.

NEO now intends to apply for a Development and Production Consent to undertake the Affleck field redevelopment (the "Development").

Note: In Q1 2022, NEO Energy took 100% ownership of the Affleck field.

Information about the Affleck reservoir and fluid characteristics are provided in the Project Description (Section 3.3.1).

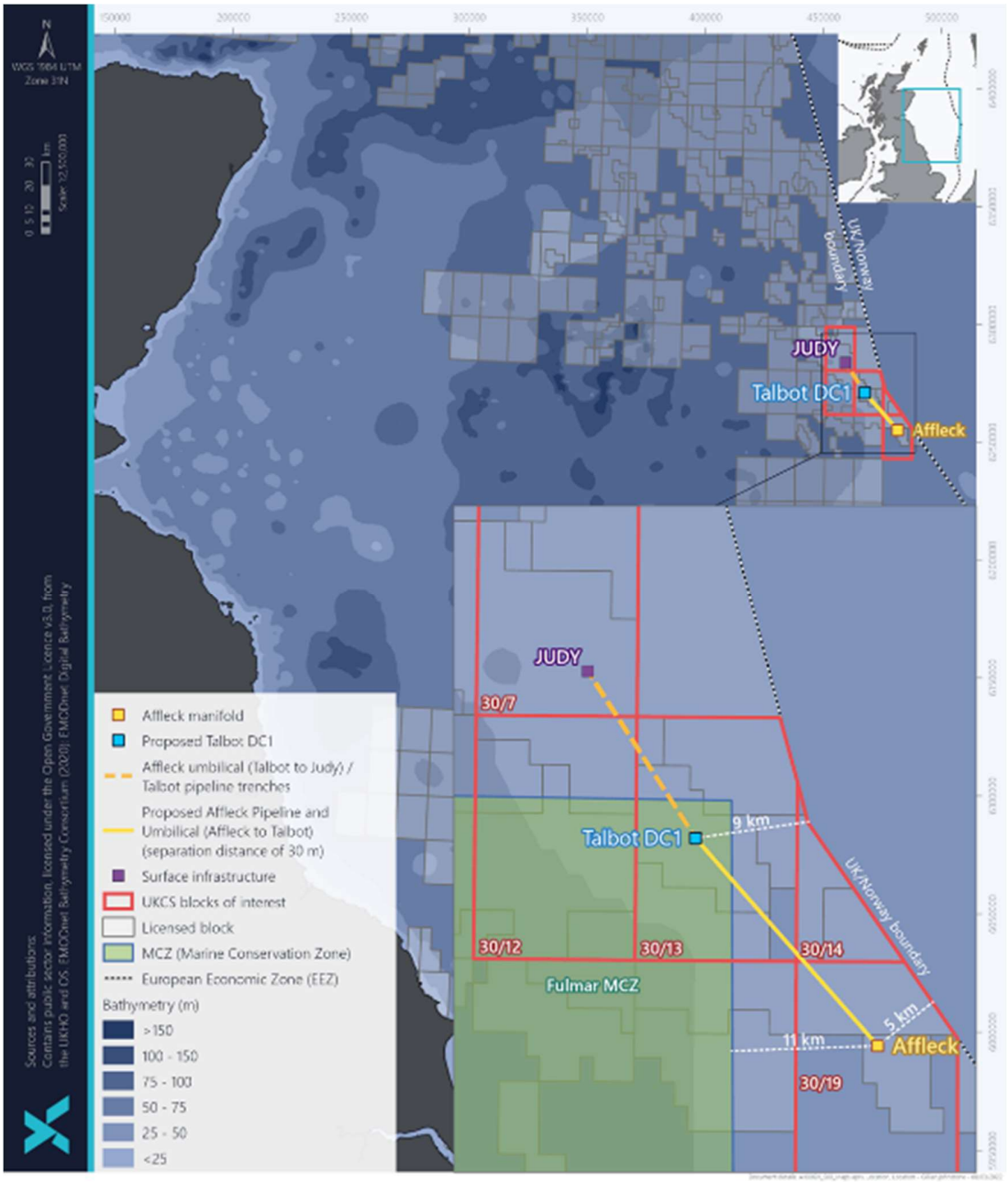


Figure 1-2 Affleck Field location and proposed Development high level layout

1.4 SCOPE OF ENVIRONMENTAL IMPACT ASSESSMENT

The overall aim of the Environmental Impact Assessment (EIA) is to assess the potential environmental impacts (both routine and accidental), that may arise from the Development and to identify the measures that will be put in place to reduce these potential impacts.

The EIA process (see Section 5 EIA Methodology) is integral to the design of the Development, assessing potential environmental impacts and concept alternatives, and identifying design and operational elements

to minimise the potential impacts of the Development as far as reasonably practicable. The process also incorporates stakeholder engagement which allows issues to be addressed at an early stage of design. This ensures that all planned activities comply with legislative requirements and with NEO's Health, Safety and Environment (HSE) policy.

The EIA scope includes installation, commissioning, operational and decommissioning activities of the Development as detailed:

- Installation, commissioning, and operation of subsea infrastructure including wells pipelines, umbilical's and subsea facilities;
- All operational shipping and loading activities occurring within the Development area; and
- Decommissioning of the Development subsea infrastructure including wells pipelines, umbilical's and subsea facilities.

Routine and non-routine activities (such as production upsets) and the risk of accidental events with possible environmental implications are included in the impact identification, assessment, and mitigation process.

The following activities are outside the scope of this EIA as they arise from activities not directly controlled by the Development, but they will be subject to NEO's guiding values and governance and assurance processes as appropriate:

- Pre-construction, maintenance and transport of infrastructure outside the Development area (e.g., at ports);
- The transport of oil once it enters the Norpipe pipeline system;
- Transport of gas once it enters the CATS pipeline system; and
- Further activities that might be undertaken at prospects for which the Development could act as an enabler; such development, should it occur, would be the subject of any necessary additional environmental assessment and approval from Offshore Petroleum Regulator for Environment and Decommissioning (OPRED).

Environmental considerations have been included in the Development decision-making process from the outset (from concept selection and through FEED) and this will continue throughout the Development lifecycle. The Project Description, Section 3 presents more detail about all the areas of the proposed Development with the alterative options considered in Section 2.

1.5 LEGISLATION AND POLICY

1.5.1 Summary of Legislation

The following regulations apply to offshore oil and gas activities and will be elaborated on in the relevant sections of this ES as required:

- **The Offshore Petroleum Activities (Conservation of Habitat) Regulations 2001**. The impacts of a project on the integrity of a protected site from the UK national site network are assessed and evaluated as part of the Habitat Regulations Assessment (HRA) process;
- **The Conservation of Offshore Marine Habitats and Species Regulations 2017** include provisions for the designation and protection of areas that host important habitats and species in the offshore marine area and for the assessment of the impact of offshore oil and gas activities;
- **The Offshore Petroleum Licensing (Offshore Safety Directive) Regulations 2015** include the assessment and management of Major Environmental Incidents;

- **Energy Act 2008**, Part 4A allows the installation of an offshore structure or the carrying out of offshore operations providing they are undertaken in accordance with the consent conditions and with the appropriate navigational markings;
- **Greenhouse Gas Emissions Trading System Regulations 2012** relate to combustion installations with a maximum rated thermal input exceeding 20 megawatts;
- **Greenhouse Gas Emissions Trading Scheme Order 2020** these regulations established the UK Greenhouse Gas ETS effective from 1 January 2021
- **The Offshore Combustion Installations (Pollution Prevention and Control) ('PPC') Regulations 2013** were amended by **the Offshore Combustion Installations (Pollution Prevention and Control) (Amendment) Regulations 2018** and are in relation to specific atmospheric pollutants from combustion installations (with a thermal capacity rating ≥ 50 MW) on offshore platforms;
- **Marine and Coastal Access Act (MCAA) 2009** covers licensable activities relating to decommissioning operations and the use of explosives for ordnance clearance or during decommissioning;
- **The Energy Savings Opportunity Scheme Regulations (ESOS) 2014** is a mandatory energy assessment and energy saving identification scheme applicable to the offshore oil and gas industry sector;
- **The Fluorinated Greenhouse Gases Regulations 2015** aim to protect the environment by reducing emissions of F-Gases in equipment;
- **The Ozone-Depleting Substances Regulations 2015** prohibits and controls the production and use of ozone depleting substances thereby reducing atmospheric emissions of these substances in line with the Montreal Protocol;
- **The Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005** and as amended 2010, 2011, 2016 and 2017 aims to prevent and eliminate pollution by oil and other substances caused by discharges of produced water into the sea;
- **The Offshore Installations (Emergency Pollution Control) Regulations 2002** provide powers to the Secretary of State to prevent and reduce pollution, and the risk of pollution, following an accident involving an offshore installation where there may be significant pollution, or an operator is failing or has failed to implement effective control and preventative operations;
- **The Offshore Chemicals Regulations (OCR) 2002** and amendments (2005, 2010, 2011, 2016 and 2017) for the use and/or discharge of chemicals during all relevant offshore energy activities, including well operations, production operations, pipeline operations, and decommissioning operations; and
- **The REACH Enforcement Regulations 2008** contain certain provisions from the OCR, so effectively the OCR are the mechanism for supporting the application of environmental protection elements of REACH to offshore installations.

The regulatory requirements result in key environmental approvals required for the Development, including:

- Master Application Template (MAT) for Environmental Impact Assessment direction;
- Subsidiary Application Template (SAT) Permits for:
  - oil and produced water discharge;
  - chemical use and discharge; and
  - consent to locate.
- Oil Pollution Emergency Plans;
- UK Emissions Trading Scheme Permit;
- PPC permit for combustion equipment;

- Pipeline Works Authorisation; and
- Deposit of Materials Consent.

Several other key regulatory drivers and requirements are applicable to the Development including:

- **The Marine Strategy Regulations 2010** providing a UK-wide framework to put in place measures to achieve or maintain good environmental status (GES) in the marine environment;
- **The Marine and Coastal Access Act 2009** requires the potential for significant risk to the conservation objectives of Marine Conservation Zones (MCZs) being achieved to be assessed;
- **The Merchant Shipping (Prevention of Pollution by Garbage from Ships) Regulations 2020** implement the Annex V to the International Convention for the Prevention of Pollution from Ships, 1973, as amended by the Protocol of 1978. Annex V contains regulations for the Prevention of Pollution by Garbage from Ships;
- **The Merchant Shipping (Prevention of Pollution by Sewage from Ships) Regulations 2020** implement Annexes IV (Regulations for the Prevention of Pollution by Sewage) and V (Regulations for the Prevention of Pollution by Garbage) of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating to that Convention. They concern, among other things: surveys to be carried out and Sewage Certificates; the prohibition the disposal of plastics into the sea; and powers of inspection and detention of ships;
- **The Merchant Shipping (Prevention of Air Pollution from Ships) Regulations 2008 (as amended)** implement Annex VI (Regulations for the Prevention of Air Pollution from Ships) of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978. The Regulations, among other things: provide for control emissions of ozone-depleting substances, nitrogen oxide and sulphur oxide; provide for the survey and certification of ships; make provision in relation to powers of inspection and detention of ships;
- **The Merchant Shipping (Oil Pollution Preparedness, Response Co-operation Convention) (Amendment) Regulations 2015** setting requirements for a Shipboard Oil Pollution Emergency Plan (SOPEP) setting out arrangements for responding to incidents that cause marine pollution by oil;
- **Environmental Protection Act (1990)** requires persons concerned with controlled waste are under a duty of care, to ensure that waste is managed properly, recovered or disposed of safely, does not cause harm to human health or pollution of the environment and is only transferred to someone who is authorized to receive it. This duty applies to any person, who produces, imports, carries, keeps, treats, or disposes of controlled waste or as a broker has control of such waste; and
- **Radioactive Substances Act 1993 (RSA 93)** as superseded by **the Environmental Authorisations (Scotland) Regulations 2018** requires the operator to have authorisation from SEPA for the accumulation, storage or disposal of radioactive waste or be able to demonstrate compliance with the conditions contained in specific exemption orders.

1.5.2 Environmental Impact Assessment

The key piece of environmental legislation for the Development is The Offshore Oil and Gas Exploration, Production, Unloading and Storage (Environmental Impact Assessment) Regulations 2020 (EIA Regulations), with associated guidance[1]. The EIA and the submitted ES is the means whereby the Secretary of State is assured that the environmental implications of the proposed Development have been properly considered and, subject to all other requirements being satisfied, the Secretary of State can agree that consent for the project can be granted by the North Sea Transition Authority (NSTA), formerly the Oil

[1] *https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1005109/The_Offshore_Oil_and_Gas_Exploration_Production_Unloading_and_Storage_Environmental_Impact_Assessment_Regulations_2020_-_A_Guide_July_2021.pdf*

and Gas Authority (OGA), via a Production consent. An EIA is mandatory for the Development as it is expected to produce more than 500 tonnes (Te) of oil per day or more than 500,000 m^3 gas per day.

OPRED regulates the environmental aspects of offshore oil and gas activities with statutory advisors including Marine Scotland, the Joint Nature Conservation Committee (JNCC) and the Scottish Fishermen's Federation (SFF). Approval of the ES by OPRED is required before approval can be granted to the FDP by the NSTA under the Petroleum Act 1998.

The EIA summarised in this ES has been undertaken in accordance with the above legislation and in line with the latest OPRED Guidance, issued 31st December 2020. The EIA Regulations require that consideration be given to the likely significant impacts of a project on the environment.

1.5.3 Energy Transition and Net Zero Context

As widespread concern has increased about the impact of climate change, so has the acknowledgement that timely action is required to address the global rise in temperature. The Paris Agreement (adopted in 2015; in force 2016) under the United Nations Framework Convention on Climate Change (UNFCCC) relating to Greenhouse Gas (GHG) emissions mitigation, adaptation and finance provides for all signatories to keep the increase in global average temperature to well below 2°C above pre-industrial levels, and to pursue efforts to limit the temperature increase to 1.5°C (UNFCCC, 2016). In line with Article 4 of the Paris Agreement, the UK has submitted a Nationally Determined Contribution (NDC) which commits the UK to reducing economy-wide GHG emissions by at least 68% by 2030, compared to 1990 levels.

To facilitate achievement of the NDC commitments, target dates were set for when the UK, including Scotland, would achieve a net balance of zero emissions (the net zero targets). The UK government set a legally binding target for the UK to reduce its greenhouse gas emissions from 1990 levels by 100% by 2050 (The Climate Change Act 2008 (2050 Target Amendment) Order 2019). In Scotland, the target year was set as 2045 via the Climate Change (Emissions Reduction Targets) (Scotland) Act 2019. The net zero targets are supported by a system of legally binding five-year 'carbon budgets and an independent body, the Climate Change Committee (CCC), to monitor progress. The UK carbon budgets restrict the amount of GHG emissions the UK can legally emit in a defined five-year period. In 2020, the 6th carbon budget was published by the CCC for consideration by Government and is the first budget to reflect the amended trajectory to 2050.

The UK Net Zero Strategy: Build Back Greener (October 2021) outlines policies and proposals for decarbonising all sectors of the UK economy to meet our carbon budgets and net zero emissions target by 2050 (and 2045 in Scotland) as follows:

- Sets out the government's vision for a prosperous, low carbon UK industrial sector in 2050.
- Provides industry with the long-term certainty it needs to invest in decarbonisation.

The Energy White Paper Powering our Net Zero Future and the UK 10 Point Plan for a Green Industrial Revolution embeds the UK Net Zero emissions strategy by describing how the transition to clean energy can be achieved by 2050. To support the Energy White Paper and the Industrial Decarbonisation Strategy requirement, the NSTA revised the oil and gas sector specific Maximising Economic Recovery Strategy to include the following central obligation with underpinning requirements:

"Relevant persons must, in the exercise of their relevant activities, take the steps necessary to:

- *secure that the maximum value of economically recoverable petroleum is recovered from the strata beneath relevant UK waters; and, in doing so,*

- *take appropriate steps to assist the Secretary of State in meeting the net zero target, including by reducing as far as reasonable in the circumstances greenhouse gas emissions from sources such as flaring and venting and power generation, and supporting carbon capture and storage projects."*

The revised Strategy, which came into force on 11th February 2021, reflects the ongoing energy transition and features a range of net zero obligations for the oil and gas industry, including increasing efforts to reduce production emissions, support carbon capture and storage (CCS) projects and unlock clean hydrogen production. The revised guidance on the development of fields demonstrates where the Net Zero requirements are embedded in the NSTA assessment and approvals process. In addition, the NSTA expects the following requirements in relation to emissions from flare and vent sources:

- "*flaring and venting and associated emissions should be at the lowest possible levels in the circumstances;*
- *zero routine flaring and venting for all by 2030; and*
- *all new developments should be planned and developed on the basis of zero routine flaring and venting*."

The North Sea Transition Deal (BEIS, 2021a) introduced a sector deal between the UK government and the offshore oil and gas industry. The sector deal supports and anchors the expert supply chain that has built up around oil and gas in the UK, to both safeguard and create new high-quality jobs. The Deal will transform the sector in preparation for a net zero emissions future and catalyse growth throughout the UK economy ensuring a just transition of the energy sector.

The oil and gas industry, through the Offshore Energies UK (OEUK, previously Oil and Gas UK (OGUK)), has developed the 'Roadmap 2035: A Blueprint for Net Zero' (https://roadmap2035.co.uk/) in which the industry outlines the role the sector can play in decarbonisation.

1.5.4 Scotland's National Marine Plan

Scotland's National Marine Plan (Scottish Government, 2015) provides an overarching framework for marine activity in Scottish waters out to 200 nautical miles (3,704 km). The aim of the marine plans is to enable sustainable development and the use of the marine area in a way that protects and enhances the marine environment, whilst promoting both existing and emerging industries. The plan includes a core set of general policies which apply across existing and future development and use of the marine environment. The general objectives and policies of the national plan, together with their relevance and degree to which the Development is aligned, are outlined in Table A-1 in Appendix A. The application of the sector specific marine plans is also presented in Table A-1 in Appendix A for the following sectors:

- Sea fisheries;
- Aquaculture;
- Wild salmon and diadromous fish;
- Oil and gas;
- CCS;
- Offshore Wind and Renewable Energy;
- Recreation and tourism;
- Shipping, ports, harbours, and ferries;
- Submarine cables; and
- Defence.

1.5.5 North East Inshore and Offshore Marine Plan

The Affleck pipeline and the southern section of the Affleck umbilical overlaps with the North East Offshore marine area, which is located adjacent to the North East England Coastline, extending from the 12 NM limit out to the UK Exclusive Economic Zone (EEZ). The North East Inshore and Offshore Marine Plan (DEFRA, 2021a) encompasses the North East Inshore Marine Plan and the North East Offshore Marine Plans. The Marine Plan aims to enhance and protect the marine environment and achieve sustainable economic growth, whilst respecting local communities both within and adjacent to the marine plan areas.

The key principles of the Marine Plan policies considered relevant to the Development are summarised in Table A-2 in Appendix A, along with comment on the degree to which the Development is aligned with these.

1.6 ENVIRONMENTAL STATEMENT STRUCTURE

The scope of the EIA was developed in conjunction with stakeholders; full details of the process applied during the assessment are provided in Section 5, EIA Methodology and the results of the assessment are summarised in this ES. The ES is submitted to OPRED to inform the decision on whether the Development may proceed, based on the residual levels of potential impact, and will be subject to formal public consultation.

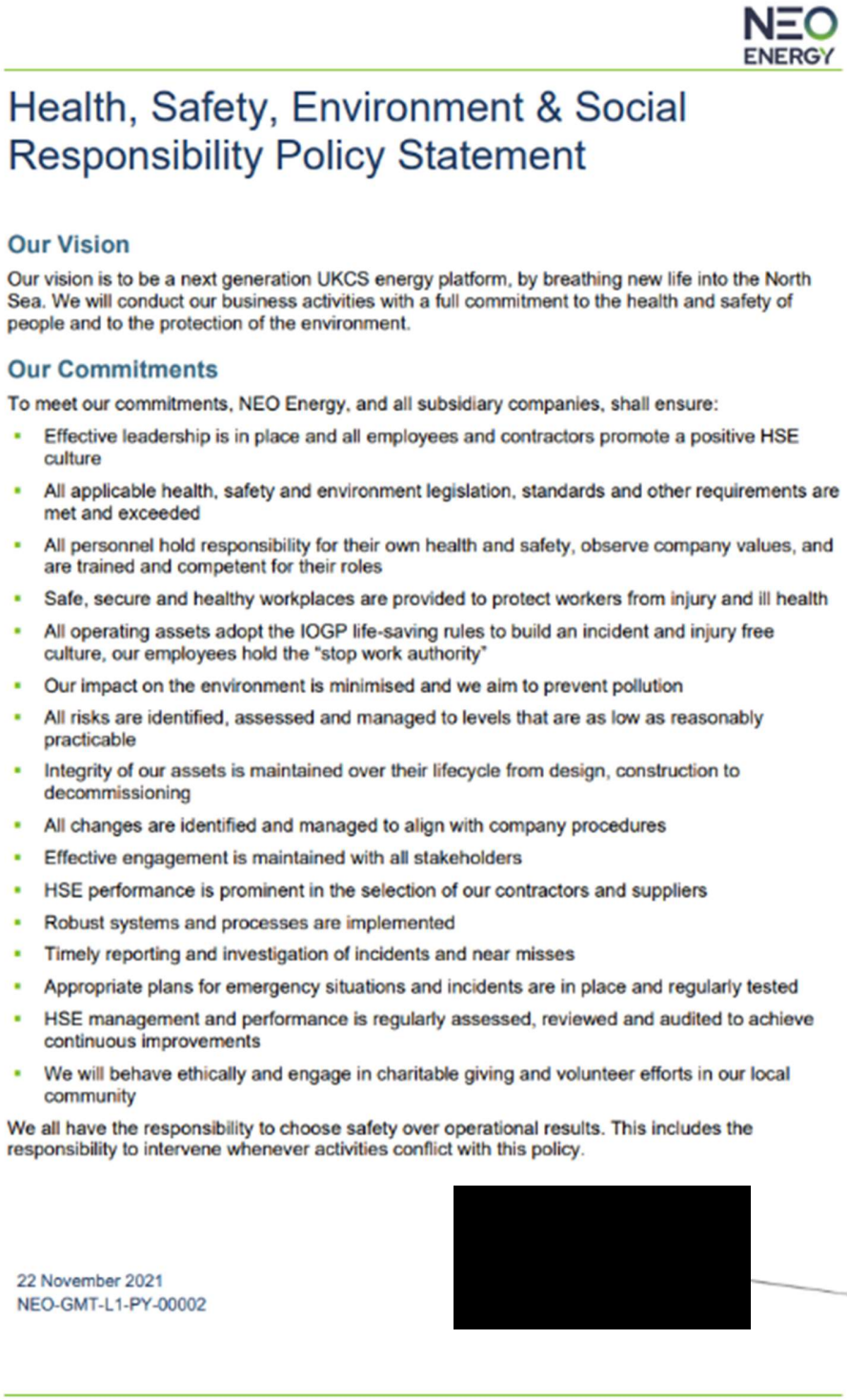
Key elements of this ES include the following:

- A non-technical summary:
- Introduction including background, scope of the Development, legislation and policy context (this Section);
- Project Description (Section 2);
- Environmental baseline and identification of the key environmental sensitivities which may be impacted by the Development (Section 4);
- EIA Methodology, describing the methods used to identify and evaluate the potential environmental impacts (Section 5);
- Detailed assessment of potential impacts, including cumulative and transboundary impacts (Section 6 to 11);
- Description of NEO's environmental management system (EMS) including delivery of Net Zero requirements (Section 12);
- Conclusions (Section 0); and
- References (Section 14).

1.7 ENVIRONMENTAL MANAGEMENT

NEO manages the activities according to the NEO environmental management system (as modified to reflect local conditions and regulations) and best industry practices. NEO aims to ensure procedures are followed during the proposed activities and that continual improvement in environmental performance is always maintained. The NEO HSE & Social Responsibility (SR) policy is shown in Figure 1-3.

Further detail on NEO's environmental management is provided in Section 12.



NEO ENERGY

Health, Safety, Environment & Social Responsibility Policy Statement

Our Vision

Our vision is to be a next generation UKCS energy platform, by breathing new life into the North Sea. We will conduct our business activities with a full commitment to the health and safety of people and to the protection of the environment.

Our Commitments

To meet our commitments, NEO Energy, and all subsidiary companies, shall ensure:

- Effective leadership is in place and all employees and contractors promote a positive HSE culture
- All applicable health, safety and environment legislation, standards and other requirements are met and exceeded
- All personnel hold responsibility for their own health and safety, observe company values, and are trained and competent for their roles
- Safe, secure and healthy workplaces are provided to protect workers from injury and ill health
- All operating assets adopt the IOGP life-saving rules to build an incident and injury free culture, our employees hold the "stop work authority"
- Our impact on the environment is minimised and we aim to prevent pollution
- All risks are identified, assessed and managed to levels that are as low as reasonably practicable
- Integrity of our assets is maintained over their lifecycle from design, construction to decommissioning
- All changes are identified and managed to align with company procedures
- Effective engagement is maintained with all stakeholders
- HSE performance is prominent in the selection of our contractors and suppliers
- Robust systems and processes are implemented
- Timely reporting and investigation of incidents and near misses
- Appropriate plans for emergency situations and incidents are in place and regularly tested
- HSE management and performance is regularly assessed, reviewed and audited to achieve continuous improvements
- We will behave ethically and engage in charitable giving and volunteer efforts in our local community

We all have the responsibility to choose safety over operational results. This includes the responsibility to intervene whenever activities conflict with this policy.

[redacted]

22 November 2021
NEO-GMT-L1-PY-00002

Figure 1-3 NEO's Health, Safety, Environment & Social Responsibility (HSE&SR) Policy

1.8 STAKEHOLDER CONSULTATION

Consultation with statutory bodies and other interested parties is an important part of assessing the environmental impacts of a proposed project. The aim of the Development consultation process ensures that the views of key stakeholders are identified early on in the EIA process, and that communication is maintained as necessary throughout the EIA process. Further information on consultation undertaken for the Development is provided in Section 5.3.

1.9 DATA GAPS AND UNCERTAINTIES

A number of assumptions have been made to define a basis for impact assessment, since there is still design development and optimisation work ongoing regarding some of the Development specifics. However, the ES has assumed the 'worst case' scenario for impact assessment, and these assumptions are detailed within the Project Description (Section 3) and within the relevant assessment chapters.

2 CONSIDERATION OF ALTERNATIVES

2.1 SCREENING OF REDEVELOPMENT OPTIONS AND RATIONALE

The Affleck field is a significant hydrocarbon resource with an estimated total hydrocarbon content of 752 million barrels (P50 STOIIP[2]), which is approximately 102,000,000 Te.[3] In consideration of how to develop this opportunity, a high-level screening study of the Affleck field redevelopment options were undertaken. The high-level redevelopment options under consideration were:

- New standalone facility;
- Subsea processing;
- Subsea tie-back to other facilities;
- Joint development with other fields/discoveries; and
- Not to re-develop the Affleck field

This broad suite of re-development options was primarily screened against their technical feasibility, commercial viability and environmental impacts.

2.1.1 New Standalone Facility

The option of a new standalone facility was ruled out at the early stages of the screening process as this was not considered to be economically viable based on the remaining reserves of the Affleck field.

2.1.2 Subsea processing

Possible subsea processing options were identified including multi-phase boosting, subsea separation, and wet gas compression. However, these options were all essentially assessed as requiring a host facility to provide final processing to export quality specifications and also the power, monitoring etc required for their operation. As such, it was concluded that there was no technical or commercial driver to consider Subsea Processing either instead of or in addition to a subsea tie-back.

2.1.3 Subsea tie-back

A subsea tie-back to a host facility was intuitively a key concept for the redevelopment of Affleck. This was the option selected when the field was originally sanctioned for development. This concept is technically mature and, given there are a number of potential hosts in the vicinity, was recognized as being the most cost-effective option with shortest schedule to first oil.

2.1.4 Joint developments with other fields

The potential for a joint development was considered in the evaluation phase.

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[2] *The P50 estimate is the 'central estimate'; there is a 50% probability of the relevant parameter being greater than the P50 estimate and a 50% probability of the relevant parameter being less than the P50 estimate. The total hydrocarbon content of an oil reservoir is often referred to as the Stock Tank Oil Initially in Place (STOIIP), referring to the oil in place before the commencement of production. This should not be confused with oil reserves, which are the technically and economically recoverable portion of oil volume in the reservoir.*

[3] *Assumes a barrels to tonnes conversion of 0.1364.*

2.1.5 Not to redevelop Affleck Field (do nothing option)

It is recognized that not developing the field further would reduce the environmental impacts to those associated with the Plug and Abandonment of the existing Affleck wells and the removal of the trees, spools and manifold. However, the do-nothing option for the redevelopment of the Affleck field was discounted due to the continued need for secure energy supply during the UK energy transition and the replacement of imports with national hydrocarbon supply. High level review of environmental impact of the tie-back option assessed the environmental impact from developing the field and determined that the project was unlikely to have any significant effects on the environment.

Whilst the country transitions to new low carbon feedstocks, production from crude oil will need to continue. This has been further exacerbated by the current geo-political climate, which has caused a wave of uncertainty surrounding the supply of hydrocarbons both within the UK and abroad. The key issues for the UK are how to produce or import these hydrocarbons with the least environmental impact (e.g., low carbon intensity and high levels of sustainability in the supply chain) whilst maintaining a diversified supply network which ensures security of supply. The Digest of UK Energy statistics for 2020 (DUKES) indicates that production of primary oil by the UK totalled 49,362 kt, with a further 39,309 kt imported. The UK exported 39,857 kt of oil (net exports 547 kt crude oil) with the net oil production used by the petrochemical industry as raw material. UK refinery throughput was 48,233 Kt of crude oil with the UK being a net importer of oil products of 5,332 kt. These statistics highlight the continued need for national oil production to reduce reliance on imports. Furthermore, the recent British Energy Security Strategy (2022) highlights the need to "fully utilise our great North Sea reserve" in order to reduce the UK´s reliance on imported fossil fuels. The strategy also seeks to drive rapid industry investment in electrifying offshore production, meaning that the UK will be in a position to use and export lower carbon oil and gas than other countries.

In 2015, the UK refined 95% of the crude it produced in just six refineries which produced a combined average of 0.78 Mbbl/d, placing the UK in 23rd position out of 66 countries refining oil based on production volume (Jing *et al.*, 2020). UK Domestic processing, terminals and refining provides a national oil supply which minimizes tanker transport emissions and produces the required raw material with a carbon intensity in the bottom third of international production and refinery emissions. National production avoids carbon leakage and maintains domestic regulatory control of emissions and energy use, in line with the UK transition to Net Zero emissions, the UK Nationally Determined Contributions and The Energy White Paper.

The production from Affleck will contribute to the continued national need for hydrocarbon production in the short-term. NEO commits to producing this field in alignment with the NSTA Net Zero Stewardship Expectation 11 (NSTA 2021), which is designed to give operators and licensees clarity on expected behaviours and good practices. Expectation 11 focuses on the following areas:

- Creating a culture of GHG emissions reduction within the UKCS;
- Ensuring that GHG emissions reduction is considered throughout the entire oil and gas lifecycle; and
- Collaboration between all relevant parties to support and progress potential energy integration developments (such as electrification).

Chapter 10 quantifies the emissions anticipated as a result the Development across the entire oil and gas lifecycle and assesses the potential impacts of CO_2e and climate change, (as well as other atmospheric pollutants). Collaborative efforts towards electrification are also discussed. Any significant environmental risks and impacts are managed in line with regulatory requirements and the NEO Low Carbon Plan (NEO Energy, 2021).

2.2 OUTCOME OF INITIAL SCREENING

The outcome of the initial high-level screening identified that a subsea tie-back (Section 2.1.3), potentially in combination with a joint development were the most technically feasible and commercially viable opportunities to redevelop the Affleck field. Furthermore, it was deemed that pursuing the Development presented worthwhile societal benefits when balanced against the anticipated incremental environmental impacts that such a redevelopment would incur.

2.3 SUBSEA TIE-BACK OPTIONS

As part of the concept select process, screening of seven potential tie-back/host options was undertaken which considered key technical constraints and opportunities (Table 2-1, Figure 2-1). Following the screening of the potential hosts, the Flyndre, Clyde and Judy Operators were engaged to clarify Affleck's likely capacity, CoP and other key host characteristics. The outcomes presented in Table 2-1 confirmed that the focus for any further work should be on the Clyde and Judy host options.

Table 2-1 Technical evaluation of potential tie-back and Host options

Host	Distance from Affleck	Screening considerations	Opportunity	Selected for further work
Clyde via Cawdor Manifold	13.5 km	▪ Cawdor manifold installed as part of Flyndre/Cawdor project. Assumed spare slot available; ▪ Early CoP (based on Clyde); ▪ Limited gas capacity available; ▪ Oil production and produced water capacity; and ▪ Fluids commingled with Flyndre and routed to Clyde for processing via 20 km Pipe in Pipe (PiP).	▪ Gas export to SEGAL; ▪ Oil export to NORPIPE; and ▪ Clyde Infrastructure Code of Practice (ICOP) suggests >4,400 barrels of oil per day (bopd) and >2,500 barrels of water per day (bwpd) capacity.	Yes
Clyde via Flyndre Manifold	14 km	▪ All issues as per Cawdor manifold tie-in; and ▪ No obvious driver to consider in preference over Cawdor manifold.	As above	No
Clyde via Orion Manifold	10.5 km	▪ Fluids routed to Clyde for processing via 16 km wet insulated tie-back; ▪ Limited gas capacity available; ▪ Flow assurance issues potentially in existing line; and ▪ Previous Affleck study work predicted arrival conditions at Clyde below hydrate and wax formation temperatures.	▪ Oil production and produced water capacity; and ▪ Shorter distance than tie-back via Cawdor or Flyndre.	No
Clyde Direct	25.5 km	▪ Limited gas capacity available; ▪ Assumed no spare risers available at Clyde; and ▪ Likely to be higher CAPEX than other options for routing to Clyde with no obvious benefit.		No
Fulmar	35 km	▪ Likely to be higher CAPEX than other options; and ▪ no obvious benefit.		No
Auk	40 km	▪ No gas export route; and ▪ Early CoP.		No
Judy	35 km (Direct)	▪ Potentially higher CAPEX than other options but with key differentiators.	Key differentiators: ▪ Later CoP (2037);	Yes

Host	Distance from Affleck	Screening considerations	Opportunity	Selected for further work
	21 km (Via Talbot) *		▪ Not reliant on Clyde/Fulmar hub; ▪ Gas export to CATS; ▪ Oil to NORPIPE; and ▪ Judy ICOP suggests Gas capacity >112.5 MMSCFD, Oil capacity >25 mbpd, PW capacity 600 - 3000 bpd.	
Alma Galia	27 km	▪ No gas export route; and ▪ CoP 2028.		No
Ekofisk	33 km	▪ Multi-platform complex in Norwegian Sector; and ▪ No obvious benefit perceived.		No
Eldfisk	30 km	▪ Multi-platform complex in Norwegian Sector; and ▪ No obvious benefit perceived.		No

*the 21 km tie-in to Judy via Talbot was part of later option selection refinement.

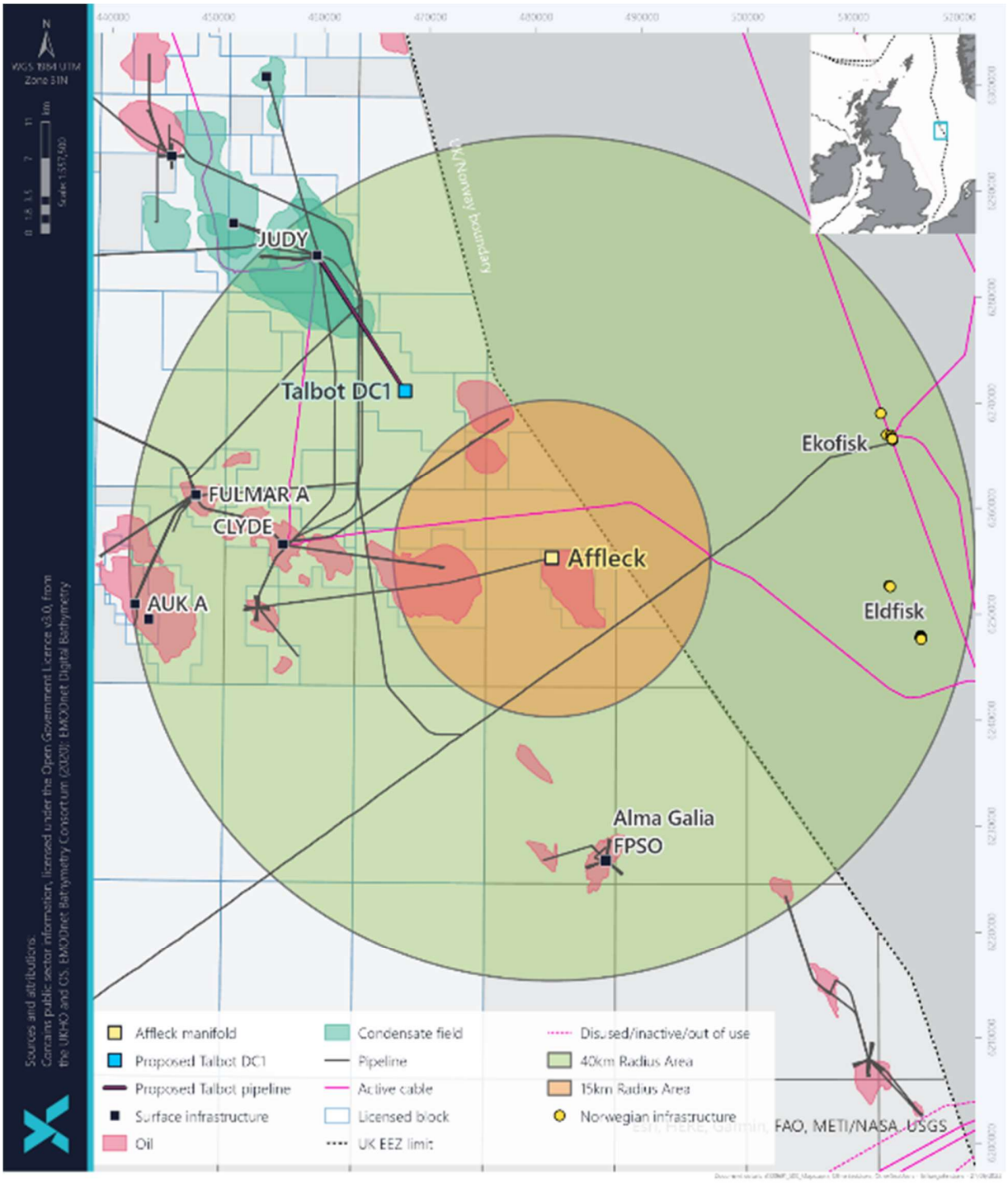

Figure 2-1 Location of host platform tie-in options in relation to Affleck

2.4 EVALUATION OF VIABLE TIE-BACK OPTIONS

The concept select process included an evaluation of potential host installations. As explained in Section 2.3, a subsea tie-back option has been selected for the Development rather than a standalone installation. The concept was technically matured and all potential hosts in the vicinity were screened.

The result of the initial screening narrowed the viable options for the redevelopment down to three:

- Judy via Talbot;
- Judy Direct; and
- Clyde via Cawdor.

These three options were subject to a more detailed evaluation process based on key differentiators, the outcomes of which are described in Table 2-2.

Table 2-2 Evaluation of viable tie-back options

Differentiator	Judy Via Talbot	Judy Direct	Clyde via Cawdor
Technical	Highest Technical ranking.	Slightly lower than Judy via Talbot. Significantly higher than Clyde option.	Lowest ranked of the three options.
Commercial	Slightly lower than Judy direct. Significantly higher than Clyde option.	Highest Commercial Ranking.	Lowest ranked of the three options.
Environmental Impact (See sections 6 to 11)	Lowest overall atmospheric emissions.	Higher emissions during construction phase than Judy via Talbot. Low atmospheric emissions during operations	High emissions compared to other options.
	Moderate seabed footprint.	Moderate / high seabed footprint.	Moderate seabed footprint.
Maximum Economic Recovery (MER)	Significantly superior to all other options.	Indicates a superior MER solution over Clyde.	Affleck erodes value.
Conclusion	Judy is the natural host for the Development. The opportunity via Talbot presented lowest emissions and best option for maximum economic recovery.	Judy is the natural host for the Development. A direct tie-back is considered less preferable than via the Talbot opportunity.	Clyde is not considered as being the natural host for the Development.

The concept select process identified that a subsea tie-back to the Judy Platform, particularly the tie-back via the Talbot development, yields the lowest atmospheric emissions. This concept also presented the most technically feasible option with the greatest economic recovery. For these reasons, the Judy via Talbot

concept offered the most attractive prospect and was selected as the redevelopment concept. Further details on the environmental considerations are provided in the following subsections.

2.5 EMISSIONS ASSESSMENT

As part of the decision-making process during the Select Stage for the selection of the host installation for the Affleck re-development, an assessment was carried out of the comparative emissions between the two potential hosts and impact on the UK Net Zero targets. The assessment considered emissions from 2024 to 2030. In later chapters the CoP of Affleck is shown to extend beyond 2030. This date was used at the time for comparative purposes only and some of the emissions data pertaining to Judy may differ to later chapters as the project has progressed and better estimates have been gathered. The host options considered were a tie-back to Clyde versus a tie-back to Judy. The Judy host option included both the direct tie-back to the installation and a tie-back via the Talbot subsea infrastructure. The primary comparison was undertaken by reviewing the total emissions for the three options expressed as Te of CO_2 equivalents (tCO_2e) and the carbon intensity (as $ktCO_2/mmboe$ i.e., $kgCO_2e/boe$). A summary of the outcomes is provided in Table 2-3, in which green cells denote the preferred host for each category.

Clyde is due for CoP in the near future and certainly within the time frame of Affleck production. The imminent CoP of Clyde would result in the large combustion plant running on Clyde to support combined Affleck and Clyde production. Even with CoP extended to 2030, the incremental emissions at Clyde due to Affleck would be 984,548 tCO_2e. That increase is considerably greater than the equivalent for a direct tie-back to Judy (15,715 tCO_2e) or a tie-back to Judy via Talbot (13,216 tCO_2e).

The Talbot project is forecast to make a small increase in emissions at Judy. The ownership of Talbot and Judy are aligned and therefore Talbot emissions may be considered Base Host emissions which would revise the incremental emissions due to Affleck over the period to 2030 from 15,715 to 13,216 tCO_2e. If this increase in Judy Base Host emissions is ignored, then a tie-back to Judy via Talbot is observed to result in an additional 4,269 tCO_2e gross emissions over the period to 2030 compared to a direct tie-back to Judy.

Table 2-3 Net Zero Assessment Summary (green cells denote preferred host for each category)

<table>
<tr><th></th><th colspan="2">Clyde</th><th colspan="2">Judy</th></tr>
<tr><td rowspan="2">CO2e emissions during Development execution</td><td colspan="2">Clyde tie-back.

Total 6,131 tCO2e.</td><td>Direct tie-back to Judy.

Total 12,838 tCO2e.</td><td>Affleck to Judy via Talbot.

Total 8,224 tCO2e.</td></tr>
<tr><td colspan="4">Reducing emissions during Development execution is important but the saving is considered low in the context of the overall life of field emission.</td></tr>
<tr><td rowspan="2">Host installation annual tCO2e emissions from 2018 to 2020</td><td colspan="2">Clyde (including allocation of Fulmar) average annual gross emissions:

256,411 tCO2e.</td><td colspan="2">Judy average annual gross emissions.

241,841 tCO2e.</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td rowspan="2">Host installations forecasted annual tCO2e emissions with and without Affleck</td><td>Clyde base.

Total emissions to 2030: 896,962 tCO2e.</td><td>Clyde + Affleck.

Total emissions to 2030: 1,881,510 tCO2e.</td><td>Judy base.

Total emissions to 2030: 2,397,775 tCO2e.</td><td>Judy base + Affleck Direct.

Total emissions to 2030: 2,413,490 tCO2e.</td></tr>
<tr><td colspan="2">Increase in total emissions due to Affleck to 2030: 984,548 tCO2e.</td><td colspan="2">Increase in total emissions due to Affleck to 2030: 15,715 tCO2e.</td></tr>
</table>

	Clyde	Judy
	Affleck via Clyde results in an appreciable increase in emissions due to the deferment of Clyde's CoP and the Affleck production going through Clyde. Affleck via Judy would have a small overall impact on total platform emission over the period assessed (circa 1%).	
Host Installation annual carbon intensity (ktCO2e/mmboe) 2018 –2020	Clyde's average carbon intensity: 75 ktCO2e / mmboe.	Judy's average carbon intensity: 16 ktCO2e / mmboe.
	The difference is significant, Judy outperforms the industry average of 21 ktCO2e and Clyde is 3 to 4 times greater. Judy contributes significantly to lower emission per barrel than Clyde for the Affleck production.	

The carbon intensity of the various options is presented in Table 2-4. Clyde base case has a much higher carbon intensity (75 kg CO2e/boe) than that for Judy (16 kg CO2e/boe). Post 2021 the carbon intensity of the production of Clyde is forecast to be about 4 times larger without the Affleck fluids. The 2020 carbon intensity for large platforms in the CNS ranges between 12 and 132 kg CO2e/boe (Oil and Gas Authority, 2020b). Clyde emissions are at the higher end of this range whilst Judy emissions are at the lower end, indicating that Judy is amongst the most efficient platforms processing hydrocarbons in the Central North Sea. The inclusion of Affleck and Talbot with Judy improves the efficiency of Judy production in the late 2020s by reducing the carbon intensity by 6 kg CO2e/boe to 21 kg CO2e/boe. The Affleck fluids also improve the carbon intensity of Clyde bringing the overall carbon intensity to an estimated 70 kgCO2e/boe.

Partial electrification of Judy is under consideration and managed by Harbour as part of the Operator's stewardship expectations. The reduction in emissions due to the partial electrification would result in a proportional decrease in carbon intensity for Affleck via Judy.

Table 2-4 Carbon Intensity Comparison of the Tie-back options

Host	Period	Basecase Description	Average Annual Carbon Intensity+ (kg CO_2e/boe)	Incremental emissions due to Affleck (t CO_2e)
Clyde	2018-2020	Clyde only	75	-
	2021-2025	Clyde only	103	-
	2023-2030	Clyde + Affleck via Cawdor	70	984,584
Judy	2018-2020	Judy only	16	-
	2021-2030	Judy only	27	-
	2024-2030	+ Affleck direct	25	15,715
	2021-2030	+ Talbot and Affleck via Talbot	21	13,216

The embodied carbon in the subsea design would differ between the Clyde (via Cawdor) and Judy (via Talbot) tie-back options due to the different distances from Affleck to the tie-back locations; 21 km Affleck to Talbot and 13.2 km Affleck to Cawdor. The subsea infrastructure designs would differ only in the lengths of 8"/12" PiP flowline and control umbilical required (all other design elements would remain the same), with the shorter Clyde option also requiring less vessel time (and therefore emissions) to install.

Development installation phase vessel emissions were quantified as 6,131 tCO_2e for the Clyde option and 8,224 tCO_2e for the Judy option thus making Clyde the lower emissions option. However, when the saving of execution phase emissions is offset against the life-of-field emissions resulting from selecting Clyde as the host, this saving becomes insignificant.

In summary, the selection of Judy via Talbot as the tie-back host for Affleck was preferred because:

- Judy has a lower carbon intensity to Clyde both historically (Judy is one of the lower carbon intensity CNS large platforms) and at all forecast phases of the proposed development;
- Gross emissions from Judy with Affleck are significantly lower than Clyde with Affleck; and
- No additional export pipeline from Judy is required to accommodate the Affleck production.

Judy has a number of ongoing projects that will further enhance the carbon efficiency of the development including the tie-back of Talbot to Judy and the ongoing Judy partial electrification project.

The development of Affleck via Clyde was found to result in a significant increase in emissions due to the deferment of the CoP of the Clyde facility. The selected concept of Affleck via Judy has a small overall impact on total platform emission over the period assessed (circa 1%).

2.6 CONSIDERATION OF SEABED IMPACTS

In addition to the Net Zero assessment, NEO has also taken into account the associated environmental effects to the seabed between the two primary Affleck tie-in options to the Clyde platform and Judy platform. This represents the most significant physical impact resulting from the development options reviewed as part of the consideration of alternatives. The key differentiator in terms of seabed impact between options is the final overall footprint, the location of the footprint and the level of disturbance in relation to areas or species of conservation concern (Table 2-5). Of particular concern is the location of relevant infrastructure and host assets within the Fulmar MCZ (Figure 2-2). This table provides a preliminary estimate of the seabed impact between the two options. Since Judy was selected as host, the Development has matured. Based on the assumption that selecting Clyde as a host would have likewise resulted in project changes, for the purposes of comparison, the seabed impact analysis has assumed new umbilicals to both assets.

Table 2-5 Initial environmental differentiations for host selection

Environmental Differentiator	Clyde	Judy
Length of potential footprint/ Distance from Affleck field	38 km. Pipeline Affleck to Cawdor - 13 km. Umbilical Affleck to Clyde - 25 km.	58 km. Pipeline Affleck to Talbot - 21 km. Umbilical Affleck to Judy - 37 km.
Number of infrastructure components required/ estimated area Estimated total Area	Affleck Manifold (125 m^2). Affleck Tie in structure at Cawdor (90m^2). In total - 215 m^2.	Affleck Manifold (125 m^2). Affleck Tie in structure at Talbot (90 m^2). In total - 215 m^2.
Is there infrastructure or pipelines running through any habitats of conservation concern or known conservation objectives i.e., Fulmar MCZ	Yes	Yes
Estimated length of potential footprint within conservation zones	Umbilical 14 km. Pipeline 0 km. Total 14 km.	Umbilical 7 km. Pipeline 4 km. Total 11 km.
Initial prediction of rock placement requirements (inc. likely crossings)	Estimated 21,718 Te.	Estimated 57,800 Te.
Estimated rock requirement in MCZ	Approximately 5,073 Te based on requirements for two crossings of umbilical.	Approximately 4,568 Te for contingency Pipeline Upheaval buckling (UHB) (no crossings).
Likely method of installation	Reel lay, trench and bury	Reel lay, trench and bury
Preferred Option	Of the two options, the Clyde option has the greater overall impact within the MCZ. The long-term environmental footprint from rock placement within the MCZ was assessed to be similar for both options with slightly more rock predicted to be required for the crossings within the MCZ for the Clyde option than UHB for the Judy option. Therefore, from a seabed impact perspective, the Judy tie-back option is considered to have slightly less of an environmental impact to conservation zones and thus the preferred option from that perspective.	

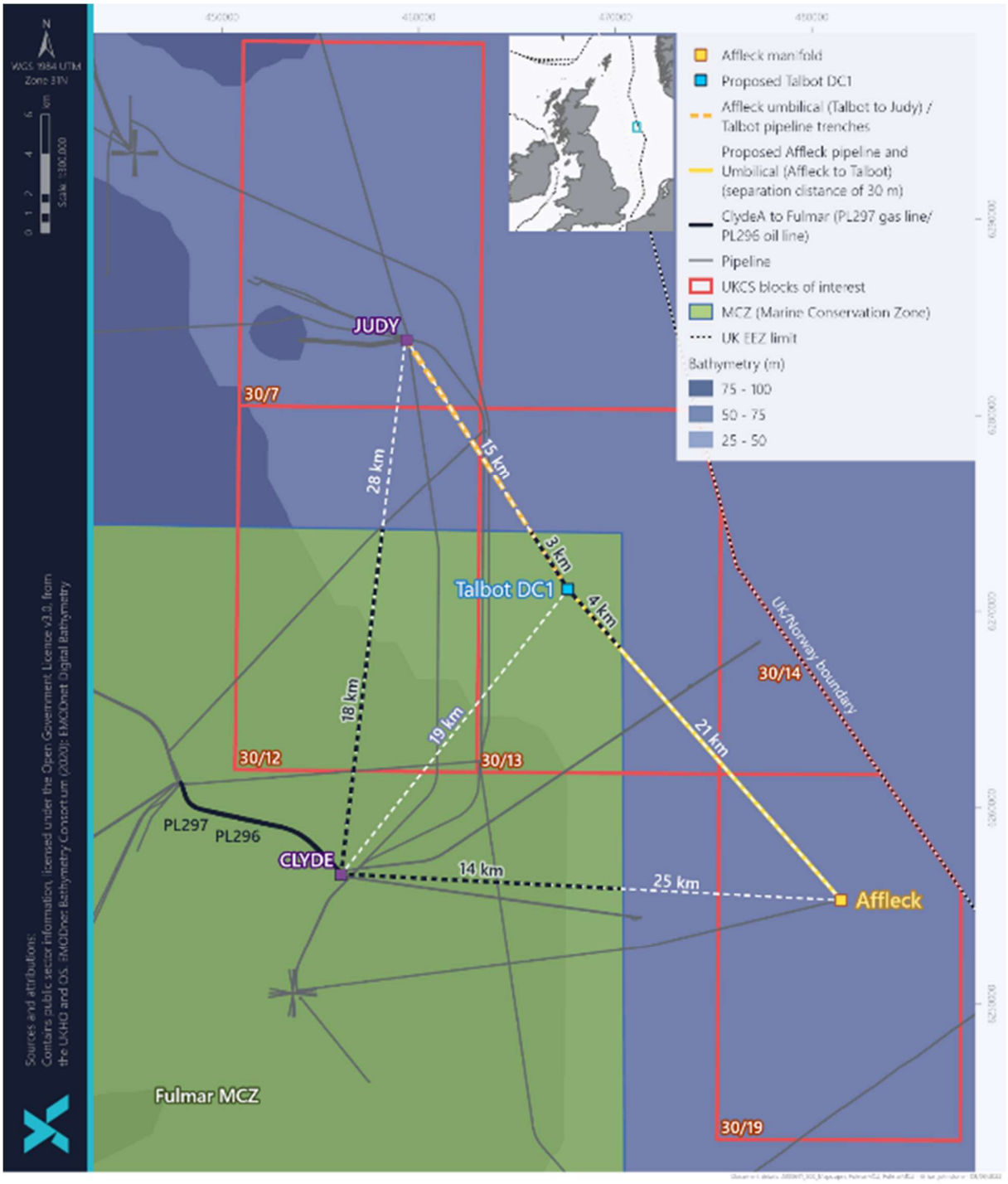

Figure 2-2 Options location in relation Fulmar MCZ

2.7 CONCLUSION OF HOST OPTION SELECTION

NEO's analysis concluded that Judy is the natural host for the Development. The selected option is to tie back to the Judy installation via the Talbot infrastructure (Figure 1-1). The key drivers for this decision are:

- Compliance with the updated MER obligations to assist the Secretary of State in meeting the net zero carbon by 2050 target, both for the Affleck field and at the wider host level;
- Compliance with the NSTA Stewardship Expectations 11: Net Zero through the minimization of greenhouse gas emissions;
- Improved economic return for Affleck owner including lowered costs of emissions trading as lower emissions;
- Favourable technical performance:
  - High uptime;
  - Low carbon intensity;
  - Stable Hub with an extended period forecast until Cessation of Production; and
  - Higher capacity available.
- Favourable commercial terms:
  - Longer tariff period and lower tariffs;
  - Lower exposure to Host OPEX sharing; and
  - No exposure to potential misalignment between the different ownership groups of the subsea infrastructure and the host.

The two existing Affleck wells will be tied back to the existing Judy platform via the Talbot DC1 manifold (proposed by Harbour Energy (HE)), where production fluids will be comingled. NEO will reconnect to the Affleck manifold (existing) and link to the Talbot DC1 manifold (proposed) via a new tie-in structure. There will therefore be significant re-use of infrastructure to redevelop the Affleck wells. This is in line with the NSTA Net Zero Stewardship Expectations. New infrastructure will include the following:

- A new tie-in structure connecting to the Talbot DC1 manifold;
- A new 21 km 8"/12" PiP multiphase pipeline between the Affleck manifold and the tie-in structure (trenched and buried);
- A new 37 km umbilical (static and riser) between the Affleck manifold and the Judy Platform (trenched and buried); and
- Associated crossings/trenching and protection.

There is no requirement for a well flowback or test or a full function test as the wells have previously been in production; therefore, there is no planned flaring due to drilling or well test activities. An integrity test of all tree valves will be performed prior to first oil, which does not involve flaring.

3 PROJECT DESCRIPTION

3.1 AFFLECK WELLS A1 AND A2 DESIGN

3.1.1 Well background

The Development comprises the existing A1 and A2 wells (Table 3-1). These wells are both horizontal producer wells having been drilled in 2007 and tied back to the Janice FPU before being shut in in 2016, as explained in Section 1.2.

Table 3-1 Overview of the Affleck wells A1 and A2

Affleck Well Name	Type/Status	Latitude	Longitude	Maximum Flow rate (m^3/day)
30/19a-A1y (A1)	Producer/ Shut in	56º 26′ 36″ N	02º 42′ 05″ E	2,507.58
30/19a-A2y (A2)	Producer/ Shut in	56º 26′ 37″ N	02º 42′ 05″ E	1,461.2

Both wells are currently shut-in and not connected to any host for the evacuation of reservoir fluid. Once the pipeline is connected to the new host, the wells are expected to flow reservoir fluids. Therefore, no drilling activities will be required as part of this Development.

3.1.2 A1 and A2 Tree Status

During the original Affleck project decommissioning campaign, trees were pressure tested and their production spools back to the Affleck manifold were left connected and flushed with monoethylene glycol (MEG).

As the flowline and umbilical have been uncoupled, it is currently not possible to monitor pressure at the wellhead. Therefore, the wells are currently suspended at the x-mas tree, with no monitoring capabilities.

Currently both wells are sitting with hydrocarbon fluid in column and the horizontal section. Fluid segregation has happened with a certain amount of gas at the top of each well. It is assumed that both Affleck wells have enough wellhead pressure (WHP) to be able to simply flow by opening the chokes and flow the wells.

A risk review process has been undertaken and the key risks identified to the successful return to production of the wells include:

- Failure of Tree Valves to operate on start up;
- Failure of Surface-Controlled Subsurface Safety Valve (SCSSV) to open on command at start up; and
- Failure of Subsea Control Modules (SCMs)/Subsea controls.

The risk review concluded that the well design process, material selection, and relatively benign well conditions will provide a low residual risk of failure occurring (e.g., due to corrosion or other failure mechanism).

Mitigations are as follows:

- Xmas tree valves were all successfully tested during 2016; and will be retested in 2023; and

- The valves are designed to sit static for prolonged periods, (subsea valves are typically only functioned annual/bi-annual). These have sealing capability, with low additional risk of failure due to e.g., stem packing leak.

SCSSV's have good reliability and have been successfully functioned and integrity tested to date, with no history of problems.

3.1.3 A1 and A2 tree re-entry and integrity tests

As previously mentioned, no new well structures will be required since the manifold and two subsea wellheads (A1 and A2) are in place ready for re-use. However, a Dive Support Vessel (DSV) will be mobilised in 2023 to conduct integrity testing on the trees/sub surface safety valves, as well as testing the SCMs. Procedures will be developed to minimise discharges to sea associated with these tests.

3.1.4 Affleck Well controls system

The Affleck subsea control system involves the installation of a new EHC umbilical (See Section 3.2.4), and the retention of the existing Aker control systems. The scope of work at the Affleck manifold includes:

- Possible change-out of the existing Subsea Control Modules (SCM) for refurbished and retention of the existing for spares; and
- Hook-up of a new Affleck infield umbilical with bullet type Umbilical Termination Assembly (UTA).

A new Affleck Topsides Umbilical Termination Unit (TUTU) will be installed to route chemicals, hydraulics and power to the Affleck location.

3.2 SUBSEA INFRASTRUCTURE

3.2.1 Overview

The new infrastructure proposed at Affleck is summarised in Table 3-2 and discussed in the following subsections.

Table 3-2 Summary of new Affleck subsea infrastructure

Infrastructure Type	Installation method	Document Section
21km 8"/12" Pipe in Pipe production line (Affleck manifold to Talbot)	Reel laid, trenched and buried	3.2.3
37 km Electrohydraulic umbilical (Affleck manifold to Judy platform).	Trenched and buried	3.2.4
Affleck Tie in structure (Within Talbot 500m safety zone)	Installed from a support vessel and piled to seabed	3.2.5
Tie in spools (Affleck and Talbot)	Installed from a support vessel and mattress protected	3.2.6

3.2.2 Seabed Preparation

Any physical seabed preparation will be determined by available survey data and infield site surveys immediately prior to structure installation. Seabed surveys prior to structure installation shall be performed by ROV in collaboration with acoustic positioning.

The new subsea structures for Affleck are designed to be free draining; however, should some form of seabed levelling be required this would typically be performed using Remotely Operated Vehicles (ROV) or diver dredging equipment, in the form of zip pumps or suction dredgers. Sandbag markers shall be placed on the seabed to provide a visual reference for landing the structure. It is not anticipated that boulder removal shall be required at any of the new structure locations.

Affleck field installation methodology had not been assessed in detail at the time of writing. However, the Pre-FEED installation schedule assumed utilising the vessels and installation methodology based on Talbot installation methodology.

3.2.3 New Production Pipeline

The Affleck A1 and A2 trees are already connected to the Affleck manifold via rigid tie in spools and protected by mattresses from when this field was tied back to Janice (now decommissioned). The new infrastructure proposed is to tie-in a 21 km 8”/12” PiP production line.

Subject to further evaluation, the PiP pipeline shall be trenched and buried separate to the umbilical for protection against fishing interaction and to mitigate against upheaval buckling. The expected depth of cover is likely to be achieved by trenching the line to between 1.5 m and 1.8 m target trench depth.

Trenching and burial will be undertaken by the trenching support vessel (TSV) using Multi-Pass Plough (MPP) and Back-Fill Plough (BFP). The PiP will be installed first and then trenched. The Affleck PiP pipeline will be terminated with a flange and will be connected to the Affleck 8” manifold header flange with diver-made up interconnecting spools (Section 3.2.6).

The trench transitions at the PiP ends will be protected by rock placement (50 m sections). The tie-in spools will be covered with concrete mattresses for protection during operation. Concrete mattresses will also be used to facilitate crossings, with rock placement protection as required. Rock placement requirements along the route have been estimated for upheaval and buckling mitigation, crossings, and trench transitions. More detail on pipeline protection is provided in Section 3.2.7. It is assumed that the vessel will initiate the pipeline using a Dead Man Anchor (DMA) which will be confirmed as part of detailed design.

A Reel Lay Vessel (RLV) will be utilised for the pipeline l installation. A Trenching Support Vessel (TSV) will be used to undertake trenching and post installation backfill, and a Construction Support Vessel (CSV) for the tie-in structure installation.

3.2.4 Electro-hydraulic Control (EHC) Umbilical

The new 37 km Affleck umbilical shall be required for hydraulic power of actuated valves, signal and power of instrumented systems and injection of wax inhibitor, scale inhibitor, corrosion inhibitor and methanol. The Affleck umbilical shall be laid on the seabed before being trenched and backfilled separately to the Affleck Pipeline. Both lines will run parallel to each other until reaching the Talbot DC1 manifold. Although the Affleck pipeline will tie into the Talbot DC1 manifold, the EHC umbilical will tie into the Judy platform, and will be routed around the Talbot DC1 manifold.

Crossing the Talbot production line before again transitioning into its own standalone trench back to the Judy Platform. It will approach the Judy Platform via the North Eastern face and gain topsides access via a dedicated J tube and into a standalone Affleck TUTU (Figure 3-1). The trench itself will be a maximum width of 3.5 m at surface level.

The Affleck umbilical will be terminated within the Affleck manifold using an UTA and will interface with the existing UTA cradle in order to be supported and secured. Flying leads will be used to connect the Affleck UTA to the existing Subsea Distribution Unit (SDU) on the manifold. The control system shall utilise new Aker topside equipment.

Separate functionality is provided for all Affleck and Talbot services, and individual wax, corrosion, methanol, and scale inhibitor cores are provided in the Affleck umbilical. The design allows total segregation of the Affleck and Talbot umbilical functionality. The total functionality for Affleck and Talbot could not be accommodated in a single umbilical and so separate umbilicals were required.

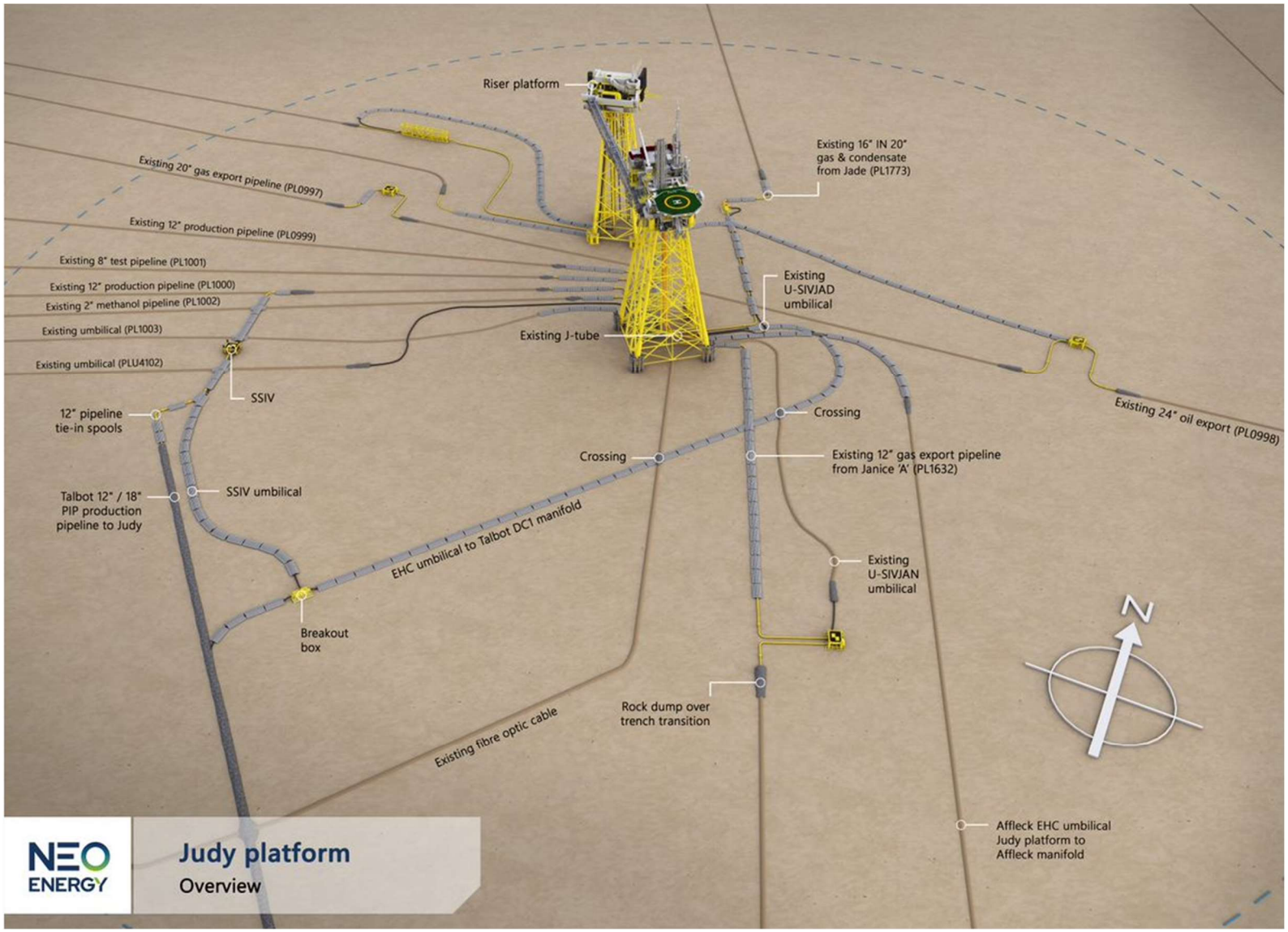

Figure 3-1 Proposed tie-in configuration at the Judy Platform

3.2.5 Affleck Tie-in structure

The main functional requirements of the Affleck Tie-in structure are as follows:

- Connection to Talbot DC1 manifold;
- Allow for pigging of the Affleck pipeline from Affleck to Talbot;
- Allow for pigging of the Talbot pipeline from Talbot to Judy platform;
- Isolation of the Affleck system from Talbot;
- Support local hydraulic, chemical and power distribution;
- House a manifold mounted multi-phase flow meter (MPFM); and
- Third party future tie-in (for process piping).

The Affleck Tie-in structure will weigh approximately 95 Te and measure 10.8 m x 8.3 m x 6.2 m. It will be installed within the Talbot 500 m safety zone and will be designed as a slab-sided fishing friendly structure, capable of providing the necessary protection from fishing loads. The structure will be lowered to the seabed via construction vessel on DP and piled to resist trawl impact loading. Pipework and equipment within the structure shall be protected from dropped objects.

Due to the shear strength of the soils coupled with the 100-yr storm conditions, a gravity-based structure would require a much larger footprint. It was therefore determined that a piled structure would be most suited in order minimise the overall footprint and weight of the structure, which in turn allows for a smaller installation vessel to be used.

3.2.6 Rigid Tie in Spools

Subject to further evaluation, replacement of the existing rigid tie-in spools may be required for connecting the Affleck wells (A1 and A2) to the Affleck production manifold, along with new and the production pipeline to the Affleck and Talbot manifolds. Rigid tie-in spools at Affleck Manifold and tie-in structure will be diver installed via DSV. A summary of the spools to be installed are provided in Table 3-3 and the proposed configuration of these spools at the Affleck end and Talbot ends are outlined in Figure 3-2 and Figure 3-3. Further details on concrete mattress requirements are provided in Section 3.2.8.

Table 3-3 Summary of tie-in spools

Spool type	Length (m)	From	To
Affleck A1Y 6” Well Spool	47	Affleck A1 Well	Affleck Manifold
Affleck A2Y 6” Well Spool	27	Affleck A2 Well	Affleck Manifold
Two - Piece 8” Spools	100	Affleck Manifold	Affleck Production PiP
Affleck 8” Production Manifold Piping	5	Affleck Manifold	Affleck Manifold
Two - Piece 8” Spools	100	Affleck Pipeline	Affleck tie-in structure (Talbot end)
Two- piece 10” spools.	25	Affleck Tie in structure	Talbot DC1 Manifold

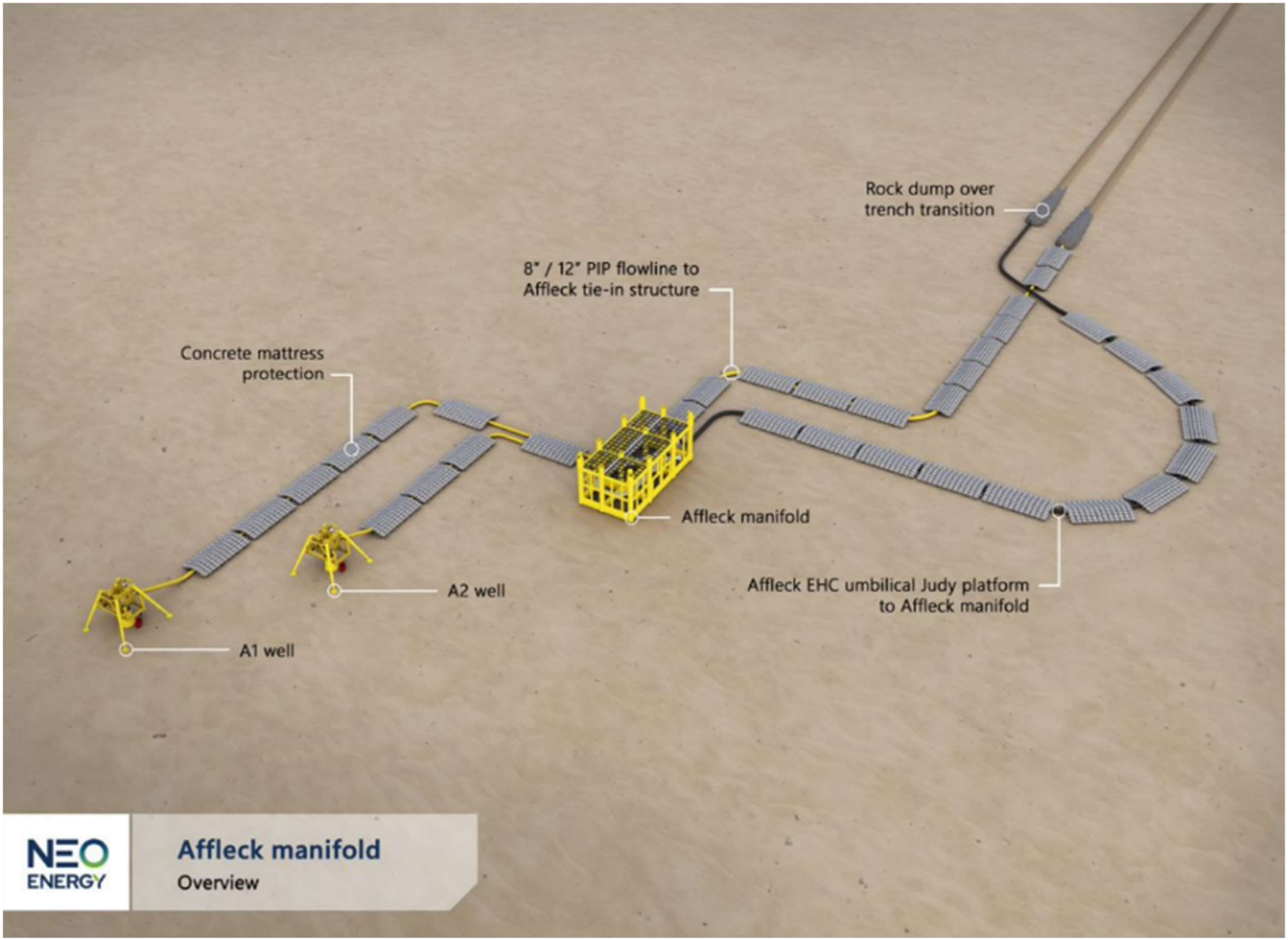

Figure 3-2 Proposed Tie -in configuration at Affleck manifold

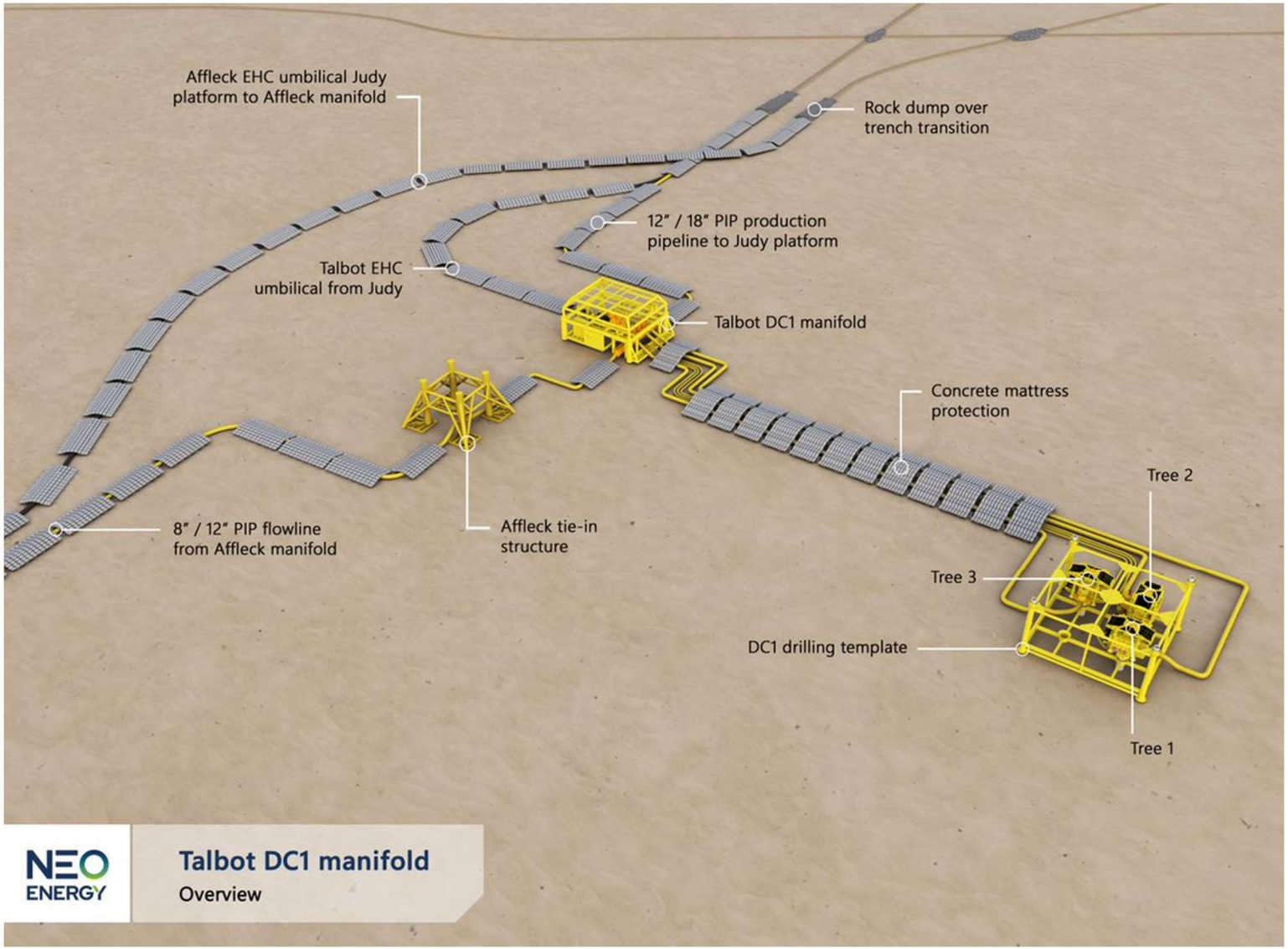

Figure 3-3 Proposed tie-in configuration at Affleck tie-in structure and Talbot DC1 manifold

3.2.7 Pipeline Crossings, Trench Transitions and Protection

The rigid tie-in spools will be covered with concrete mattresses for protection during operation. Additional external protection for the tie-in spool goosenecks to prevent snag points may be provided in the form of grout bags and/or mattresses, if required. It is estimated that 50 x 1 Te bags grout bags will be required to be to be placed at the Talbot and Affleck manifold approaches.

With respect to pipeline and cable crossings, each crossing requires the application of protection material, (e.g., mattresses, grout bags, rock protection). Hence, the number of crossings was a consideration during the selection process, with the aim of minimising resource use, as well as minimizing the environmental impact associated with the placement of protection material. The number of crossings was thus reduced to the extent practicable.

There will be three crossings along the main pipeline route between Affleck and Talbot, including a fibre-optic cable from Clyde to Valhall, and the trenched and buried production and umbilical lines from Flyndre to Clyde (Table 3-4). In addition to these, the dedicated Affleck umbilical will incur up to four additional crossings between Talbot and Judy that are beyond the 500 m platform safety zone, as listed in in Table 3-4 (Crossing numbers 4-6).

Concrete mattresses will be used for protection along pipeline crossings as well as facilitate the crossing, with rock placement protection as required.

Table 3-4 Crossings along the Affleck PiP and umbilical route

No	From	To	Operator	PL No.	Size	Service	Status
1	Clyde	Valhall	North Sea Communications	-	N/A	Fibre Optic Cable	Buried
2	Flyndre	Clyde	Repsol Sinopec	PL3189	8”/12” PiP	Mixed Hydrocarbon	Buried
3	Flyndre	Clyde	Repsol Sinopec	PLU3190	7”	EHC Umbilical	Buried
Additional crossings for the section of the umbilical between Talbot and Judy							
4	Stella	Judy Wye	Ithaca	PL4028	10”	Oil Export	Buried
5	Judy	Norpipe	Harbour	PL0998	24”	Oil	Exposed
6	Gannet A	Fulmar A	Shell	PL763	16”	Oil	Buried
7	Janice	Judy	Total	PL1632	12”	Gas (Not-in-Use)	Buried

The total requirements of mattresses and rock are discussed in the following subsections.

3.2.8 Mattresses requirements

Concrete mattresses will be deployed from the DSV using a suitably rated deployment frame to provide required protection of exposed infrastructure (predominantly spools, umbilical overage and jumpers). Pending final quantity and deck layout, some mattresses may be installed by the CSV. A summary of the reasonable worst case estimated number of mattresses required is provided in Table 3-5.

Table 3-5 Summary of Mattress requirements

Location	Dimension	Number of Mattresses
Judy Approach	6 m x 3 m (150 mm thickness)	9
Talbot Approach		46
Affleck Approach		60
Pipeline Crossings	6 m x 3 m (300 mm thickness)	8
Umbilical Crossings		18
Total	-	141
Total + 50% Contingency (Worst case)	-	212

3.2.9 Rock Placement

Rock requirements along the route have been estimated (based on worst case) for UHB mitigation, crossings and trench transitions. The maximum worst case total amount of rock is 60,750 Te. All rock would be installed by a dedicated rock placement vessel with fall pipe, ensuring accurate placement and optimised use of the rock material. The rock installation along the pipeline will be based on the as-built trenching and Out of Straightness (OOS) survey results and analysis.

A summary of the rock requirements is included in Table 3-6:

- Up to 36,750 Te of rock will be surface laid for pipeline crossings and trench transitions.
- Up to 24,000 Te of rock may be required for UHB.

Table 3-6 breakdown of maximum rock requirements

	Rock Quantity (Te)*		
	Affleck PiP	Affleck Umbilical	Combined
Surface laid (including crossings and transitions)	17,500	19,250	36,750
UHB mitigation (contingency)	24,000	0	24,000
Total	41,500	19,250	60,750

**includes 20% additional contingency*

The expected worst case rock requirement has been accounted for with 14 m wide berms assumed for all crossings and 6 m wide berms across all transitions. However, the quantity of rock to mitigate against upheaval buckling is still to be fully assessed and the final requirements will take into account the soil strength and residual UHB risk. Rock placement for mechanical protection at trench transitions and crossings and for upheaval buckling mitigation will be completed by a purpose-built vessel based on the as-built trenching and OOS survey results and analysis. The cumulative impact of both the total rock requirement for this Development and the rock deposits already in place within the surrounding development area will be assessed within this Environmental Statement.

3.2.10 Pre-commissioning and commissioning

A pre-commissioning philosophy will be developed which will give attention to pre-commissioning activities and acceptance criteria for flooding, cleaning and gauging operations.

Commissioning of the pipelines will involve chemical use and discharge to flood, clean, gauge and hydrotest the new pipeline, barrier testing, installing spools and de-watering will all require the use and discharge of chemicals. The selection of chemicals is provided in Table 3-7.

Table 3-7 Chemicals proposed for used (and discharge) for the pre-commissioning of the pipelines

Chemical name	Chemical Function
RX-5208	Biocide/Oxygen scavenger
RX-5254	Corrosion inhibitor
RX-9034A	Dye
RX-9022	Pipeline hydrotest dye
Debris Pick up Gel	Pigging Chemical
MEG	Completion chemical

These chemicals are all Centra for Environment, Fisheries and Aquaculture (CEFAS) registered chemicals for offshore use in the UK. These chemicals are listed as Gold indicating that they would not be expected to incur significant environmental risk.

3.2.11 Subsea Installation Vessel Requirements

It is assumed that all subsea installation vessels shall operate within the parameters of DP2. No moored or anchored vessels shall be utilised. A summary of the vessel requirements is provided Table 3-8.

Table 3-8 Summary of vessels requirements for the Development

Vessel Type	Duration (Days)	Operations to be undertaken
Survey Utility Vessel (SUV)	46	Pre/post lay surveys, crossing construction, pipelay support, pipeline pre-commissioning, protection installation (where relevant), general survey support to TSV activities and spool metrology.
Reel Lay Vessel	25	Pipeline installation (Deep Energy vessel was assumed or alternatively Apache II).
Trenching Support Vessel (TSV)	19	Post Pipelay Trenching, Post Umbilical Installation Jet Trenching
Construction Support Vessel (CSV)	24	Tie-In Structure installation and umbilical lay (North Sea Atlantic was assumed).
Diving Support Vessel (DSV) –	25	Brownfield tie-in, spool installation, spool tie-in, leak testing, umbilical termination relocation and tie-in, flying lead installation and tie-in and mattress installation and commissioning support (Deep Explorer was assumed).

Vessel Type	Duration (Days)	Operations to be undertaken
Rock Placement Vessel	1 trip[4]	Crossing Protection, Pipeline/Umbilical End Protection, UHB Mitigation (where required).
Guard Vessel	229	As Required for Unprotected Assets.

3.3 JUDY PLATFORM

This section provides an overview of the oil and gas production expected at Affleck and any associated affects this will have on the host Judy platform complex (Figure 3-4), including produced water and chemical usage, incremental power demand and associated emissions including flaring and venting.

As the Development is based around a tie-in via the Talbot subsea development, the risk and management of the combined production of both Affleck and Talbot to Judy has been taken into account, where applicable.

The Affleck reservoir produces a relatively light crude with an API Gravity of 36.5° and a wax content of 13.8%. Affleck oil will be exported to Teesside via the Norpipe pipeline system with produced water passed to the Judy produced water treatment system and discharged. The Affleck produced gas shall be exported from Judy via the CATS pipeline system.

Affleck fluids will mix with Talbot fluids at the Talbot DC1 manifold and will be routed to the Judy Platform via a common pipeline. The Affleck and Talbot fluids will be routed to the Judy HP Separator where they will mix with the Judy, JAWS and Joanne fluids. The gas will be routed to the Judy Platform gas processing facilities for processing and export via the CATS. The produced liquids are routed to the LP Separator. From here the oil is sent to the oil export system (to Teesside through the Norpipe export pipeline) and the water is routed to the produced water system for treatment and overboard disposal.

[4] *Assume to be 10 days*

Figure 3-4 Judy Platform complex

3.3.1 Affleck Reservoir Characteristics

The Affleck field is a Chalk reservoir formed over a non-piercing salt diapir within the Central Graben 11 km to the east of the Orion Field and 10 km west of the Norwegian Tommeliten Alpha discovery. The reservoir contains oil of 36.5 degrees American Petroleum Institute (API) gravity with a Gas – Oil Ratio (GOR) of 1740 standard cubic feet (scf)/ stock tank barrel (stb) and reservoir viscosity of 0.27 centiPoise (cp).

The Affleck crude is a light crude oil, with an API gravity of 36.5° and a wax content of 13.8%, which is a fluid at summer temperatures (13°C), becoming more viscous at lower temperatures.

3.3.2 Oil and Gas Production

As explained in the previous sections, Affleck production will be comingled with Talbot production and produced back to the Judy platform. Production modelling has shown that when Talbot production is concurrent with Affleck production, production rates at Talbot can negatively affect the production rate at Affleck, and vice-versa. It is worth noting that production forecasts are provided to 2037 (P90) and 2035 (P50 and P10), although it is most likely that economic COP will occur earlier. The current capacity of the Judy Platform is provided in Table 3-9.

Table 3-9 Installed Capacity of the Judy Platform

	Production capacity
Oil	13,200 te/d (100,000 bbl/d)
Gas	12,742 Mm^3/d (450 mmscf/d)
Water	3,215 te/d (20,000 bbls/d)

The installed capacity for oil and gas at Judy will be comfortably sufficient to incorporate Affleck without any modifications. The high case (P90) production forecast for Affleck over 14 years (first oil 2024) is presented in Table 3-10 based on production via an 8-inch Affleck to Talbot pipeline and a 12-inch pipeline to Judy. This forecast also assumes a mid-case Talbot production which is concurrent with Affleck. The Affleck oil production, averaged for full year, is predicted to increase in the initial years to a peak of approximately 696 te /day (5,218 bbl/d), followed by a drop after the second year of production. In Table 3-10, Figure 3-5, an uptime assumption of 90% is incorporated in the forecasts.

Both the low and mid case production forecasts (first oil 2024) have been included for context in Figure 3-6 and Figure 3-7; however, they will not be included in more detail as they are not the base case for the ES.

The produced gas will be separated, dried, treated to export specifications and compressed for export via the 20-inch gas export pipeline into the CATS pipeline along with Talbot gas. Affleck gas will also be used as fuel gas on Judy platform. Gas production follows a similar pattern to oil although peak gas production is retained for the initial 5 full year's production, at around 764 Mm^3/day (27mmscf/d).

Table 3-10 High case Affleck Production (Basis for this ES)

	Oil Production		Produced Water		Produced Gas	
Year	bbl/day	Tonnes/day	(bbl/day)	Tonnes/day	(Mmscf/d)	Mm3/d
2024*	751	100	4	1	2	65
2025	5,218	696	138	22	27	764
2026	3,917	523	196	31	27	764
2027	3,265	436	249	40	27	763
2028	3,063	409	407	65	27	764
2029	2,845	380	984	156	26	742
2030	2,717	363	1,798	286	20	577
2031	2,540	339	1,727	274	14	388
2032	2,244	299	1,920	305	10	292
2033	1,987	265	3,858	613	8	234
2034	1,712	228	4,286	681	7	188
2035	1,583	211	4,092	650	5	151
2036	1,404	187	3,714	590	5	133
2037	1,244	166	3,840	610	4	122

*Initial production in Dec 2024. The rate provided is an average production rate over full year.

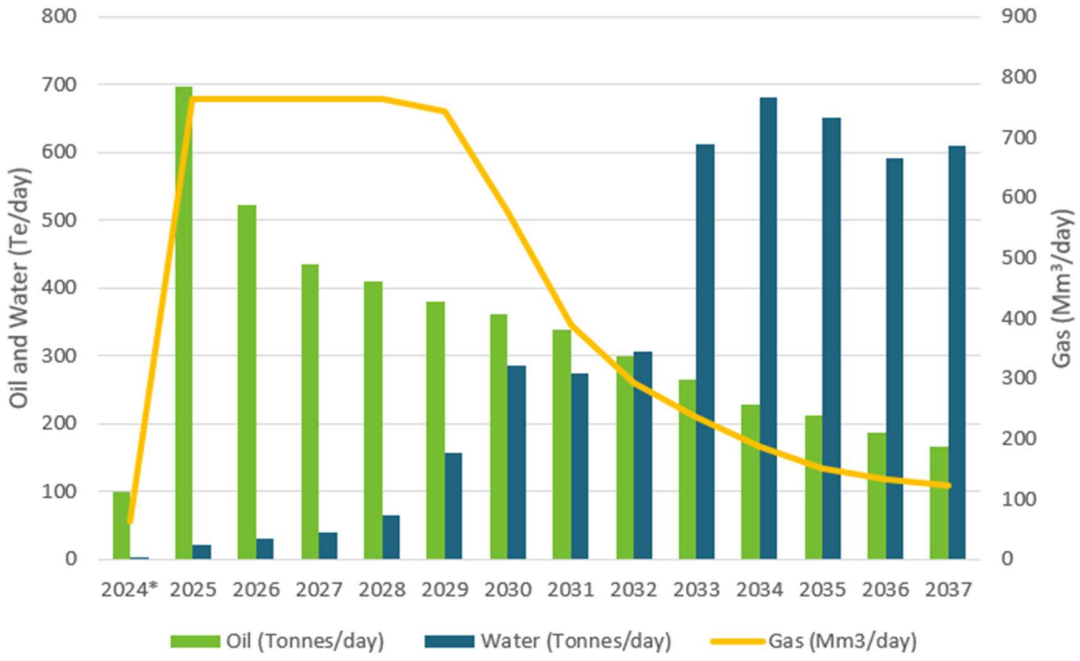

Figure 3-5 Affleck High case production

Table 3-11 Mid case Affleck Production

	Oil Production		Produced Water		Produced Gas	
Year	bbl/day	Tonnes/day	(bbl/day)	Tonnes/day	(Mmscf/d)	Mm3/d
2024*	584	78	83	13	2	65
2025	4,237	565	1,415	225	27	764
2026	2,782	371	1,645	261	27	763
2027	1,044	139	822	131	27	763
2028	783	104	706	112	25	696
2029	1,503	201	1,538	244	22	616
2030	1,389	185	1,641	261	16	459
2031	1,283	171	2,005	318	12	346
2032	1,185	158	3,336	530	9	263
2033	1,095	146	4,373	695	8	222
2034	1,012	135	6,956	1105	6	165
2035	0	0	0	0	0	0

*Initial production in Dec 2024. The rate provided is an average production rate over full year.

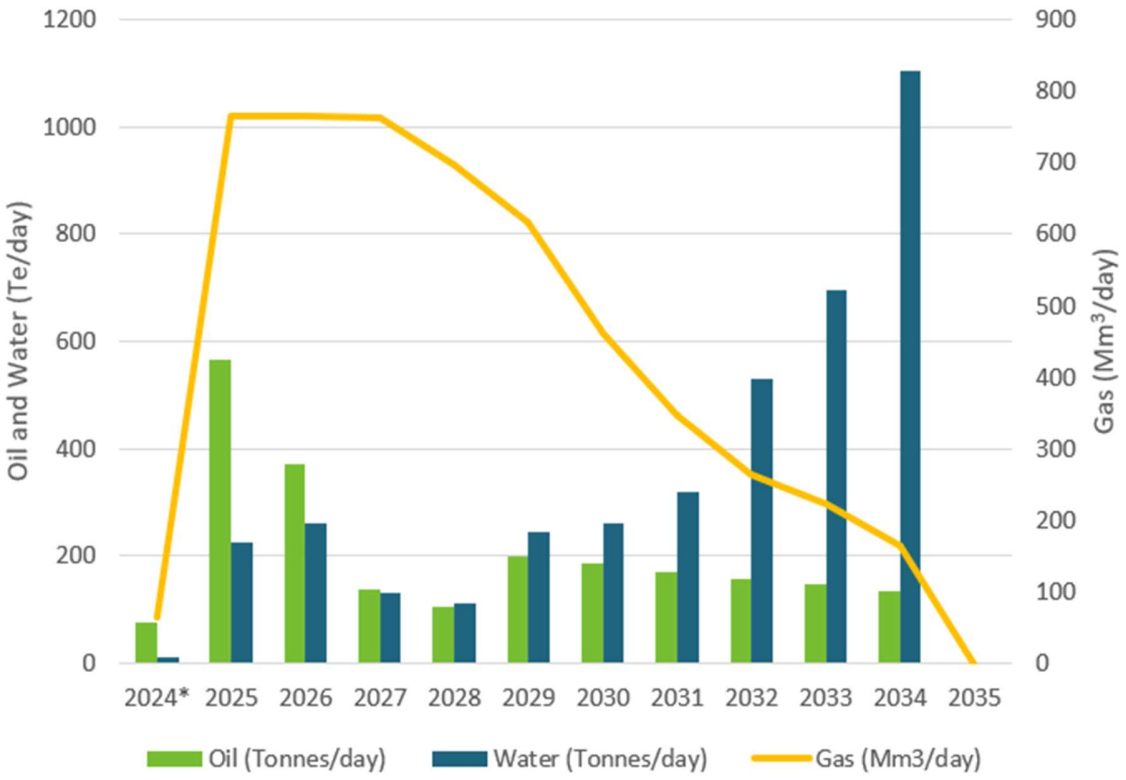

Figure 3-6 Affleck Mid case production

Table 3-12 Low case Affleck Production

	Oil Production		Produced Water		Produced Gas	
Year	bbl/day	Tonnes/day	(bbl/day)	Tonnes/day	(Mmscf/d)	Mm3/d
2024*	589	79	112	18	2	62
2025	3,791	506	2,473	393	23	637
2026	1,716	229	2,323	369	13	354
2027	1,046	140	2,378	378	11	323
2028	894	119	3,871	615	10	281
2029	764	102	5,406	859	9	262
2030	653	87	6,801	1080	9	260
2031	558	74	6,217	988	7	192
2032	477	64	5,343	849	3	92
2033	408	54	4,588	729	2	56
2034	348	46	3,933	625	1	41
2035	0	0	0	0	0	0
*Initial production in Dec 2024. The rate provided is an average production rate over full year.						

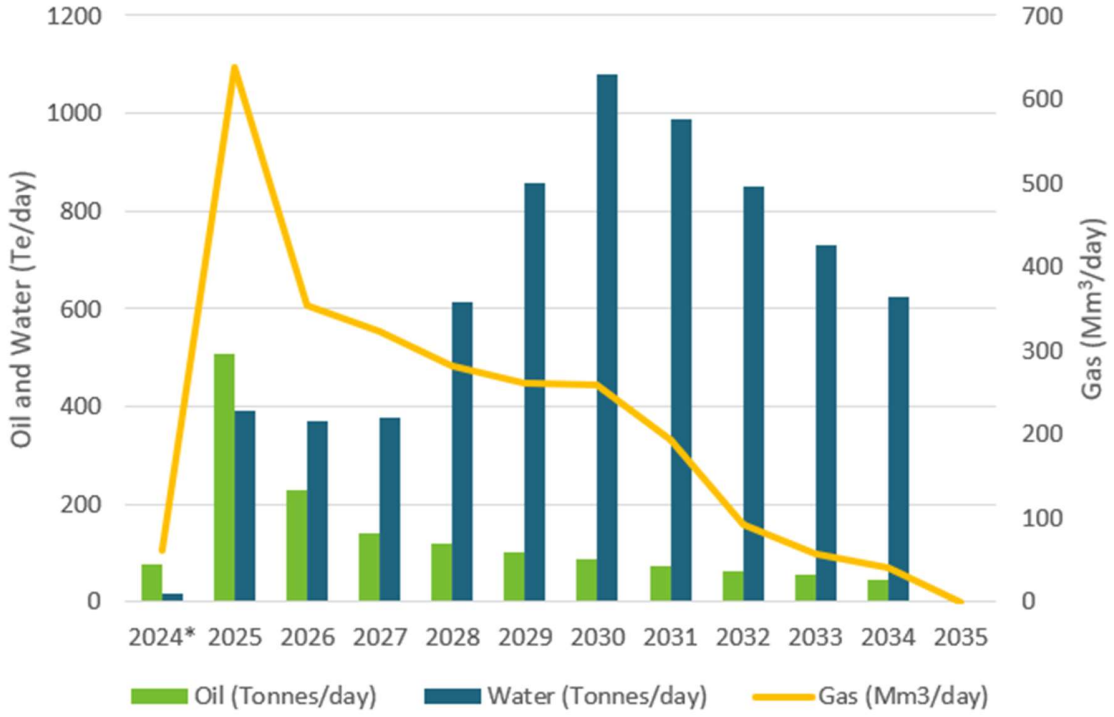

Figure 3-7 Affleck Low case production

3.3.3 Produced Water

There is no Produced Water Reinjection (PWRI) on Judy, so produced water from Affleck shall be treated by the existing Judy produced water system where it will be discharged to sea with an oil concentration of <30 mg/l. Currently all produced liquids (i.e., oil and water) of Judy are routed to the LP Separator for liquid-liquid separation. The LP Separator operates as a 3-phase separator routing oil to the export booster pumps, produced water to Judy produced water system and gas to the Judy Riser Platform (JRP) Flash Gas Compressor (FGC).

The Judy LP hydrocyclones, JRP CFU and Degasser currently treat all produced water on the facility. Affleck produced water in the high case is initially low for the first years of production and remains above 1,700 bbl/d for the remaining life of the field in the high production scenario, reaching a peak of around 682 m^3/day (4,288 bbl/d). However, in the low production case, produced water production could reach around 1081 m^3/day (~6,800 bbls/day). The produced water treatment modifications proposed increase the produced water capacity on Judy.

3.3.4 Produced Water Modifications and Upgrades

The Development (along with the Talbot development) will incorporate modifications to the existing Judy facilities, including separator internal modifications and upgrades to the hydrocylones, Compact Floating Unit (CFU) and Degasser to accommodate the increase in produced water rates. The Development upgrades will increase the Judy platform produced water handling capacity from around 17,200 bbl/day to around 20,000 bbl/day which will accommodate both Affleck and Talbot produced water.

3.3.5 Flaring and Venting

Flaring on the Judy Platform is due to process trips and upsets and when the flash gas compressor is not available. Predictions of flaring for the flare consent are based on planned maintenance activities and events that require the platform to shut-down production and de-pressurize the platform and infield pipelines, which results in additional flaring. Additional flaring is anticipated when Affleck is restarted following shutdown, and this is estimated at five flaring events each year, one estimated at 102 Te of gas (510 Te per year) to depressurise the pipeline. There will be limited changes to the associated topside inventory, and therefore increased flare loading from Affleck is expected to be minimal. This is discussed further in Section 10.4.4.

3.3.6 Gas Compression and Power Generation

The Judy platform gas compression system consists of two compression trains powered by two GE LM2500 gas powered generators, with the volumes of gas to be compressed requiring both trains. The addition of Affleck processing does not alter this philosophy, however there will be an incremental increase in fuel gas demand and the associated emissions from combusting Affleck gas.

Power generation is provided by three Siemens SGT-200 gas turbines and a Siemens SGT-200 DLE turbine. The normal operating mode of power generation on the Judy Platform is to have the three units operating on reduced load, although it is technically feasible to meet the normal operating load with two machines: operating experience dictates that three are used to ensure reliability. The proposed Affleck production is not predicted to alter this operating philosophy.

The fuel gas requirements were found to be well within the available capacity, with the maximum compression train power requirement found to be 14.8 MW for the Talbot plus Affleck case (Chrysaor, 2021). This represents a 9% increase over the peak Talbot power requirement and is well within the existing power turbine limit of 21 MW per power turbine. Therefore, there will be no significant effects on fuel gas usage and the associated emissions from combustion gas as a result of Affleck.

3.3.7 Chemical requirements

The Development basis is to provide subsea chemical injection from topsides chemical injection facilities at defined concentrations. It is anticipated the injection pumps specified for Talbot can also be used for the Affleck chemical injection. A new Affleck TUTU will be installed to route chemicals, hydraulics and power to the Affleck location. Hydraulic power for Affleck will be provided by the Talbot HPU. Most of the Judy Platform modifications identified for Talbot will be utilised for Affleck.

The following chemicals have been selected based on preliminary production chemistry analysis:

- Methanol for hydrate control;
- Wax inhibitor to mitigate risk of operational issues due to wax formation and build up;
- Scale inhibitor to mitigate produced water self-scaling risk in the pipeline and across subsea choke valve; and
- Corrosion Inhibitor - to protect the carbon steel flowlines.

The proposed chemical injection design basis for Affleck operation is provided in Table 3-13.

Table 3-13 Chemical Injection Requirements

Chemical Injection	Product	Requirements	Rate	Injection Point
Scale Inhibitor	SA1110N	Once water cut exceeds 5%.	20 parts per million (ppm) (based on water rate)	Xmas Tree (u/s choke)
Wax Inhibitor	PARA 11840A (previously) WM1840	Until WAT exceeded during start-up	250 ppm (based on oil rate)	Manifold
Methanol	-	During upset conditions only	2.1 m^3/hr	Xmas Tree (u/s choke)
Corrosion Inhibitor	CORR11988A	Continuous basis	100-500 ppm (based on gross fluids)	Manifold

For combined Affleck and Talbot production, wax and corrosion inhibitor will be injected at Affleck only, with dosing controlled by chemical concentration and topside metering for full pipeline inhibition and comingled production.

Corrosion inhibitor must be dosed at sufficient concentrations to protect the carbon steel production flowlines. All individual production wells are to be tied into the main flowline using corrosion resistant alloy spools, thus corrosion inhibitor philosophy is to inject inhibitor at the Affleck manifold (both Affleck and Talbot flowing) or at the Talbot DC1 manifold (Talbot only flowing). It is however noteworthy that the Corrosion inhibitor CORR11988A is listed as a 'Sub' chemical, however NEO have been advised through the 'Affleck Corrosion Inhibitor Assessment', that there is no alternative available at present. This may be reassessed as new chemicals become available through life of field.

Scale inhibitor must be injected at each well individually when the well cuts water, generally 5% water by volume for Affleck. Failure to inject adequate scale inhibitor may result (over time) in scaling of system locations where notable pressure drops are experienced (wellhead valves, chokes, and production tubing). It is expected that Scale inhibitor will be injected for Affleck on a continuous basis at a dosage of 20 ppm. This is the same dosage that Scale inhibitor is currently applied on the Judy Platform.

Wax inhibitor is proposed to be injected into Affleck fluids continuously in order to minimise wax formation and minimise gel strength. Preliminary basis is intermittent injection during cold start-up until the WAT is exceeded. The basis for Talbot is to inject continuously from start of field life. The dosage of Wax inhibitor is expected to be up to 250 ppm, which is relatively high compared to the current wax inhibition applied from Judy platform at around 60 ppm.

It is worth noting that corrosion inhibitor, scale inhibitor and wax inhibitor are already used at the Judy platform on a continuous basis. The premise for Affleck is that it will use the same chemicals as those selected for Talbot.

3.3.8 Pipeline Pigging

Pipeline pigging is an important activity having a direct impact on the operational and technical integrity of a pipeline. The main purpose of pigging includes but is not limited to the following:

- Maintaining pipeline efficiency by removing flow restrictions (e.g., scale, wax, Asphaltene, liquid build-up, etc.); and
- Pipeline inspection and fitness assessment throughout the operational life.

Facilities exist on the Affleck Manifold production header to allow the installation of a temporary subsea pig launcher/receiver. Cognisance has been given within the FEED Study to the practicalities of pigging operations recognising both commissioning pigging as well as possible future operational pigging. The capability to install a temporary subsea pig launcher/receiver will also be present on the Affleck Tie-in structure at the Talbot end of the PiP.

Based on work to date, no liquid/solid displacement pigging is envisaged as necessary for Affleck or Talbot pipelines, however inspection pigging may be required at periods in the life of the development. A Wax Deposition study was completed in FEED which concluded that routine operational pigging is not required.

For Affleck, intelligent pigging may be required to inspect the pipeline for metal loss, pitting, cracks, and remaining wall thickness during its design life. Intelligent pig runs can assess wall loss from internal or external corrosion, and they can demonstrate the presence of mechanical damage from external sources. Intelligent pigging is essential to verify the condition of the pipeline and to demonstrate the effectiveness of the injected corrosion inhibitor during its operational life.

Based on Affleck Steady State flow assurance results, no liquid/solid displacement pigging is envisaged as necessary for Affleck or Talbot pipelines.

3.3.9 Design Life

A 15-year minimum design life will be adopted for all new Affleck infrastructure. The design life of the existing Affleck infrastructure was 15 years. A life extension review was undertaken for the existing components within the system to assess that their design life could be extended by 15 years.

3.3.10 Decommissioning

All subsea infrastructure to be installed is essentially recoverable in the reverse manner to which it was installed. Decommissioning activities shall be undertaken in line with proven procedures; however, these shall be driven by as-found surveys prior to decommissioning operations.

Any installed products which may become compromised during recovery shall be recovered using safe and effective recovery methods, utilising recovery baskets and specialist tooling where necessary.

Pipeline and umbilical products may be recovered in an operation akin to the reverse of installation or if HSE concerns are present regarding the integrity of the products, cutting them in situ provides a proven viable alternative. Infield structures (manifolds, PLEMs) shall be designed to ensure adequate lift point capacity for recovery operations.

As referenced above, structures are designed cognisant of the potential for future recovery. This is factored into the lift points design in line with code. Pipelines are flanged, thus allowing for future connection of recovery heads. Umbilical UTA's incorporate lift points, again suitable for recovery. Should for any reason it be unsafe to recover the architecture in the reverse means of installation, alternative solutions are available.

Protection aids such as mattresses or grout bags can be recovered using specialist recovery baskets.

Once production from the Development becomes irrevocably uneconomic, permission will be sought for production to cease. Decommissioning of oil and gas facilities in the UK is regulated under the Petroleum Act 1998, as amended by the Energy Act 1998. The UK's international obligations on decommissioning are governed principally by the Oslo-Paris Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention).

Content of Offshore Oil and Gas Field Development Plans states "in accordance with the UK's international obligations, all installations emplaced after 9 February 1999 must be completely removed to shore for reuse, recycling or final disposal on land". The Department for Business, Energy and Industrial Strategy (BEIS) (2018) provides specific guidance on decommissioning activities and shows the process leading to approval of a Decommissioning Programme. At the onset of the decommissioning phase NEO will adhere to the decommissioning guidance that is current at the time. The well will be abandoned at the end of field life as per the well abandonment legislation and guidelines applicable at the time.

The OSPAR provisions do not apply to pipelines; however, BEIS (2018) guidance sets out UK policy on pipeline decommissioning. The decommissioning strategy for the pipelines and umbilical will depend on a number of factors including, the availability of suitable technology and the potential environmental, safety and cost implications of decommissioning methods at the end of field life.

The ultimate intention is to leave the seabed of the development area in such a condition that it will pose no risk to the marine environment or to other sea users, and the development has been designed with this intention in mind. No development decisions have knowingly been taken that will preclude this goal.

The subsea infrastructure associated with the Development (pipelines, umbilical, spools, and jumpers) and deposited materials (mattresses and grout bags) can be recovered during decommissioning from the seabed dependent on their integrity status. Prior to the end of field life, there may well be changes to the statutory decommissioning requirements as well as advances in technology and knowledge. NEO will aim to utilise recognised industry standard environmental practice during all decommissioning operations, in line with the legislation and guidance in place at the time of decommissioning. Discussions on what may be required will be held with the Regulator as early as possible before decommissioning commences.

Prior to the decommissioning process, re-use and recycling alternatives will be considered where feasible to reduce the potential for materials having to go to landfill. In advance of the decommissioning process an inventory of development equipment will be made and the potential for further reuse will be investigated. As an integral component of the decommissioning process, NEO will undertake an environmental appraisal to support a Decommissioning Programme, this will include comparatively assessing the technical, financial, health, safety, and environmental aspects of decommissioning options.

NEO are cognisant of the Scottish Fishermen's Federation Offshore Oil and Gas Decommissioning Policy and Key, including seeking the return to a clean seabed as far as is practicable. NEO engaged with all relevant stakeholders during the scoping process for this development and will continue to engage with the stakeholders throughout the life of the development, including prior to decommissioning.

4 ENVIRONMENTAL BASELINE

4.1 INTRODUCTION

As part of the EIA process, it is important that the main physical, biological and socio-economic sensitivities of the receiving environment are well understood. This section describes the main characteristics of the offshore environment in the vicinity of the Development (UKCS Blocks 30/7, 30/12, 30/19, 30/14 and 30/13), with particular attention being given to those aspects that may be sensitive to, or affected by, the proposed operations. This section draws on a number of data sources including published papers on scientific research in the area, industry wide surveys (e.g., the Offshore SEA3 programme) and site-specific investigations commissioned.

The following publicly available data sources were utilised to inform the baseline section:

- UK Offshore Energy Strategic Environmental Assessment (OESEA) 3 (DECC, 2016);
- UK SeaMap, 2018 (JNCC, 2019a);
- Marine Management Organisation (MMO) Marine Information System (MIS); and
- Department for Environment, Food and Rural Affairs (DEFRA's) Magic Map.

Specific site surveys carried out within the Development area are summarised below, with locations of each illustrated in Figure 4-1.

- **Gardline (2019a,b,c) Talbot Site and Route seismic survey, geophysical shallow hazards, geotechnical, habitat assessment and environmental baseline survey. UKCS Block 30/13, 30/12 and 30/7.**

These surveys were undertaken in July and August 2019 and were located at two provisional drill centre locations and a proposed pipeline route at the Talbot site in UKCS Blocks 30/7, 30/12 and 30/13. The overall aim was to gain information on the conditions and hazards at the site to ensure the safe, secure, and efficient installation and operation of a jack-up drilling rig, and to delineate the sensitive habitats or species at the site. The survey included 19 grab sample stations (also investigated by a 200 m long camera transect) and nine camera only stations (drop down camera) with a total of 28 stations being investigated. Grab samples were obtained using 0.1 m^2 modified Day grabs. 23 Cone Penetrometer Test (CPT) and vibrocore stations were also investigated. The Talbot pipeline route runs adjacent to the Affleck umbilical between Talbot and Judy.

- **Gardline (2021a,b,c). Environmental baseline survey, habitat assessment and seafloor survey. UKCS Blocks 30/13. 30/14 and 30/19.**

This survey was undertaken between September and October 2021 across the proposed Affleck pipeline route, encompassing an area of 21 km in length and 500 m in width. The aim of the survey was to provide geotechnical, bathymetric, seabed feature, and environmental data for the pipeline corridor. Sixteen stations were investigated along the pipeline corridor, including 15 camera and grab stations and one camera only station, each 2 km apart. Grab samples were obtained using 0.1 m^2 modified Day grabs and each station was investigated using camera transects of 200 m in length. 11 CPT stations were also investigated along the pipeline corridor.

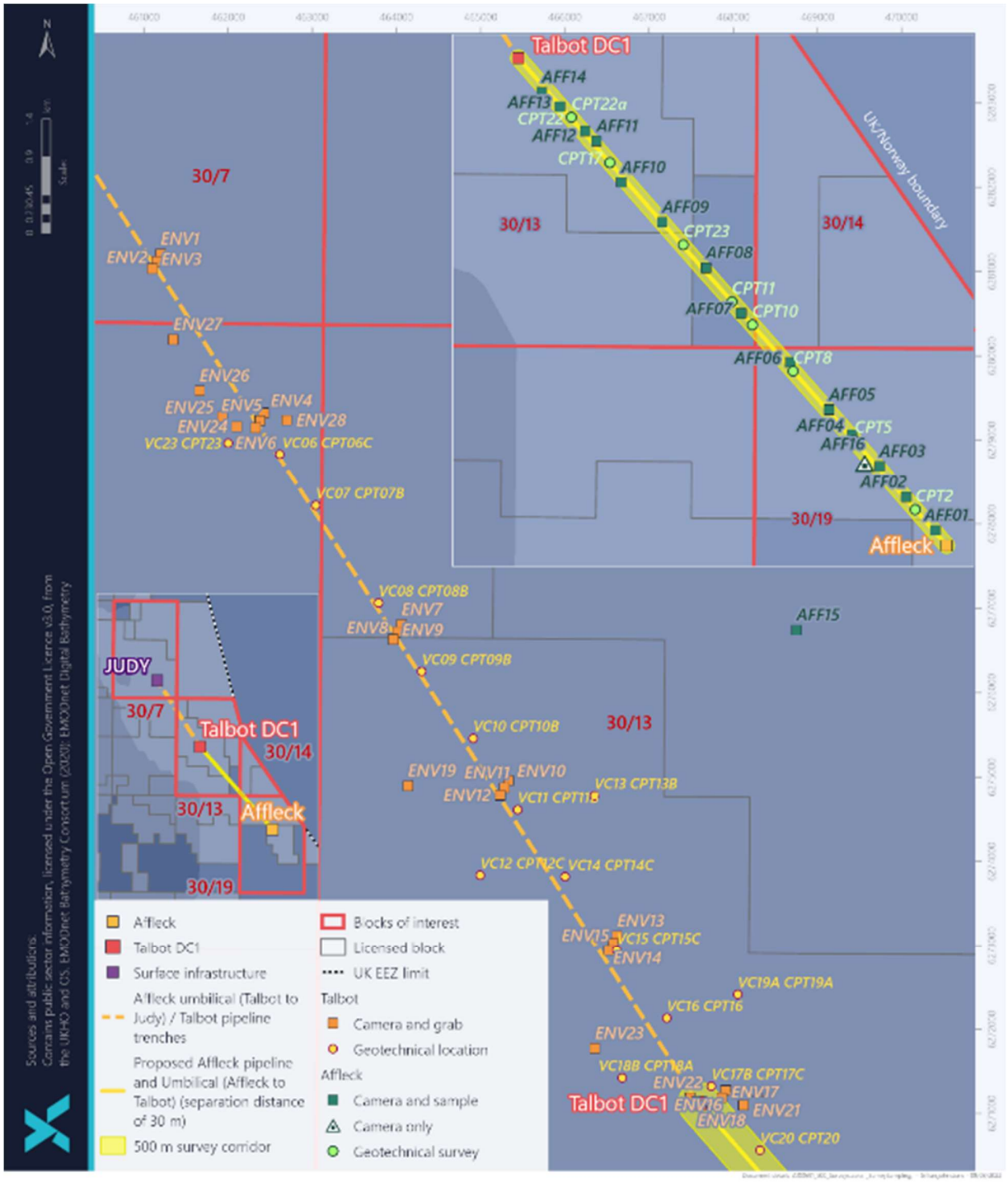

Figure 4-1 Location of the previous survey data around the Development area

4.2 PHYSICAL ENVIRONMENT

4.2.1 Weather and Sea Conditions

Currents in the North Sea circulate in an anti-clockwise direction, driven by inflows from the Atlantic via the Fair Isle Channel and around the north of Shetland and outflow northwards along the Norwegian coast (DECC, 2016). Against this background of tidal flow, the direction of residual water movement in the Central North Sea (CNS) is generally to the south-east (DTI, 2001; DECC, 2016). Offshore tidal current velocities in the region of the Development are between 0.01-0.5 m/s during mean spring tides. The mean spring tidal range is approximately <1.01 – 2.00 m, which is considered to be low. In this region of the North Sea, the water column is seasonally stratified (Summer and Autumn), and the strength of the thermocline is determined by solar, tidal and wind forces (DECC, 2016).

The prevailing winds in the CNS 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, CNS to Northern North Sea (NNS), are highly variable and there is a greater incidence of north-westerly winds (DECC, 2016). The average wind speed at the development area over a 30-year long-term period is approximately 10 – 11 m/s (DECC, 2016).

The annual mean wave height in the CNS region follows a gradient decreasing from the northern area of the Fladen/Witch Ground to the southern area of the Dogger Bank. The wave height within the Development area ranges from 2.01 to 2.25 m and the annual mean wave power ranges from 18.1 to 24 kW/m, which is typical of the wider area (ABPmer, 2008). McBreen *et al.* (2011) shows that wave energy at the seabed ranges between 'low' (less than 0.21 N/m^2) and 'high' (more than 1.2 N/m^2) in the CNS region.

Sea surface temperature and salinity are largely influenced by tidal flow. Data on salinity and temperature from the years 1971 to 2000 indicates that surface and near-bed temperature at the development is approximately <8°C and 8-10°C, respectively, and that surface and near-bed salinity is approximately 34 – 35 parts per thousand (ppt) (Berx and Hughes, 2009).

4.2.2 Bathymetry and Seabed Conditions

4.2.2.1 Bathymetry and Seabed Features

The North Sea is a large shallow sea with a surface area of around 750,000 km^2. Water depths in the CNS gradually deepen from south to north from approximately 40 m at the Dogger Bank to approximately 100 m at the Fladen/Witch Ground (DTI, 2001; DECC, 2016). The main topographic features in the CNS are the Dogger Bank, a large sublittoral sandbank submerged through sea-level rise, located in the south-west corner of the region, marking a division between the Southern North Sea (SNS) and CNS, and the Fladen/Witch Ground, a large muddy depression generally considered to define the northern extent of the CNS (DTI, 2001; DECC, 2016). No major seabed topographic features are in the vicinity of the Development area (DECC, 2016).

The water depths recorded within the Affleck pipeline survey area ranged from 70 to 72 m Lowest Astronomical Tide (LAT), with a gentle deepening towards both ends of the pipeline route (Gardline, 2021b). Similar water depths recorded in the Talbot survey area (adjacent to the Affleck umbilical between Talbot and Judy) ranging from 71.2 to 75.4 m with a gentle deepening towards the northwest of the site (Gardline, 2019b).

The seabed at the Affleck and Talbot survey areas was generally interpreted to be flat and featureless as shown by the bathymetry in Figure 4-2 and Figure 4-3 (Gardline, 2019a, Gardline 2021b). In the Affleck

pipeline survey area, the only features of note in the geophysical data were existing pipelines, wells, boulders and spudcan depressions (maximum depth of 2 m) (Figure 4-4). Similarly, in the Talbot survey area, the only recorded seabed features included existing infrastructure, boulders, anchor scars, spudcan depressions and buried debris as shown in Figure 4-5 (Gardline, 2019a).

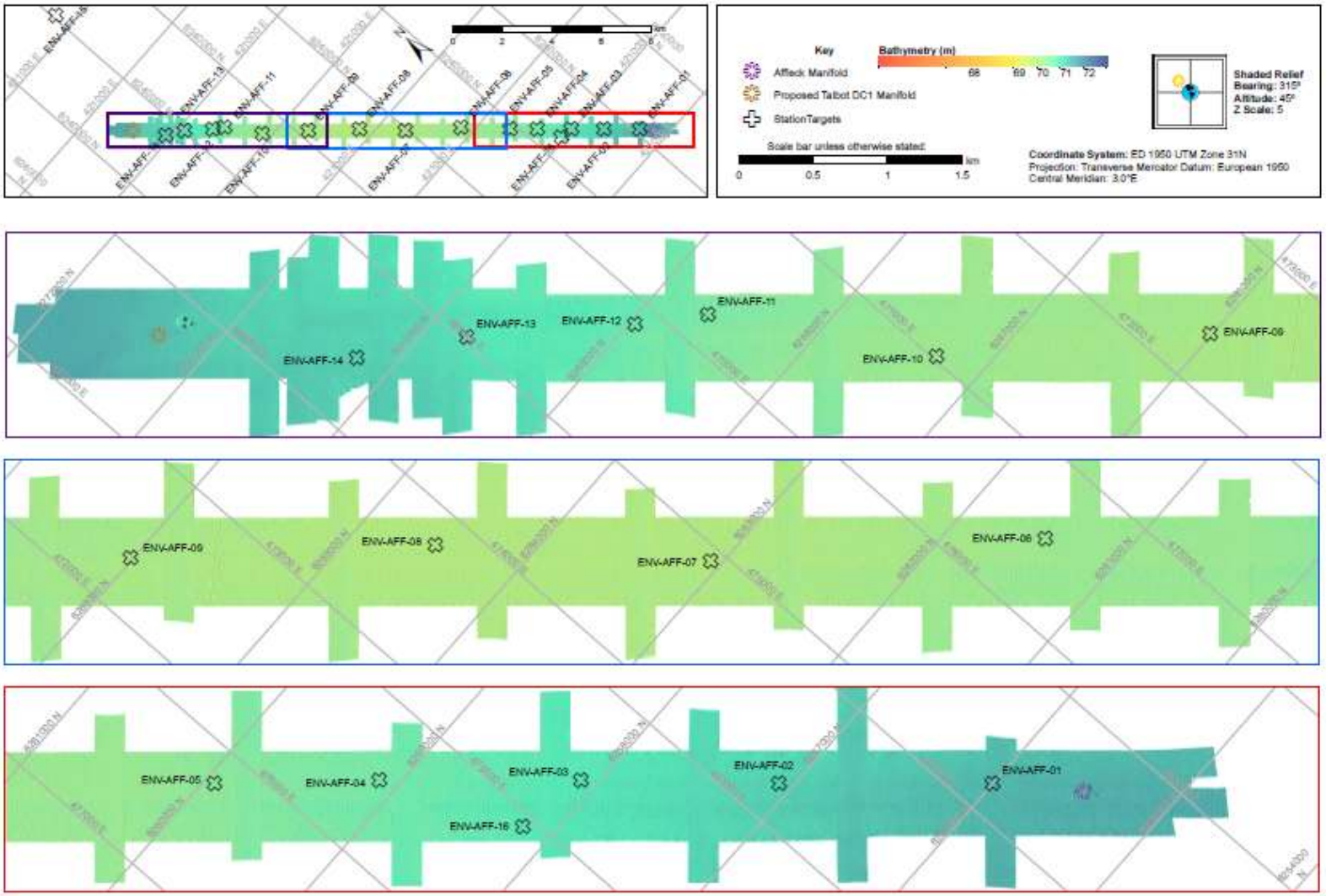

Figure 4-2 Bathymetry along the Affleck pipeline route survey (Gardline, 2021c)

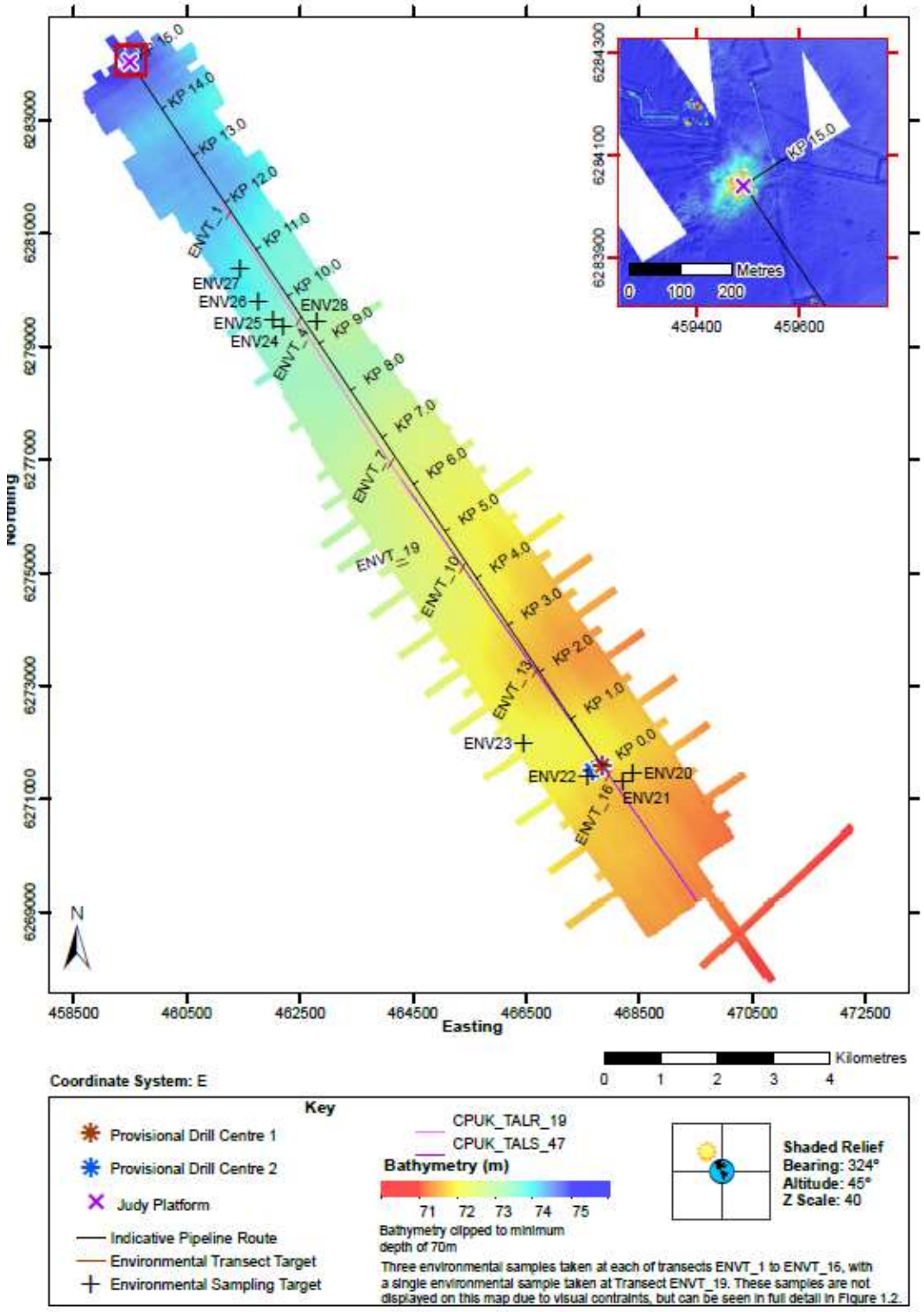

Figure 4-3 Bathymetry along the Talbot route survey area (Gardline, 2019b)

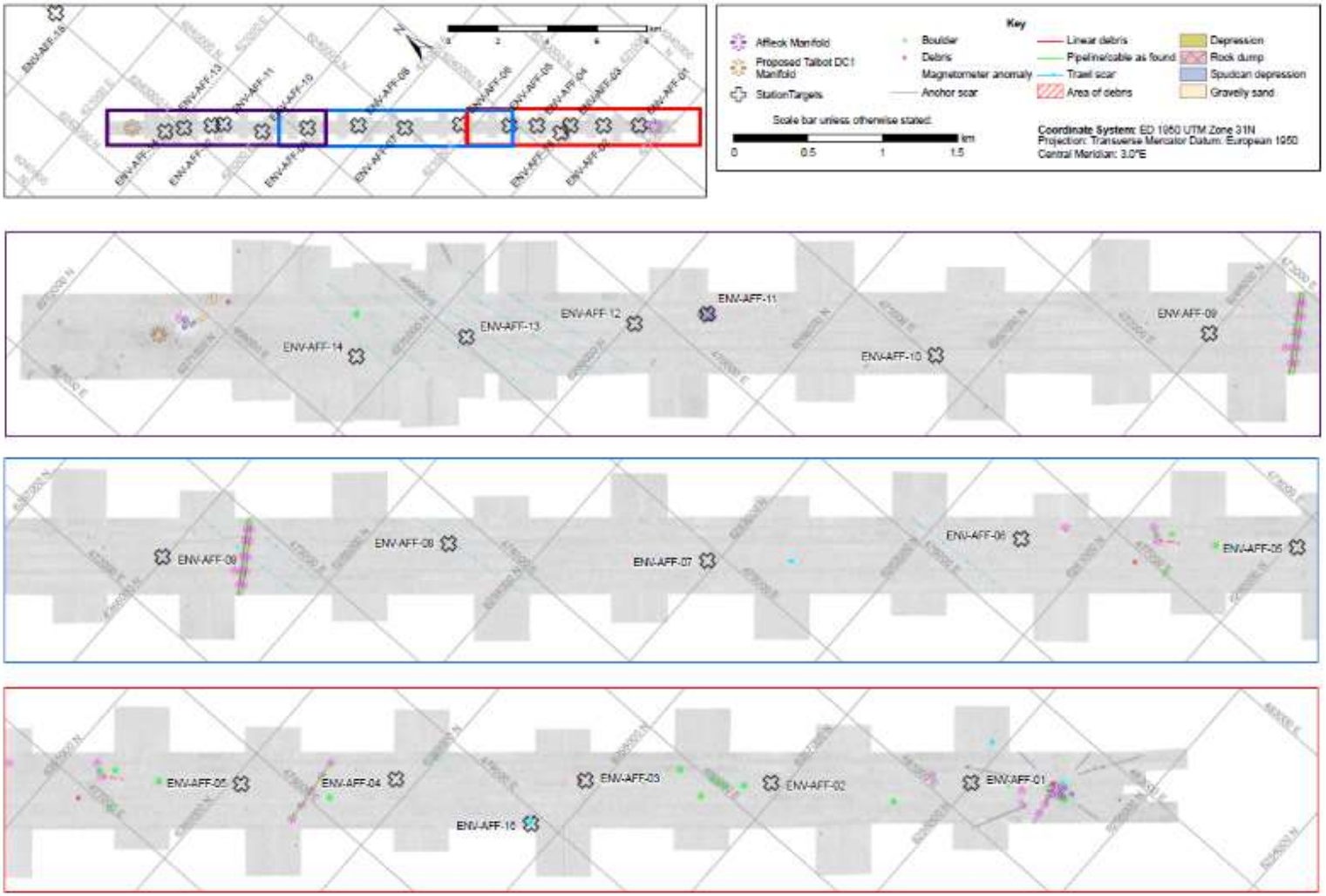

Figure 4-4 Affleck Pipeline Survey Seabed Features and Side Scan Sonar (SSS) Mosaic (Gardline, 2021b)

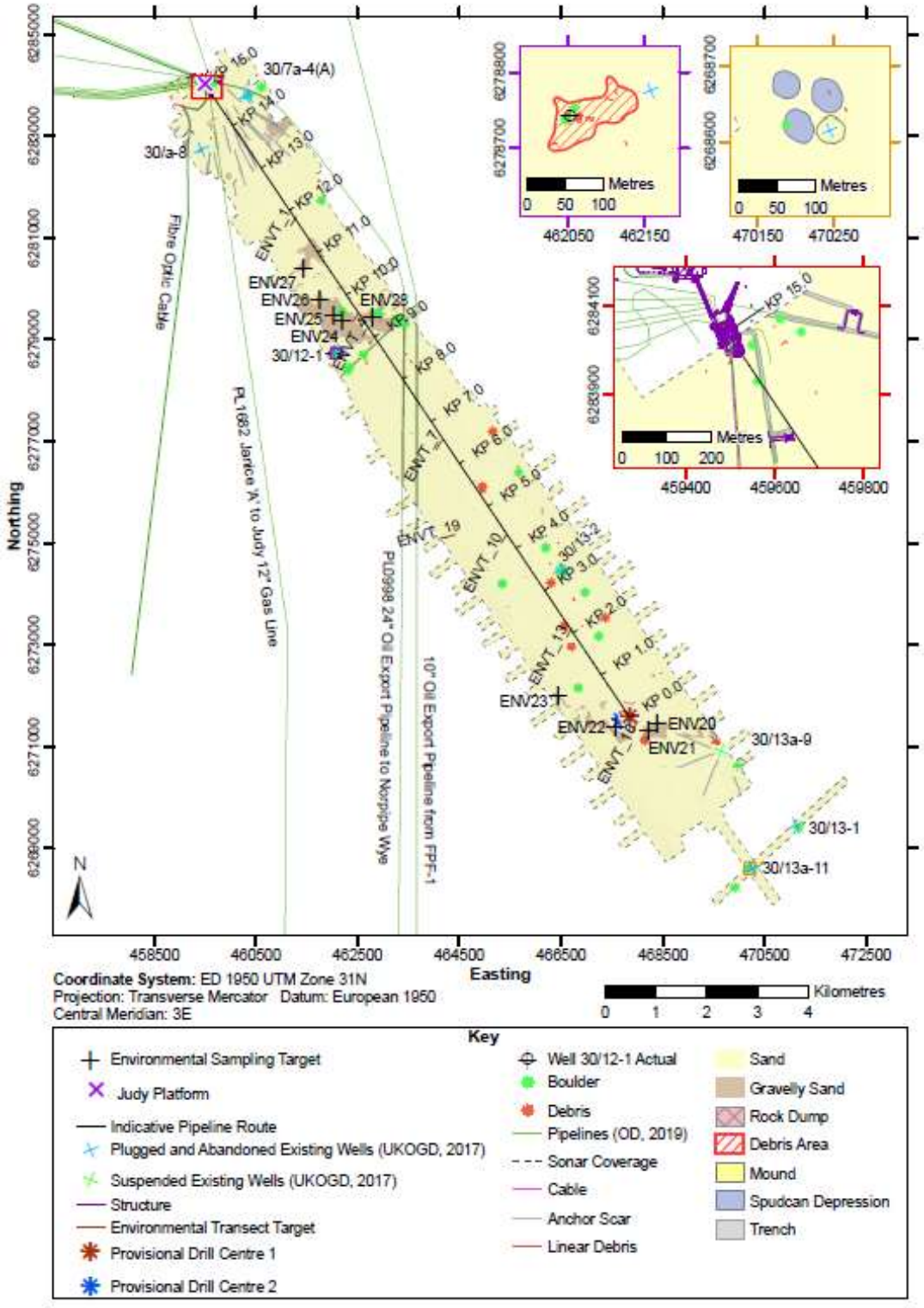

Figure 4-5 Talbot Survey Seabed Features and SSS Mosaic (Gardline, 2019b)

4.2.2.2 Sediment Type

The UKSeaMap online resource provides a broad-scale habitat classification of the seabed in UK waters which uses the European Union Nature Information System (EUNIS) classification system (JNCC, 2019a). The seabed type within the Development area is mostly classified under the habitat complex 'deep circalittoral sand', EUNIS habitat code A5.27, with a small area to the southwest of the pipeline classified as 'deep circalittoral coarse sediment', EUNIS habitat code A5.15 (Figure 4-6). EUNIS habitat A5.27 is described by the European Environment Agency (EEA) (2021) as 'offshore (deep) circalittoral habitats with fine sands or non-cohesive muddy sands'. EUNIS habitat A5.15 is described as 'offshore (deep) circalittoral habitats with coarse sands and gravel or shell' (EEA, 2021).

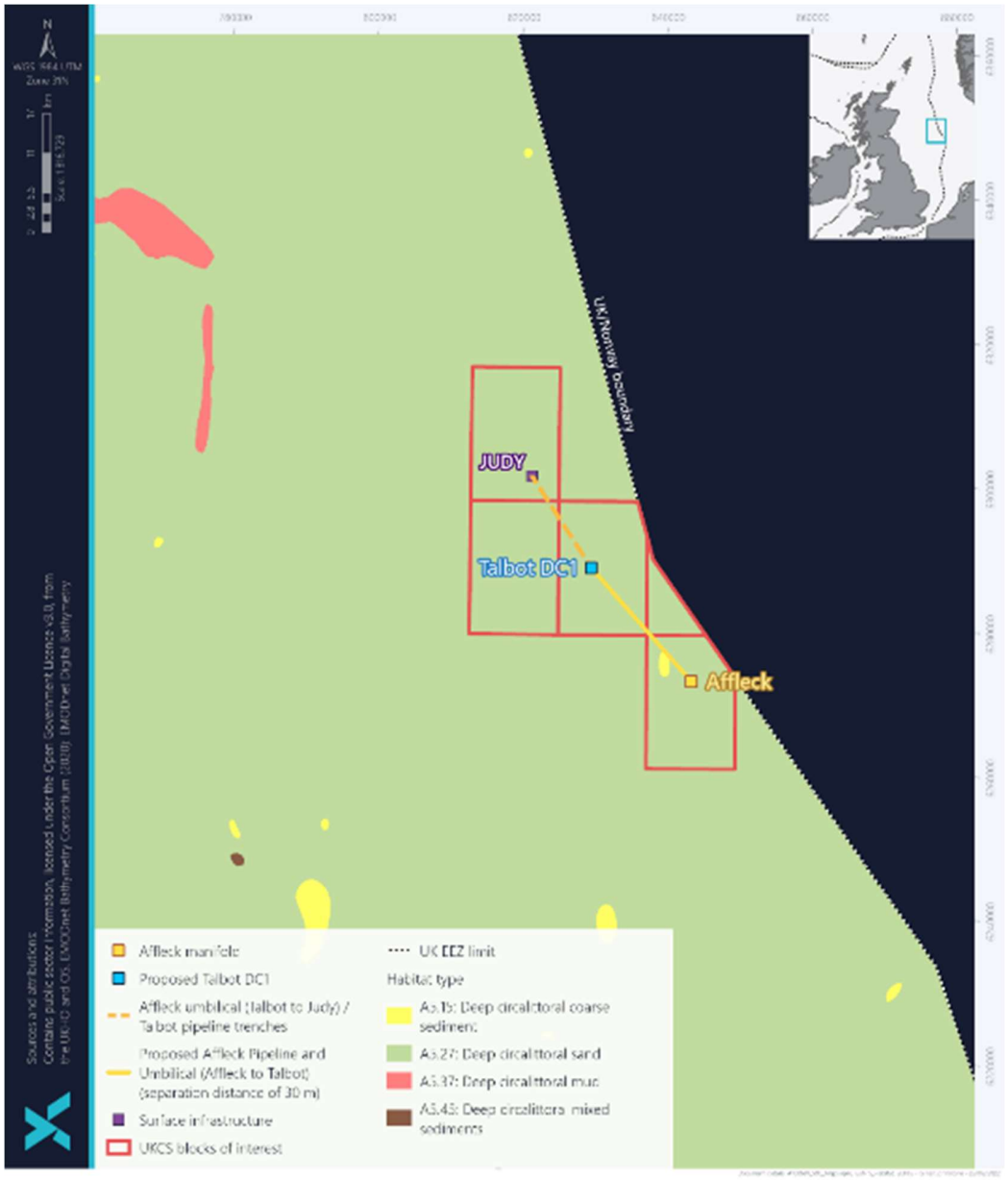

Figure 4-6 Seabed habitats in the vicinity of the Development Area

Seabed sediments observed in the Affleck pipeline survey area consist of loose silty sand with occasional shell fragments and overall appear homogenous (Gardline, 2021b). The main sediment type was interpreted to be EUNIS habitat A5.27, although localised areas of EUNIS habitat A5.45 ('deep circalittoral mixed sediments') were also present. Examples of the sediments observed in the Affleck pipeline survey area are displayed in Figure 4-7.

Figure 4-7 Examples of Sediments Observed During the Affleck Pipeline Survey (Gardline, 2021a)

The seabed sediment along the Affleck pipeline can be further described from the Particle Size Analysis (PSA) conducted on sediment grab samples during the 2021 survey. Mean particle diameter ranged from 135 µm to 174 µm, which is characterised under the Wentworth classification as fine sand. Sand was dominant in the samples, accounting for 88% of the sediment on average. Particles > 2 mm (classified as gravel) were absent from six stations and accounted for less than 1.5% of the sediment at the remaining stations. The sediment was characterized under the Folk and Ward classification either as poorly or moderately well sorted sand. Overall, the sediment was considered to be consistent with the regional area. Total organic matter (TOM) ranged from 3% - 10.1% and Total Organic Carbon (TOC) ranged from 0.07% - 0.26% (Gardline, 2019c).

The geophysical and geotechnical data collected along the Affleck pipeline route indicated that beneath the Holocene sands, dense to very dense fine shelly silty sand is present, and beneath this, medium to high strength sandy clay with occasional boulders is present (Gardline, 2021c).

Within the Talbot survey area, the sediments were interpreted to comprise silty sand with frequent shell fragments (Gardline, 2019b). Example photographs from the survey are shown in Figure 4-8. Bacterial mats

were also observed at two sampling locations, although no Methane-Derived Authigenic Carbonate (MDAC) was recorded (Gardline, 2019b). As per the Affleck pipeline survey area, sediments across the Talbot survey area were consistent with EUNIS habitat A5.27 or EUNIS habitat A5.45 (Gardline, 2019b, Gardline 2021b).

Station: ENV1
Soft sediment with occasional shell fragments

Station: ENV20
Soft sediment with common shell fragments

Station: ENV21
Soft sediment with few shell fragments

Station: ENV23
Soft sediment with abundant shell fragments and scattered gravel

Figure 4-8 Examples of Sediments Observed During the Talbot Survey (Gardline, 2019b)

PSA of the sediments sampled at the Talbot survey area also indicated that the sediments were dominated by sand. The mean particle size ranged from 240.7 µm to 274.2 µm and the sand fraction (≥ 63 µm to 2 mm) contributed to between 90.1% to 98.5% of the sediment. Gravel (≥2mm) was absent from all samples (Gardline, 2019b). TOM ranged from 0.7 to1.1% and TOC ranged from 0.17 to 0.24%, which was considered to be typical of the wider area. All stations were classified as medium or fine sand under the Wentworth classification and sand under the modified Folk classification (Gardline, 2019c).

Geophysical and geotechnical data at the Talbot DC1 manifold indicate that beneath Holocene sands dense to very dense shelly silty sand is present (up to 6 m below the seabed) (Gardline, 2019a).

EUNIS habitats A5.27 and A5.15 are associated with the UK Biodiversity Action Plan (UKBAP) habitat 'Subtidal sands and gravels' as well as the Priority Marine Feature (PMF) 'Offshore subtidal sands and gravels' and EUNIS habitat A5.27 may occur within Annex I sandbanks, although the presence of EUNIS habitat A5.27 does not always mean that Annex I sandbanks are present (JNCC, 2018a).

The sediments observed in the Development area are consistent with those predicted through UKSeaMap (see Figure 4-6). In addition to the site-specific data, some survey data in the vicinity of the development was available through UKBenthos to compare the survey results with regional data (OGUK, 2021). This includes data at Affleck, Cawdor (approximately 2 km from the Affleck Pipeline) and Flyndre (approximately 6 km from the Affleck Pipeline).

Sediment samples in the Affleck field, available on UKBenthos, indicated that the fines (silt and clay) content ranged from 6.7 to 15.8% (mean: 11.4%). Slightly lower but still similar fines content were recorded at Cawdor (range: 5.2 to 11.7%, mean: 7.3%) and at Flyndre (range: 8.4 to 11.4%, mean: 9.5%). UKBenthos does not provide descriptive sediment characteristics.

Total organic matter at the Affleck field ranged from 1.1 to 1.4% (mean: 1.2%). Similar concentrations were recorded at Cawdor (range: 0.8 to 1.2%, mean: 0.98%) and Flyndre (range: 1.1 to 1.6%, mean: 1.4%) (OGUK, 2019).

4.2.2.3 Sediment Contaminants

Hydrocarbons

Total Hydrocarbon Content (THC) values in the samples collected along the Affleck pipeline route in 2021 ranged from 5.3 to 13.0 µg/g. Six samples exceeded the UK Offshore Operators Association (UKOOA) (2001) background concentration for the North Sea in locations > 5 km from oil and gas installations (9.5 µg/g). However, all samples were located within 5 km of existing infrastructure and were below the UKOOA (2001) 95th percentile THC concentration of 40.1 µg/g. Therefore, the THC concentrations were considered to be consistent with background concentrations and below thresholds expected to impact faunal communities (Gardline, 2021c).

N-alkane concentrations ranged from 0.060 to 0.319 µg/g and were below the UKOOA (2001) mean background concentration of 0.4 µgg^{-1}. Analysis of chromatographic profiles of n-alkanes and Unresolved Complex Mixture (UCM) hydrocarbons indicated that hydrocarbons were well weathered and typical of areas of historic oil and gas exploration. In addition, pristane was dominant over phytane, indicating that THC concentrations in the survey samples were primarily attributed to biogenic aliphatic hydrocarbons (Gardline, 2021c).

Total Polycyclic Aromatic Hydrocarbon (PAH) concentrations along the Affleck pipeline route ranged from 0.016 µg/g and 0.126 µg/g. Total Naphthalenes, Phenantherenes and Dibenzothiophenes (NPD) were below the Limit of Detection (LOD) at two stations, with the remaining stations ranging from 0.001 µgg^{-1} and 0.013 µg/g. The concentrations of Total PAH were below the UKOOA (2001) mean for sandy sediments (0.268 µg/g) and the Effects Low Range (ERL) and Apparent Effects Thresholds (AET), indicating that toxic effects from PAHs were unlikely. Analysis of the molecular characteristics of PAHs indicated that the PAHs originated from a diffuse pyrogenic source (Gardline 2021c).

The THC values in the sediments sampled during the 2019 survey at Talbot ranged from 7.6 to 14.4 µg/g. Almost all samples exceeded the UKOOA (2001) background concentration for the North Sea in locations > 5 km from oil and gas installations. However, all samples were below the UKOOA (2001) 95th percentile THC concentration and were considered to be representative of the wider area. Concentrations of n-alkanes ranged from 0.089 to 0.229 µg/g and were all lower than the UKOOA (2001) mean background concentration of 0.4 µg/g. N-alkanes and UCM hydrocarbons were analysed through chromatographic profiles and interpreted to have molecular patterns typical of the North Sea sediments with background

levels of contamination which indicated that there was no point source contamination. Pristane was dominant over phytane and together with the Carbon Preference Index (CPI) values, indicated that biogenic aliphatic hydrocarbons contributed to the THC concentrations at the Talbot survey area (Gardline, 2019c).

Total PAH concentrations at Talbot ranged from 0.032 µg/g to 0.185 µg/g (although this maximum was considered as a statistically high outlier). The concentrations of total NPD were below LOD at several stations, with a maximum concentration of 0.035 µg/g. One station (ENV 9) contained elevated PAH concentrations compared to the remainder of samples and these exceeded the OSPAR (2008) background concentrations. However, all concentrations were below the relevant ERL and AET concentrations, indicating that toxic effects from PAHs were unlikely (Gardline, 2019c).

Hydrocarbon concentrations available through UKBenthos survey data from nearby fields were also analysed. THC concentrations at the Affleck field ranged from 4 to 4.6 µg/g (mean: 4.28 µg/g). Similar concentrations were recorded at Flyndre (range: 3.4 to 3.8 µg/g, mean: 3.6 µg/g) with higher concentrations recorded at Cawdor (range: 5.4 to 10 µg/g, mean: 8.4 µg/g) (OGUK, 2021). The THC concentrations of most samples were within the UKOOA (2001) background concentration for the North Sea in locations > 5 km from oil and gas installations (9.51 µg/g), with the exception of samples at Cawdor.

Concentrations of n-alkanes at Affleck ranged from 0.19 to 0.27 µg/g (mean: 0.23 µg/g). Similar concentrations were recorded at Cawdor (range: 0.14 to 0.31 µg/g, mean: 0.24 µg/g and Flyndre (range: 0.17 to 0.25 µg/g, mean: 0.21 µg/g) (OGUK, 2021).

The concentrations of naphthalanes, phenantherenes, diabenzothiophrenes and other PAH compounds is provided in Table 4-1. The mean concentration of PAH 4-ring (molecular weight (mw) 228) at Flyndre and the mean concentration of PAH 6-ring (mw 276) at Affleck exceeded the respective UKOOA (2001) background concentration for the Central North Sea in areas > 5 km from oil and gas infrastructure at Flyndre. One sample of PAH 6-ring (mw 276) at Flyndre exceeded the UKOOA (2001) background concentration (OGUK, 2021). No samples exceeded the UKOOA (2001) 95th percentile concentrations.

Table 4-1 Concentrations of Polycyclic Aromatic Hydrocarbons (PAH) in samples available on UKBenthos (OGUK, 2021) at fields in the vicinity of the Development

Field (Year of Survey)	Naphthalanes	Phenantherenes	Diabenzothiophrenes	PAH 4-ring (mw 202)	PAH 4-ring (mw 228)	PAH 5-ring (mw 258)	PAH 6-ring (mw276)
Affleck (2006)	**Mean:** 0.002 µg/g **Range**: <0.001 – 0.003 µg/g)	**Mean:** 0.01 µg/g **Range**: 0.008 – 0.015 µg/g)	**Mean**[5]**:** <0.001 µg/g	**Mean:** 0.009 µg/g **Range**: 0.004 – 0.011 µg/g)	**Mean:** 0.013 µg/g **Range**: 0.012– 0.014 µg/g [1])	**Mean:** 0.041 µg/g **Range**: 0.034 – 0.049 µg/g)	**Mean:** 0.093 µg/g **Range**: 0.082 – 0.11 µgg)
Cawdor (2014)	**Mean:** 0.002 µg/g **Range**: <0.001 – 0.009 µg/g)	**Mean:** 0.004 µg/g **Range**: 0.001 – 0.009 µg/g)	**Mean**[5]**:** <0.001 µg/g	**Mean:** 0.0047 µg/g **Range**: 0.001 – 0.009 µg/g)	**Mean:** 0.005 µg/g **Range**: 0.001 – 0.008 µg/g)	**Mean:** 0.025 µg/g **Range**: 0.015 – 0.034 µg/g)	**Mean:** 0.030 µg/g **Range**: 0.016 – 0.043 µg/g)
Flyndre (2006)	**Mean**[5]: <0.001 µg/g	**Mean:** <0.001 µg/g **Range**: <0.001 – 0.002 µg/g)	**Mean**[5]: <0.001 µg/g	**Mean:** 0.004 µg/g **Range**: 0.004 – 0.004 µg/g)	**Mean:** 0.024 µg/g **Range**: 0.02 – 0.028 µg/g)	**Mean:** 0.026 µg/g **Range**: 0.021 – 0.032 µg/g)	**Mean:** 0.06 µg/g **Range**: 0.051 – 0.07 µg/g)

Purple cells correspond to sites with sample concentrations which exceed the UKOOA (2001) mean for the Central North Sea.

[5] *No range was provided for this in the UKBenthos database as all concentrations were noted as < 0.001 µg/g*

Heavy Metals

Sediments sampled along the Affleck pipeline route in 2021 were analysed to determine heavy metal concentrations. Barium concentrations were analysed using a hydrofluoric acid extraction as well as by sodium fusion, which allows for barium which is more tightly bound to other compounds to be more easily digested. Barium concentrations ranged from 193 µg/g to 434 µg/g using by fusion and from 300 µg/g to 500 µg/g by extraction. The maximum value was interpreted as a statistical outlier, and this was likely due to the station (ENV-AFF-11) being 37 m from plugged and abandoned wells. The hydrocarbon concentrations were not significantly elevated at this station, and therefore, it was not expected that the elevated barium was a result of the presence of oil-based drilling mud, but rather, potentially a result of diffuse water-based drilling mud or from the ubiquitous presence of barium in the area. With the exception of ENV-AFF-11, barium concentrations were below the UKOOA (2001) mean of 348 μgg^{-1} in locations > 5 km from existing infrastructure, and therefore, considered typical of the wider area (Gardline, 2019c).

Several metals were present at concentrations which exceeded CNS background concentrations for areas over 5 km from the nearest platform and almost all stations exceeded the background concentrations for chromium and lead (Table 4-2). Considering the existing oil and gas developments in the area, the concentrations are considered to be consistent with areas associated with oil and gas activities. When the metals were normalised to 5% aluminium and compared to the OSPAR (2005) Background Concentration (BC), Background Assessment Criteria (BAC) and Background Reference Concentration (BRC) for the CNS, which for natural variations derived from differences in sediment characteristics. Barium and lead exceeded the BC levels at all stations and the mean concentration for lead was slightly above the OSPAR BAC value. Chromium exceeded the OSPAR (2005) BC value at two stations and arsenic and copper both exceeded the OSPAR (2005) BC value at one station. Despite this, all metal concentrations were below the ERL and AET value, indicating that no toxicological effects on the faunal community were occurring.

Sediments samples at the 2019 Talbot survey were also analysed for heavy metal concentrations. Barium concentrations extracted through hydrofluoric acid ranged from 206 µg/g to 267 µg/g and those analysed via sodium fusion ranged from 157 µg/g to 1270 µg/g. Barium concentrations were elevated at four stations (ENV5, ENV3, ENV4 and ENV7) which was interpreted as potentially resulting from the presence of oil-based drilling muds or as a result of historical contamination. Similar to Affleck, as the hydrocarbon concentrations were not elevated at the stations with higher barium concentrations compared to others, the likelihood of oil-based drilling muds driving the elevated barium concentrations was considered low. ENV5 contained the maximum concentration of barium observed across the survey area, and this was considered to be a statistical outlier. This station lies approximately 750 m from a plugged and abandoned well which may explain in this elevated barium concentration. The barium concentrations at the Talbot survey area were below the 95th percentile of 720 µg/g, with the exception of ENV5. The mean concentration for all other metal concentrations were considered to be within the relevant OSPAR (2005) BAC concentrations and generally consistent with the wider area (Gardline, 2019c) (Table 4-2).

Table 4-2 Summary of sediment metal analysis across the Affleck and Talbot survey areas (Gardline, 2019c; Gardline, 2021c)

Metal	Range of values across the Affleck Survey Area (µg/g)			Range of values across the Talbot survey area (µg/g)			CNS background concentration (μgg^{-1})	Background reference
	Min	Max	Mean	Min	Max	Mean		
Aluminium	11,600	14,600	12,847	12,300	1,400	13,147	N/A	N/A
Arsenic	2.6	4.6	3.2	2.8	4.2	3.2	N/A	N/A
Barium (by fusion)	193	434	233	201	219	211	348 (mean), 720 (95th percentile)	UKOOA, 2001
Barium (by extraction)	300	500	327	157	1270	352	348 (mean), 720 (95th percentile)	UKOOA, 2001

Metal	Range of values across the Affleck Survey Area (µg/g)			Range of values across the Talbot survey area (µg/g)			CNS background concentration ($\mu g g^{-1}$)	Background reference
	Min	Max	Mean	Min	Max	Mean		
Cadmium	< LOD	< LOD	N/A[6]	<LOD	<LOD	N/A[6]	0.03 (mean), 0.12 (95th percentile)	UKOOA, 2001
Chromium	11.7	15.8	13.4	12.6	16.2	14.3	9.13 (mean), 31.0 (95th percentile)	UKOOA, 2001
Copper	<LOD	7.2	N/A[6]	3.1	13.0	4.7	2.41 (mean), 6 (95th percentile)	UKOOA, 2001
Iron	3,850	5,320	4,613	4,830	6,730	5,879	4,725 (mean) 11,160 (95th percentile)	UKOOA, 2001
Mercury	<LOD	<LOD	N/A[6]	<LOD	0.02	N/A[6]	0.03 (mean), 0.12 (95th percentile)	UKOOA, 2001
Nickel	2.3	3.8	2.8	3.6	8.6	4.4	7.3 (mean), 19 (95th percentile)	UKOOA, 2001
Lead	8.4	11.8	9.9	9.1	10.9	9.9	6.75 (mean), 16.7 (95th percentile)	UKOOA, 2001
Tin	<LOD	1.4	N/A[6]	<LOD	<LOD	N/A[6]	N/A	N/A
Vanadium	10.3	15.7	12.6	11.3	13.7	12.6	N/A	N/A
Zinc	<LOD	21.2	N/A[6]	7.9	14.8	9.3	13.5 (mean), 32.6 (95th percentile)	UKOOA, 2001

Cells in purple correspond to concentrations UKOOA (2001) background mean value.

Cells in blue correspond to concentrations above UKOOA (2001) 95th percentile value.

The heavy metal concentrations in samples available on UKBenthos at the Affleck field, Cawdor field and Flyndyre field are provided in Table 4-3. The UKOOA (2001) background concentration for areas > 5 km from an oil and gas platform in the Central North Sea for chromium, copper and lead was exceeded at Affleck, Cawdor and Flyndyre and the UKOOA (2001) background concentration for cadmium and zinc was exceeded at Affleck and Flyndyre. The concentration of zinc at the Cawdor field survey exceeded UKOOA (2001) 95th percentile value. All other heavy metal concentrations were within the UKOOA (2001) background concentrations for areas > 5 km from an oil and gas platform in the CNS (Table 4-3).

[6] Mean could not be calculated as one or more values below LOD.

Table 4-3 Concentrations of Heavy Metals in samples available on UKBenthos (OGUK, 2019) at fields in the vicinity of the Development

Field (Year of Survey)	Barium	Cadmium	Chromium	Copper	Nickel	Lead	Vanadium	Zinc	Mercury
Affleck (2006)	**Mean:** 290 µg/g **Range:** 280 – 320 µg/g	**Mean:** 0.12 µg/g **Range:** 0.1 – 0.2 µg/g	**Mean:** 11.8 µg/g **Range:** 11 – 12 µg/g	**Mean:** 3 µg/g **Range:** 3 – 3 µg/g	**Mean:** 4.2 µg/g **Range:** 4 – 5 µg/g	**Mean:** 12.8 µg/g **Range:** 12 – 15 µg/g	**Mean:** 12.6 µg/g **Range:** 12 - 13 µg/g	**Mean:** 17 µg/g **Range:** 14 – 24 µg/g	**Mean:** 0.012 µg/g **Range:** 0.01 – 0.02 µg/g
Cawdor (2014)	**Mean:** 227 µg/g **Range:** 216 – 240 µg/g	**Mean:** <0.1 µg/g **Range:** <0.1 – 0.1 µg/g	**Mean:** 13.6 µg/g **Range:** 11.4 – 17.7 µg/g	**Mean:** 5.9 µg/g **Range:** 4.7 – 7.5 µg/g	**Mean:** 4.0 µg/g **Range:** 3.4 – 5 µg/g	**Mean:** 9.4 µg/g **Range:** 8.5 – 10.3 µg/g	**Mean:** 23.3 µg/g **Range:** 21.7 – 24.7 µg/g	**Mean:** 36.4 µg/g **Range:** 29.3 – 57 µg/g	**Mean:** <0.01 μgg^{-1} **Range:** <0.01 – 0.03 µg/g
Flyndre (2006)	**Mean:** 250 µg/g **Range:** 233 - 269 µg/g	**Mean:** 0.2 µg/g **Range:** 0.1 – 0.3 µg/g	**Mean:** 12.7 µg/g **Range:** 11 – 15 µg/g	**Mean:** 3.3 µg/g **Range:** 3 – 4 µg/g	**Mean:** 4 µg/g **Range:** 4 – 4 µg/g	**Mean:** 13 µg/g **Range:** 12 – 15 µg/g	**Mean:** 14.3 µg/g **Range:** 13 – 16 µg/g	**Mean:** 19.7 µg/g **Range:** 15 - 26 µg/g	**Mean:** 0.02 µg/g **Range:** 0.01 – 0.04 µg/g

Cells in purple correspond to concentrations UKOOA (2001) background mean value.
Cells in blue correspond to concentrations above UKOOA (2001) 95th percentile value.

4.3 BIOLOGICAL ENVIRONMENT

4.3.1 Plankton

Planktonic assemblages exist in large water bodies and are transported simultaneously 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.

The distribution and abundance of plankton is heavily influenced by water depth, tidal mixing and thermal stratification within the water column (Edwards *et al.*, 2010). The majority of the plankton occurs in the photic zone, i.e., the upper 20 m or so of the sea in temperate latitudes, which receives enough light for photosynthesis (Johns and Reid, 2001). However, zooplankton can extend to greater depths and many species undergo diurnal vertical migrations, rising to feed before returning to depth. Natural seasonality and high small-scale variability, both in species composition and abundance, is an important feature of planktonic communities. Many species of larger animals such as fish, birds, and cetaceans, are dependent upon plankton for food. The distribution of plankton, 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 *Tripos* (*T. fusus*, *furcam*, *lineatum*) 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) have been observed in the area (DECC, 2016). Densities of phytoplankton fluctuate throughout the year, with sunlight intensity and nutrient availability driving its abundance and productivity together with water column stratification (Johns and Reid, 2001; DECC, 2016). Plankton production generally shows two peaks in the year. The first occurs in spring when increased sunlight allows exploitation of the nutrient rich water generated over winter, and the second occurs in autumn, when the onset of mixing delivers additional nutrients while there is still sufficient energy from sunlight to power photosynthesis (DECC, 2016).

Zooplankton species richness is greater in the northern and central areas of the North Sea, than in the south and displays greater seasonality. Zooplankton communities in this area are dominated in terms of biomass and productivity by copepods, particularly *Calanus* species such as *C. finmarchicus* and *C. helgolandicus*. Other important taxa include *Acartia*, *Temora*, and *Oithona spp*. Larger zooplankton species such as euphausiids and decapod larvae are also important to the zooplankton community in this region (DECC, 2016).

C. finmarchicus has historically dominated the zooplankton of the North Sea and is used as an indication of zooplankton abundance. 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 in particular, and a relative increase in the populations of *C. helgolandicus* has occurred (DECC, 2009; Edwards *et al.*, 2010; Baxter *et al.*, 2011).

4.3.2 Benthos

The biota living near, on, or in the seabed, is collectively termed benthos. The diversity and biomass of the benthos is dependent on a number of factors including substrata (e.g., sediment, rock), 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.

The CNS and NNS predominantly consist of deep circalittoral sand with areas of finer sediments to the north. Generally, the benthic communities in the NNS are more diverse compared to the south (DECC, 2016).

Visible fauna in the seabed imagery and video footage taken across 16 stations during the Affleck pipeline survey were generally sparse, with 24% of seabed images containing no visible fauna. The most frequently recorded fauna were juvenile Asteroida, the anemone Parazoanthus and Animalia tubes of unknown species. Other fauna recorded included Annelids (*Aphrodita aculeata, Myxicola cf. infundibulum*, *Oxydromus flexuosus*, Pectinariidae, Serpulidae, Terebellida), Arthropoda (Brachyura, Paguroidea), Bryozoa (Flustridae), Cnidaria (*Alcyonium digitata*, Ceriantharia, *Hormathia digitata, Hydractinia echinata*, Pennatulidae), Echinodermata (*Asterias rubens, Astropecten irregularis*), Mollusca (*Acanthocardia echinata*, *A. islandica* including siphons, Bivalvia including siphons, *Buccinum undatum*, Scaphopoda) and Porifera. A marine buoy was identified within the survey area and this area of hard substrate was associated with a higher faunal density than the remainder of the survey area (Gardline 2021b).

Visible fauna across the 69 sediment samples recovered from the Affleck pipeline survey area included Annelida (Polychaeta, tubes), Echonidermata (Asteroidea, Echinoidea), Mollusca (*A. islandica* shells, Bivalvia, Gastropoda, Scaphopoda) (Gardline, 2021b).

Macrofaunal analysis undertaken on the samples collected for the Affleck pipeline survey indicated that the faunal community was relatively homogenous across the sample stations and the juvenile and adult-only dataset were highly similar (98.9%). Annelida dominated the faunal community, accounting for 80% of individuals and 40% of taxa. Mollusca were the second most dominant taxa followed by 'others', Arthropoda and Echinodermata. The most dominant species were *P. jeffreysii, P. assimilis*, and *Galathowenia.* The number of individuals observed at each station varied across the survey area and this was mainly due to variations in the abundances of *Paramphinome jeffreysii*, *Pholoe assimilis* and *Owenia*. Despite this, there was a high degree of uniformity across the survey stations in terms of taxa. Statistical analysis indicates that the faunal community had a low species dominance and that all stations were more similar than dissimilar. The variations in the faunal community are likely due to natural fluctuations in sediment characteristics and concentrations (Gardline, 2021b).

Six ocean quahog (*A. islandica*) were observed across five stations during the Affleck pipeline survey, as well as a single pair of siphons at one sampling location and dead and broken shells of this species throughout the survey area. Three juvenile ocean quahog were recorded across the survey area, all at a single station (AFF-11) (Gardline, 2021b).

The seabed imagery recorded three small pencil burrows and a single seapen at one station. The burrows were not considered to be consistent with, or in sufficient density to be, the OSPAR (2009) threatened and/or declining habitat, seapen and burrowing megafauna communities (Gardline, 2021b).

The most frequently recorded visible fauna in the seabed images taken during the Talbot survey area was the mollusc Scaphonopoda, which was present in 69% of the seabed images. The annelid *Ampharete falcata* and the echinoderm Asteroida were also observed frequently in the seabed images. Typical species recorded observed in the sediment samples included Annelids (*A. falcata, Ditrupa sp*., Polychaeta, Terebillidae), Echinodermata (*Echinocardium cordatum*, Echinoidea) and Mollusca (Bivalvia, Scaphopoda) (Gardline, 2019b).

The macrofaunal analysis undertaken for the sediment samples collected at the Talbot survey indicated that the benthic community was relatively homogenous across the survey area with a high degree of evenness. In the adult dataset, the faunal community was dominated by annelid worms accounting for 61% of the sampled individuals and 38% of taxa, followed by arthropods and molluscs which accounted for 16% and 10% of recorded individuals, respectively. In the full dataset, which includes juveniles, the contribution of Echinodermata to the faunal community increased from 4% in the adult only data set to 19%. Of the 195

taxa recorded, 24 were recorded at all stations and generally the community was interpreted to represent that of one which was subject to little disturbance or contamination. The most commonly recorded species include *Paramphinome jeffreysii, Eudorellopsis deformis* and *Galathowenia oculata*. Statistical analysis of the macrofaunal data indicated that variation in species composition was unlikely to be influenced by physico-chemical parameters and more likely related to a reduction in Polychaete species in the south of the survey area (Gardline, 2019c).

Faunal burrows were observed across almost all sampling locations in the Talbot survey (representing a density of 8% of the seabed across all images), although no seapens were observed. An assessment for the presence of the OSPAR (2008) declining and/or threatened habitat, 'seapen and burrowing megafauna communities' concluded that the density of burrows observed in the seabed images was 'rare', and in conjunction with the absence of any visible burrowing megafauna, the burrows were not considered to resemble the seapen and burrowing megafauna community habitat (Gardline 2019b).

Horse mussels (*Modiolus modiolus*) (total of 236 individuals) were recorded across all camera and video sampling locations in the Talbot survey area. An assessment for the potential for the horse mussels recorded in the seabed images and video footage to be biogenic reefs, an Annex I of the Habitats Directive (1992) and an OSPAR (2008) threatened and/or declining habitat was undertaken. The assessment considers the 'reefiness' of areas of *M. modiolus* coverage of > 25 m^2. At several locations in the survey area, the density of *M. modiolus* was > 25 m^2 and therefore warranted an assessment of 'reefiness'. At an additional two sampling locations, *M. modiolus* was adjacent to areas of higher SSS reflectivity which exceeded 25 m^2. Due to the combination of *M. modiolus* coverage being > 25 m^2 coverage associated with higher reflectivity and an elevated seabed, the areas of *M. modiolus* across 11 sampling locations were considered with medium confidence to likely form Annex I reef habitat. However, the assessment also notes that this conclusion should be treated with caution, as the acoustic signature which can be used to identify areas of horse mussel bed was not well defined and may be associated with shells or hard substrate. Therefore, it is considered that there is insufficient evidence for the positive identification of biogenic reef.

Porifera were observed across all stations in the Talbot survey except two, and therefore, an assessment of the resemblance of the Porifera to be the OSPAR (2008) threatened and/or declining habitat 'deep-sea sponge aggregations' was made. The coverage of Porifera across all stations and transects was <0.01% of the seabed, which was considered to be rare.

Ocean quahog siphons were recorded at seven sampling locations in the Talbot survey area and dead shells were also recorded across almost all stations. The presence of ocean quahog could not be confirmed.

Survey data available on UKBenthos for the Affleck, Cawdor and Flyndre fields was also analysed. At Affleck, the most abundant species recorded in a 2006 survey were the echinoderms: *Echinoidea spp*. and *Ophiuroidea spp*., the polychaetes: *G. oculata*, *P. jeffreysii* and *Amphictene auricoma,* the anemone: *Cerianthus lloydii*, brittlestar (*Amphiura filiformis)*, the amphipod: *Harpinia antennaria,* and the crustacean: *E. deformis* (OGUK, 2021).

At Cawdor, echinoderms and polychaetes were also abundant. Juvenile *Echnidoidea spp*. were most abundant followed by the polychaetes *P. jeffreysii*, *G. oculata*. Juvenile *Ophiurodea spp*. and the mollusc *Cardiidae spp*. were also highly abundant followed by the polychaetes *Pholoe assimilis*, *Spiophanes bombyx*, the mollusc *Kurtiella bidentata* and bristleworm (*Scoloplos armiger)* (OGUK, 2021).

A similar species composition was recorded at Flyndre, with echnioderms and polychaetes being dominant. Juvenile echinoderms, *Echinoidea spp.* and *Ophiuroidea spp.* were dominant in terms of abundance followed by polychaetes *P. jeffreysii*, *G. oculata*, the mollusc *K. bidentata*, the anemone *C. lloydii*, brittlestar, the amphipod *H. antennaraia*, the crustacean *Ostracoda spp.*, and *Nematoda spp.* (OGUK, 2021).

4.3.3 Fish and Shellfish

A number of commercially important fish and shellfish species can be found in the vicinity of the Development. 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 North Sea is historically important for its fish stocks, with fishing occurring throughout the year.

The Development is located within the International Council for the Exploration of the Sea (ICES) rectangles 41F2 and 42F2, in an area of spawning and nursery grounds for several commercial important species, as shown in Table 4-4, Figure 4-9, Figure 4-10 and Figure 4-11.

The Development falls within low or undetermined intensity nursery grounds for anglerfish (*Lophius piscatorius*), blue whiting (*Micromesistius poutassou*), European hake (*Merluccius merluccius*), haddock (*Melanogrammus aeglefinus*), herring (*Clupea harengus*), ling (*Molva molva*), mackerel (*Scomber scombrus*), Norway pout (*Trisopterus esmarkii*), plaice (*Pleuronectes platessa*), sandeels (*Ammodytes marinus*), spotted ray (*Raja montagui*), spurdog (*Squalus acanthias*) and whiting (*Merlangius merlangus*) (Coull *et al.*, 1998; Ellis *et al.*, 2012). The Development also lies within a high intensity nursery ground for cod (*Gadus morhua*) and a low or undetermined intensity spawning ground for cod, lemon sole (*Microstomus kitt*), Norway pout, plaice, mackerel, sandeels and whiting (Coull *et al.*, 1998; Ellis *et al.*, 2012). A high concentration spawning area for mackerel overlaps with ICES rectangles 41F2 and 42F2 and a high concentration spawning area for Norway pout overlaps with ICES rectangle 42F2.

The following species are UKBAP species and Species of Principal Importance under the Natural Environment and Rural Communities (NERC) Act 2006: anglerfish, blue whiting, European hake, herring, ling, mackerel, plaice, sandeel, spurdog, whiting, and cod (BRIG, 2007). All of these species are also PMFs with the exception of European hake and plaice and with the addition of Norway pout. Cod, spurdog and spotted ray are also on the OSPAR (2008) list of threatened and/or declining species and habitats. Blue whiting, cod, haddock, herring, lemon sole, plaice, spotted ray, sprat, spurdog and whiting are on the International Union for Conservation of Nature (IUCN) Red List. All species are listed as 'Least Concern' with the exception of cod, haddock and spurdog which are listed as globally vulnerable (IUCN, 2021).

Table 4-4 Fisheries sensitivities within ICES rectangles 41F2 and 42F2 (Coull et al., 1998; Ellis et al., 2012)

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/N	S*/N	S*/N	S/N	N	N	N	N	N	N	N	N
European hake	N	N	N	N	N	N	N	N	N	N	N	N
Haddock	N	N	N	N	N	N	N	N	N	N	N	N
Herring	N	N	N	N	N	N	N	N	N	N	N	N
Lemon sole			S	S	S	S	S	S				
Ling	N	N	N	N	N	N	N	N	N	N	N	N
Mackerel	N	N	N	N	S*N	S*N	N	N	N	N	N	N
Norway pout	S/N	S*/N	S*/N	S/N	S/N	N	N	N	N	N	N	N
Plaice	S*/N	S*/N	S/N	N	N	N	N	N	N	N	N	S/N

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sandeels	S/N	S/N	N	N	N	N	N	N	N	N	S/N	S/N
Sprat					S*	S*	S	S				
Spotted ray	N	N	N	N	N	N	N	N	N	N	N	N
Spurdog	N	N	N	N	N	N	N	N	N	N	N	N
Whiting	N	S/N	S/N	S/N	S/N	S/N	N	N	N	N	N	N

S = Spawning, N = Nursery, S/N = Spawning and Nursery; * = peak spawning; Shading = high intensity nursery as per Ellis et al., 2012, Shading = High concentration spawning as per Coull et al., (1998)

Fisheries sensitivity maps produced by Aires *et al.,* (2014) detail aggregations of fish species in the first year of their life (i.e., group 0 or juvenile fish) occurring around the UKCS. Maps from Aires *et al.*, (2014) which show the probability of the presence of aggregations of 0 group anglerfish, blue whiting, European hake, haddock, herring, mackerel, horse mackerel (*Trachurus trachurus*), Norway pout, plaice, sprat (*Sprattus sprattus)* and whiting are displayed on (note, for European hake and anglerfish the maps show probability of presence of 0 group fish as opposed to presence of aggregations). The probability of the presence of aggregations of 0 group fish species occurring in the Development area was low for all species, although slightly higher probabilities are present for cod, haddock, and hake[7].

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., sandeel and herring) have very specific habitat requirements, and as a consequence their spawning grounds are relatively limited and potentially vulnerable to seabed disturbance and change.

Predicted spawning areas for cod were modelled based on the abundance of spawning fish within three population subareas and nine environmental layers (González-Irusta and Wright, 2016). Based on these predictions, the Development lies within an area classified by unfavourable spawning habitats (low mean abundance values).

In general, areas used for spawning are regarded as more sensitive than nursery areas (CEFAS, 2001). Although there is fish spawning and nursery activity in the Development area, the spawning and nursery areas are part of larger offshore areas. Cod, Norway pout, plaice, lemon sole and whiting which are known to spawn in 41F2 and 42F2 are not demersal spawners and are not reliant upon specific locations or benthic habitat types. Their spawning activities cover large areas and so their eggs and juveniles are unlikely to be significantly impacted by the Development. Sandeel are benthic spawners with a demersal egg phase and require specific habitat conditions for spawning. Sandeels are shoaling fish which lie buried in the sand during the night, and hunt for prey in mid-water during daylight hours (DECC, 2016). They are restricted to sandy sediments (Holland *et al.*, 2005; DECC, 2016). They feed mainly on planktonic prey such as copepods and crustacean larvae, but they can also consume polychaete worms, amphipods, and small fish including other sandeels. When active, sandeels swim continually in order to remain clear of the bottom (DTI, 2001). Sandeels usually spawn between November and February and lay eggs in clumps on sandy substrates. The larvae are pelagic up to approximately two to five months after hatching and are believed to over-winter buried in the sand. Sandeel are important not only to commercial fisheries but also are also

[7] *The probability maps show information detailing the performance of the Random Forest model used to classify the data sets, this ranked probability of the presence of aggregations each species from low to high.*

of ecological significance as they are a vital food source for marine birds and predatory fish (DECC, 2016). According to Mazik, *et al.* (2015), sandeels are likely to avoid areas with greater than 10% of silt/clay or very fine sand. PSA results of the samples collected during the Affleck pipeline survey contained 8.3 – 16.1% fines and the PSA results of the samples collected during the Talbot survey contained 1.5 – 10% fines (Gardline, 2019c, Gardline, 2021b). Only one station at the Affleck survey contained a fines content of less than 10%. Therefore, it is expected that the sediment may be suitable for sandeel spawning, although this will mostly be applicable to the section of the Affleck umbilical between Talbot and Judy. A recently developed statistical model produced by Marine Scotland indicate that the probability and density of sandeel burrows in the Development area is low[8] (Langton *et al*., 2021).

Blocks 30/7, 30/12, 30/19, 30/13 and 30/14 are also not within a potential herring spawning ground (Oil and Gas Authority, 2019).

[8] *Depth biases in the statistical model mean that sandeel habitat suitability predictions in water depths > 70 m are less accurate.*

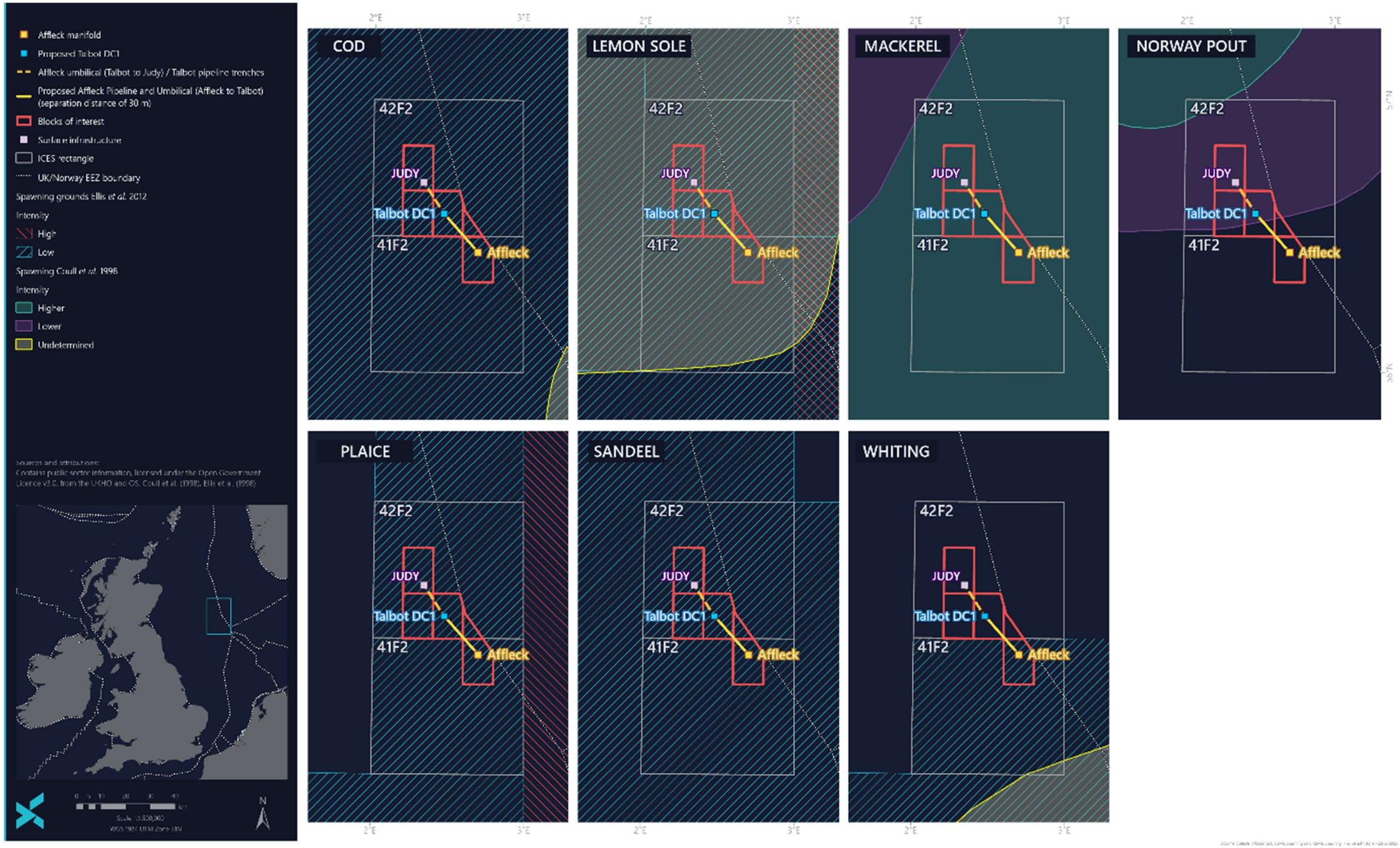

Figure 4-9 Potential fish nursery grounds around the Development area (Coull et al., 1998; Ellis et al., 2012) (1)

Figure 4-10 Potential fish nursery grounds around the Development area (Coull et al., 1998; Ellis et al., 2012) (2)

Figure 4-11 Areas of potential fish spawning around the Development area (Coull et al., 1998; Ellis et al., 2012)

4.3.4 Seabirds

Much of the North Sea and its surrounding coastline is an internationally important breeding and feeding habitat for seabirds. In the CNS and 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 as a result 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 (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.

According to the density maps provided in Kober *et al.*, (2010), the following species have been recorded within UKCS Blocks 30/7, 30/12, 30/19, 30/14 and 30/13, which the Development area lies within; northern fulmar, northern gannet, Artic skua (*Stercorarius parasiticus)*, great skua, black-legged kittiwake, great black-backed gull (*Larus marinus)*, common gull (*Larus canus)*, lesser black-backed gull (*Larus fuscus)*, herring gull (*Larus argentatus)*, common guillemot, razorbill, little auk (*Alle alle)* and Atlantic puffin.

The JNCC has released the latest analysed trends in abundance, productivity, demographic parameters and diet of breeding seabirds, from the Seabird Monitoring Programme (JNCC, 2021a). This data provides at-a-glance UK population trends as a % of change in breeding numbers from complete censuses. From the years 2000 - 2019, the following population trends for species known to use the field area have been recorded: northern fulmars (-33%), northern gannet (+34%), arctic skua (-70%), razorbill (+37%), black legged kittiwakes (-29%) and common guillemots (+60%). Generally, breeding seabird numbers of some species have shown a long-term decline, most probably as a result of a shortage of key prey species such as sandeels associated with changes in oceanographic conditions (Baxter *et al.*, 2011: DECC, 2016).

The Seabird Oil Sensitivity Index (SOSI) identifies sea areas where seabirds are likely to be most sensitive to oil pollution. It is an updated version of the Oil Vulnerability Index (JNCC, 1999) as it uses survey data collected between 1995 and 2015 and includes an improved method to calculate a single measure of seabird sensitivity to oil pollution (Webb *et al.*, 2016). The survey area covers the UKCS and beyond. Seabird data was collected using boat-based, visual aerial, and digital video aerial survey techniques. This data was combined with individual species sensitivity index values and summed at each location to create a single measure of seabird sensitivity to oil pollution. Block/month combinations that were not provided with data have been populated using the indirect assessment method provided by Webb *et al.* (2016). Maximum sensitivity values were used in this assessment to provide a worst-case scenario assessment.

As shown in Table 4-5, Figure 4-12 and Figure 4-13 , the seabird sensitivity is low for Blocks 30/13, 30/14 and 30/19 between December and May and between July and September. Seabird sensitivity in Blocks 30/13 and 30/14 in May and June is very high and medium in Block 30/19 in this time period. There is no available data for the months of October and November for these blocks. Seabird sensitivity in Block 30/7 is low between December and March and between May and September and no data is available for the remaining months for this block. In 30/12, sensitivity is low between December and February and between March and October. Sensitivity is Medium and February and no data is available for October and November.

Table 4-5 Seabird oil sensitivity index for Blocks 30/13, 30/14 and 30/19 and around surrounding vicinity (Webb et al., 2016)

Block	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
30/1	5*	5	5*	N	5*	5	5	5	5*	N	N	N
30/2	5	5	5*	N	5*	5	5	5	5*	N	N	5*
30/3	5	5	5*	N	4*	4	5	5	5*	N	N	5*
30/6	5*	5	5*	N	5*	5	5	5	5*	N	N	N
30/7	5	5	5*	N	5*	5	5	5	5*	N	N	5*
30/8	5	5	5*	N	1*	1	5	5	5*	N	N	5*
30/11	5*	5	5	5*	5*	5	5	5	5*	N	N	N
30/12	5	4	5	5*	5*	5	5	5	5*	N	N	5*
30/13	5	5	5	5*	2*	2	5	5	5*	N	N	5*
30/14	5	5	5*	N	2*	2	5	5	5*	N	N	5*
30/16	5*	5	5	5*	5*	5	5	5	5*	N	N	N
30/17	5*	5	5	5*	5*	5	5	5	5*	N	N	5*
30/18	5	5*	5	5*	5*	5	5	5	5*	N	N	5*
30/19	5	5	5	5*	4*	4	5	5	5*	N	N	5*
30/20	5*	5*	5	5*	5*	5	5	5	5*	N	N	N
30/23	5*	5*	5	5*	5*	5	5	5	5	5*	N	N
30/24	5*	5*	5	5*	5*	5	5	5	5	5*	N	N
30/25	5*	5*	5	5*	4*	4	5	5	5	5*	N	N
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

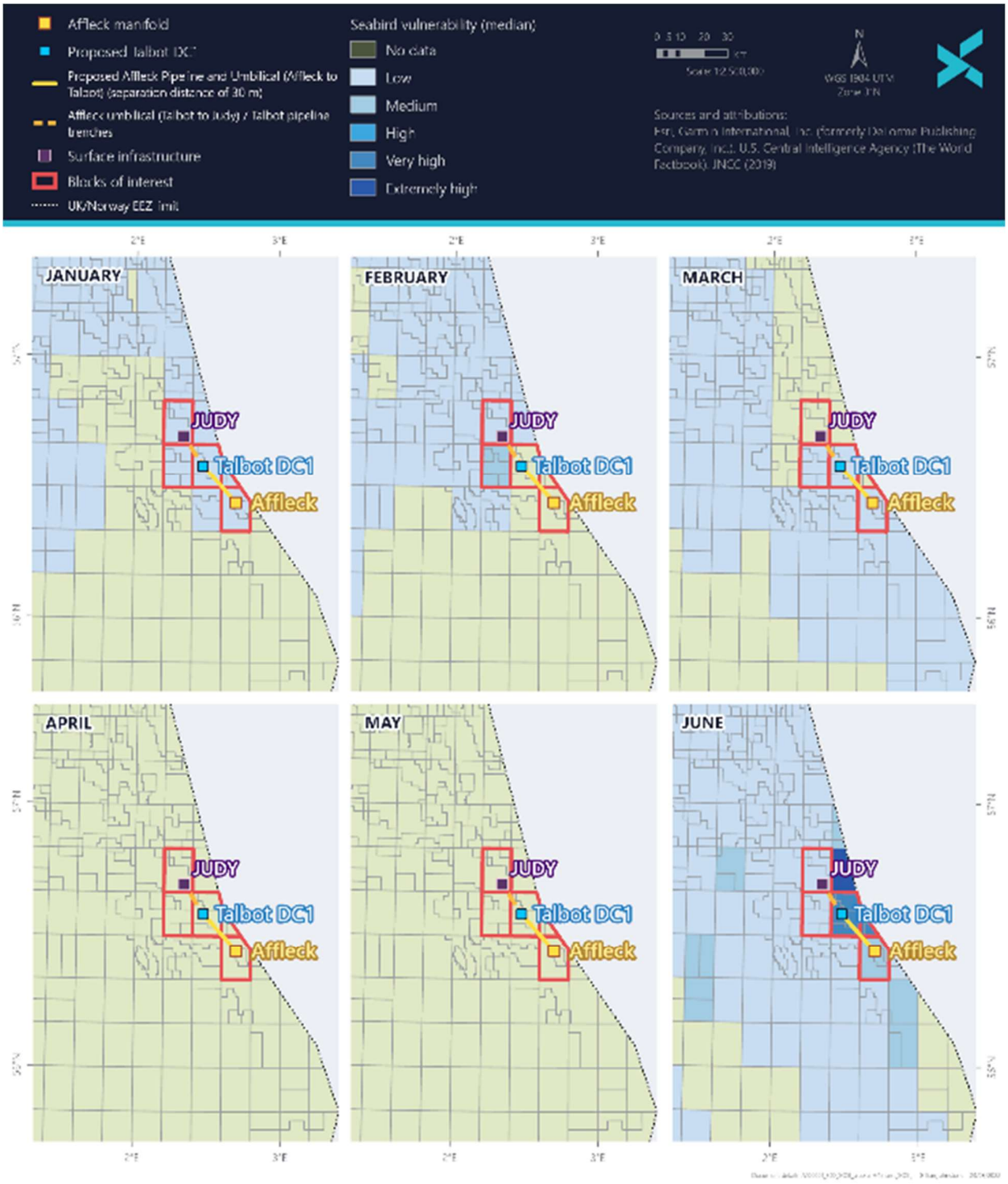

Figure 4-12 SOSI from January to June in the vicinity of the Development (Webb et al., 2016)

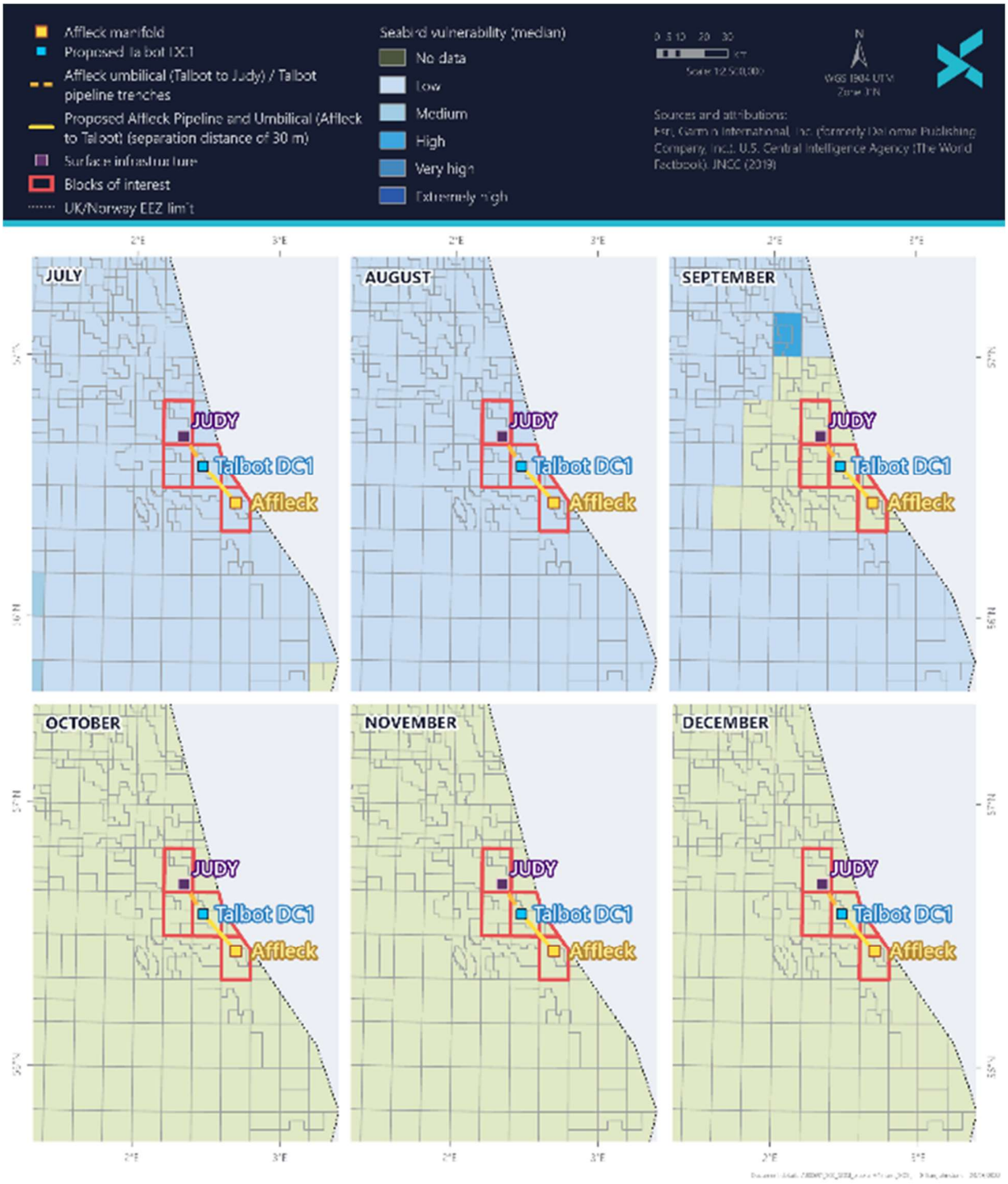

Figure 4-13 SOSI from July to December in the vicinity of the Development (Webb et al., 2016)

4.3.5 Marine Mammals

4.3.5.1 Cetaceans

The CNS and NNS have a moderate to high diversity and density of cetaceans, with a general trend of increasing diversity and abundance with increasing latitude (DECC, 2016). Twenty-eight cetaceans have been recorded in UK waters, with eleven being considered as regular visitors and the remaining species being infrequently encountered (DECC, 2016). The regular visitors to UK waters include harbour porpoise (*Phocoena phocoena*), bottlenose dolphin (*Tursiops truncatus*), white-beaked dolphin (*Lagenorhyncus albirostris*), minke whale (*Balaenoptera acutorostrata*), fin whale (*Balaenoptera physalus*), Atlantic white-sided dolphin (*Lagenorhyncus acutus*), short-beaked common dolphin (*Delphinus delphi*), Risso's dolphin (*Grampus griseus*), killer whale (*Orcinus orca*), long-finned pilot whale (*Globicephala melas*) and sperm whale (*Physeter macrocephalus*) (DECC, 2016).

The nearest protected site for marine mammals is the Southern North Sea Special Area of Conservation (SAC), designated for harbour porpoise, located over 130 km SSW of the Development.

A description of occurrence for cetaceans expected to occur within the Development area is provided in Table 4-6 and is based on Hammond *et al.,* (2021), Reid *et al.,* (2003) as well as spatial data available on MagicMap (DEFRA, 2021b).

Surveys undertaken for the "Small Cetaceans in the European Atlantic and North Sea" (SCANS-III) provide abundance and density estimates for commonly sighted cetacean species across different regions (survey blocks) in the UKCS (Hammond *et al.*, 2021). The approximate density of a particular cetacean species in the vicinity of a development can be estimated using the densities for the survey Block within which a development is located (Hammond *et al.*, 2021). The Development is located within Block Q of the SCANS-III survey (Hammond *et al.*, 2021). Within Block Q, harbour porpoise and minke whale were encountered in the SCANS-III survey and therefore, density estimates for the area are available for these species, as shown in Table 4-6. Although white-beaked and white-sided dolphins are commonly encountered in the CNS, a density estimate for these species is not available for Block Q.

As highlighted in Table 4-6, harbour porpoise is the most abundant cetacean species in the Development area (approximately 16,569 individuals in Block Q) followed by minke whale (348 individuals in Block Q). In the absence of abundance and density data for Block Q, data from the adjacent survey Block R has been used for white-beaked dolphin and white-sided dolphin with 15,694 and 644 individuals recorded in these survey block, respectively. Common dolphin and bottlenose dolphin were also recorded by Reid *et al*., 2003 as potentially being present in the Development area. Common dolphin were not recorded in Blocks Q and R of the SCANS-III survey. Bottlenose dolphin were recorded in Block R of the SCANS-III survey; however, as bottlenose dolphin are predominantly found in coastal waters, densities in the offshore waters of the Development area are expected to be low (Hague *et al*., 2020).

All cetaceans are European Protected Species (EPS), under Annex IV of the EU Habitats Directive (92/43/EEC as amended by 97/62/EC). Harbour porpoise, minke whale, Atlantic white-sided dolphin and white-beaked dolphin are all UKBAP Priority Species, Species of Principle Importance under the NERC Act 2006 and PMF. Harbour porpoise are also on the Annex II of the EU Habitats Directive (92/43/EEC as amended by 97/62/EC) and on the OSPAR (2008) list of threatened and/or declining species and habitats.

Table 4-6 Cetacean occurrence in the Development area (Hammond et al., 2021; Reid et al., 2003; Hague et al., 2020)

Species	Abundance of Individuals in Survey Block Q	Density (Animals / km^2) Within Scans-III Survey Block Q	Description of Occurrence
Harbour porpoise	16,569	0.333	Harbour porpoise are the smallest cetacean in UK waters and are seen throughout the UKCS, though the greatest numbers are found in the SNS. They usually occur in shallow waters (less than 50 m) in groups of up to three individuals, although they have been sighted in larger groups and in deeper waters (up to 200 m). Harbour porpoise movements are variable, and they do not undertake seasonal migrations, although densities are highest in the summer months (May – August).
Minke whale	348	0.0070	Minke whales usually occur on the continental shelf in water depths up to 200 m. They are mostly seasonal visitors to the North Sea and are usually sighted alone or in pairs; however, groups of up to 15 individuals may aggregate during feeding events. Data suggest that animals return to the same seasonal feeding grounds each year. They are mostly found singly, or in small groups and are rarely sighted outside of the May – September months.
Atlantic white-sided dolphin (see note[9])	644	0.0100	Atlantic white-sided dolphins have a limited distribution but are found in both temperate and cold waters of the north Atlantic Ocean, usually over deep-slope continental shelves and canyon waters. They tend to prefer deeper water and are not seen close to shore that often. They feed in groups, usually found in pods of anything between 2 and 50 individuals. It is not uncommon to see much larger pods (hundreds or even thousands of dolphins) where they have found dense concentrations of food. Densities in the region surrounding the Development are highest between May and September.
White-beaked dolphin (see note[9])	15,694	0.243	White-beaked dolphin are the second most abundant cetacean in the North and CNS and are often found in groups of up to 10 individuals. The densities of white-beaked dolphin are highest in the west and central section of the North Sea; however, sightings do occur around the Development area and even extend further north. Peak abundance in the Development area occurs between July and September.

[9] *Due to the absence of data in Block Q for white-sided dolphin and white-beaked dolphin, data was taken from the adjacent Survey Block 'R'*

Based on the available information, Blocks 30/7, 30/12, 30/13, 30/14 and 30/19 have a low cetacean density and are not considered to be significant for feeding, breeding, nursery or migrating cetaceans. The species that are most likely to occur in the Development area include harbour porpoise, minke whale, Atlantic white-sided dolphin and white-beaked dolphin. The mobile nature of cetaceans means that any potentially significant collision risk impacts to marine mammals from the Development are unlikely as vessels will be slow moving. Nonetheless, potential impacts to marine mammals from underwater noise emitted from the Development activities are assessed in detail within Section 8 of this ES.

4.3.5.2 Pinnipeds

Five species of pinnipeds have been identified in the North Sea: grey seal (*Halichoerus grypus)*, harbour seal (*Phoca vitulina),* harp seal (*Phoca groenlandica)*, hooded seal (*Cystophora cristata)* and ringed seal (*Pusa hispida)* (Jones *et al.*, 2016). However, only two of these species live and breed in the UK, namely the grey and harbour seal. Both grey and harbour seals are listed under Annex II of the EU Habitats Directive and as PMFs, and harbour seal are listed as a Species of Principle Importance under the NERC Act 2006. The bearded, ringed, harp and hooded seals are Arctic species, and have generally only been sighted on an occasional basis in UK waters.

Grey and harbour seals feed 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 have indicated that the foraging movements of harbour seals are generally restricted to within a 40 – 50 km range of their haul-outs (SCOS, 2020). The movements of grey seals can involve larger distances than those of the harbour seal, and trips of several hundred kilometres from one haul-out to another have been recorded (SMRU, 2011). However, the majority of foraging trips are expected to be within 100 km of a haul out (SCOS, 2020).

Approximately 36% of the world's grey seals breed in the UK and most (81% of UK seals) breed in Scottish colonies. Approximately 32% of European harbour seals are found in the UK. This proportion has declined by from 40% since 2002 (SCOS, 2020).

The Development is approximately 263 km offshore of the nearest coastline. As such, although pinnipeds may be encountered in the vicinity of the Development from time to time, it is not likely that they use the area with any regularity or in great numbers. This is confirmed by the latest grey and harbour seal at-sea distribution maps. These maps predict that the density of grey and harbour seals in the vicinity of the Development are low, representing approximately zero to five individuals and 0 – 0.001% of the respective UK populations, per 25 km^2 (Russel *et al.*, 2017; Carter *et al.*, 2020), as illustrated in Figure 4-14. No interactions with seal haul-out or breeding sites are expected given the intervening distance between the Development and the coastline.

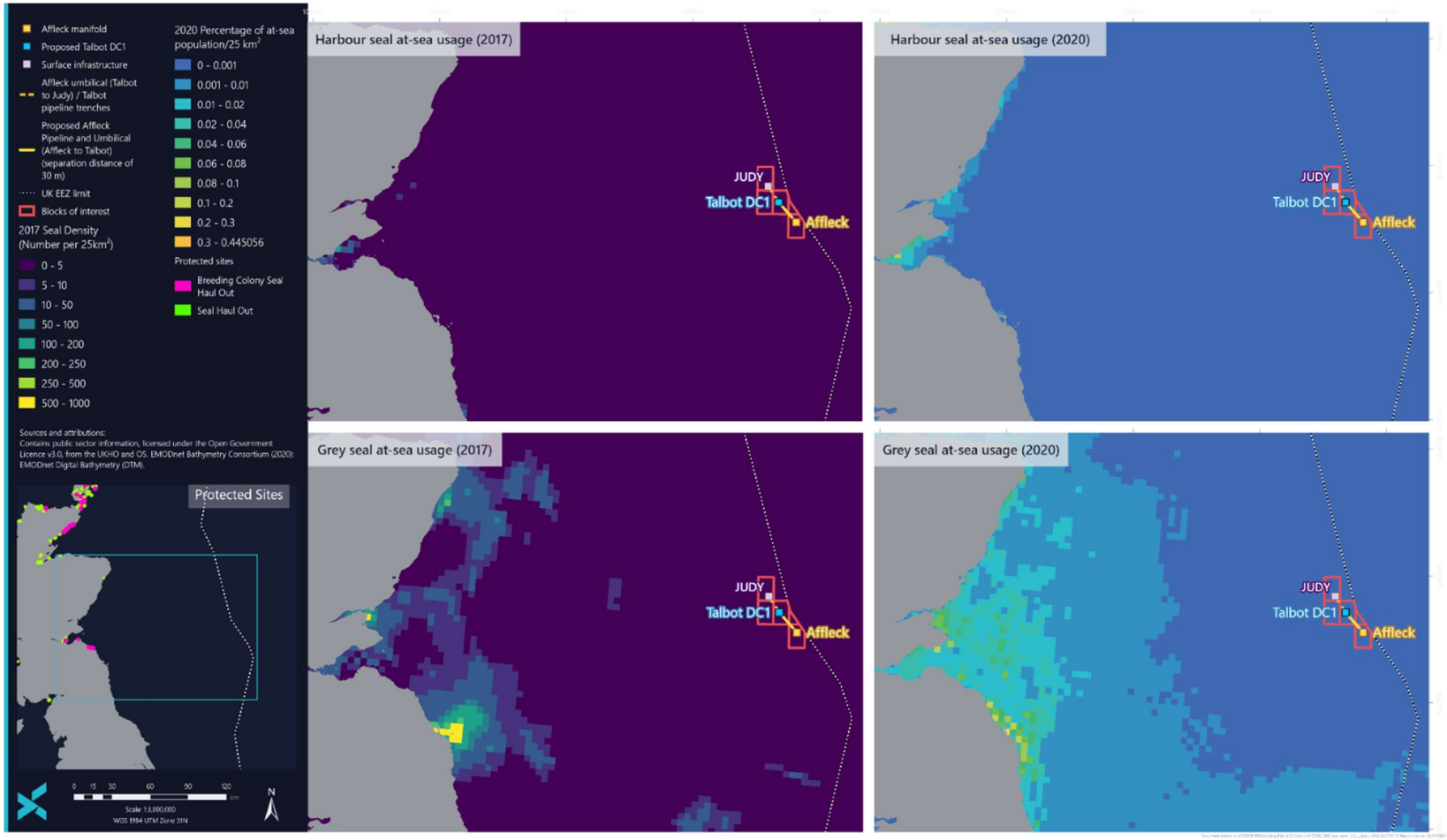

Figure 4-14 Estimated number of individuals and % of UK harbour and grey seal at-sea population per 25 km² within the vicinity of the Development Area (Russel et al., 2017; Carter et al., 2020)

4.3.6 Coastal Conservation

The Development is located approximately 263 km from the east coast of Scotland and England. Due to this distance, no impacts to onshore conservation sites (including Special Protection Areas (SPAs), as designated under the EU Birds Directive (2009/147/EC)) are expected from anticipated development activities and routine operations for the Development.

4.3.7 Offshore Conservation

4.3.7.1 Designated Sites

As illustrated on Figure 4-15, the Affleck pipeline and umbilical are partially located within the Fulmar MCZ. No other protected sites are located within 50 km of the Development. The next closest protected site beyond the Fulmar MCZ is the East of Gannet and Montrose Fields Nature Conservation Marine Protected Area (NCMPA), approximately 50.7 km northwest of the umbilical and 60 km northwest of the pipeline.

The Fulmar MCZ is designated for subtidal sand, subtidal mud, subtidal mixed sediments, and ocean quahog (JNCC, 2018a). The seabed within the MCZ is considered to provide important resources to marine fauna, such as food, spawning and shelter. Typical fauna present within the MCZ include burrowing tube anemones (*C. lloydii*), brittlestars (e.g., *A. filiformis*), sea potatoes (*Echinocardium cordatum*), sea pens (e.g., *Virgularia mirabilis*) and ocean quahog are also present. The MCZ is also important for larger mobile fauna as it provides an important food source (JNCC, 2018a). Ocean quahog are a Feature of Conservation Interest (FOCI), listed on the MCZ Ecological Network Guidance, which lists habitats and species that MCZ should be identified for due to the fact that the feature is threatened, rare of declining (JNCC and Natural England, 2016).

Three sampling stations of the Affleck pipeline route survey and eight sampling stations of the Talbot route survey were located within the Fulmar MCZ. Ocean quahog were present at 0 – 6% of seabed images in the Affleck pipeline route survey and three juveniles were identified in the macrofaunal analysis at one of the three stations. Ocean quahog were recorded at one of the two camera stations in the Talbot route survey and were identified in four of the six grab samples (Gardline, 2019c, Gardline, 2021b).

The conservation objectives for the Fulmar MCZ are to maintain each feature in favourable condition. Further details on the conservation objectives for the protected features of the MCZ are provided in Table 4-7.

Table 4-7 Conservation objectives for the Fulmar MCZ (JNCC, 2018a)

Feature	Conservation Objective
Subtidal mixed sediments, subtidal mud and subtidal sand	▪ Extent is stable of increasing ▪ Structures and functions, quality and the composition of characteristic biological communities (which includes a reference to the diversity and abundance of species forming part of or living within the habitat) are such as to ensure that they remain in a condition which is healthy and not deteriorating. Any temporary deterioration in condition is to be disregarded if the habitat is sufficiently healthy and resilient to enable its recovery. Any alteration to that feature brought about entirely by natural processes is to be disregarded.
Ocean quahog	▪ The quality and quantity of its habitat and the composition of its population in terms of number, age and sex ratio are such as to ensure that the population is maintained in numbers which enable it to thrive Any temporary reduction of numbers is to be disregarded if the population is sufficiently thriving and resilient to enable its recovery. Any alteration to that feature brought about entirely by natural processes is to be disregarded.

The Development area does not overlap with any areas identified as potential Annex I habitats by the JNCC Annex I marine habitats maps (JNCC, 2020a).

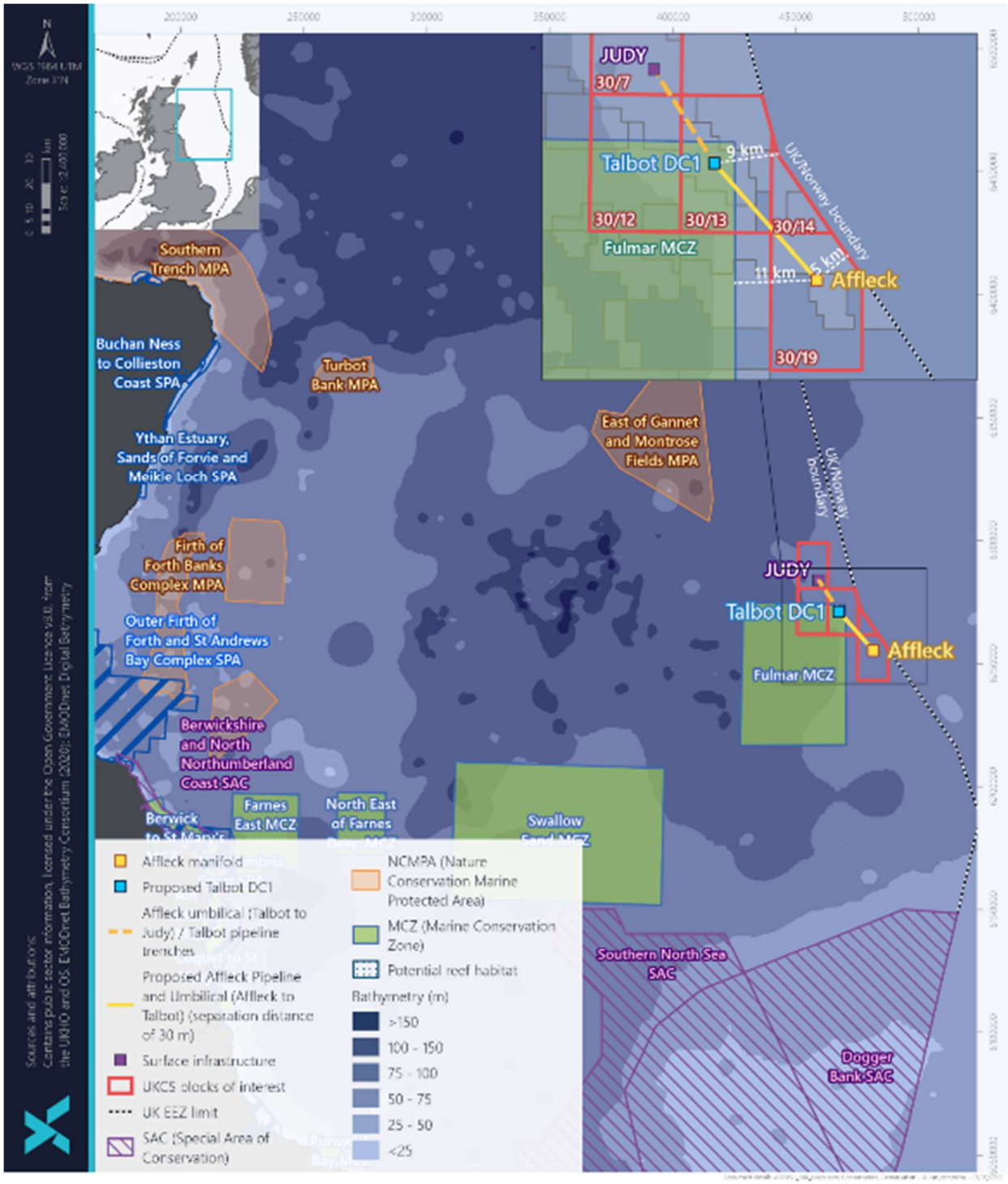

Figure 4-15 Sites of conservation importance in the vicinity of the Development

4.3.7.2 Ocean quahog (*A. islandica*)

The infaunal bivalve *A. islandica* (also known as ocean quahog) is listed under the OSPAR list of threatened and/or declining species (OSPAR, 2008). The reason for inclusion on the OSPAR list was due to significant recorded changes in the populations of this species during the last century. This long-lived bivalve is also classified as a PMF.

A. islandica can be found from shallow low-level waters to depths of about 500 m. They live buried in sand and muddy sand, often with their shells entirely hidden and just a small tube extending up to the surface of the seabed. The tube is a siphon that keeps water flowing across the animal, so that it can breathe, capture food, and expel waste (JNCC, 2019b). They are an important food source for several fish species, such as cod, and show exceptional longevity (studies have shown that it can live up to 400 years) and feature a sporadic juvenile recruitment. They are of particular risk to bottom fishing gear, and, like other slow-growing animals, once their numbers have been reduced, the population can take a long time to recover (JNCC, 2019b).

As displayed on Figure 4-16, no publicly available ocean quahog records directly overlap with the Affleck pipeline route. However, there are several records in close proximity to the umbilical to Judy and an overlap with an ocean quahog distribution area. The closest ocean quahog record to the Affleck pipeline is approximately 5.5 km northwest. Three ocean quahog records overlap with the umbilical corridor (Figure 4-16).

Six ocean quahog were observed across five sampling locations during the Affleck pipeline survey in 2021, in addition to siphons and dead and broken ocean quahog shells. Three juveniles were also recorded in the macrofaunal analysis (Gardline, 2021b). Siphons and broken shells were also observed in the 2019 survey along the proposed Talbot pipeline which is adjacent to the Affleck umbilical to Judy (Gardline, 2019b). The density of siphons ranged from 0.004 to 0.023 individuals per m^2. Juvenile *A. islandica* were also recorded through the macrofaunal analysis in all stations except two in the Talbot survey area (Gardline, 2019c).

Due to the overlap of the Affleck pipeline route and umbilical with the Fulmar MCZ and the presence of ocean quahog along the pipeline route being confirmed by the 2021 survey, it is likely that this species is present in the vicinity of the proposed development. *A. islandica* is commonly found within this area of the North Sea where populations of 40-80 years old specimens have been observed, with a substantial proportion over 100 years old (OSPAR, 2009).

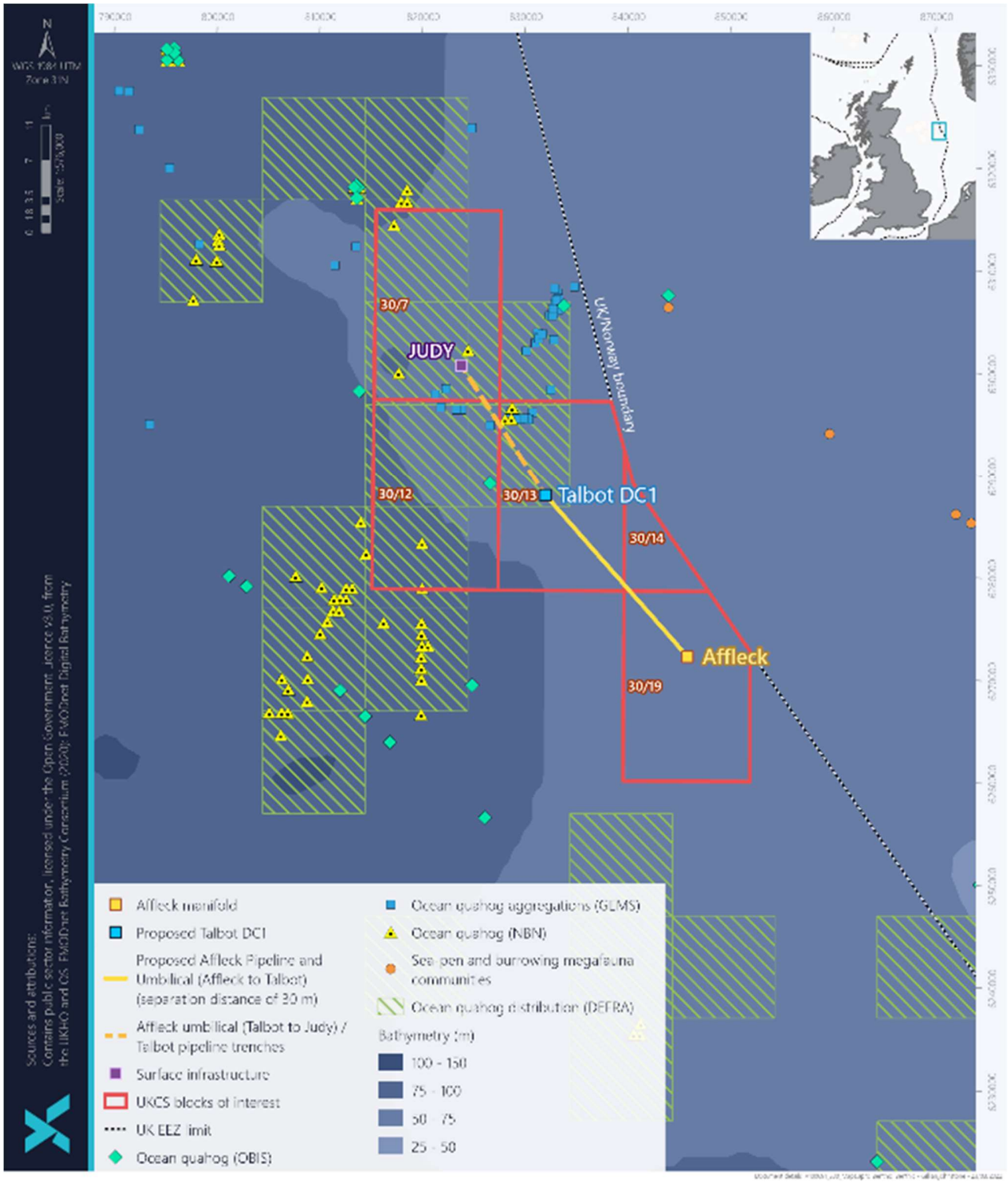

Figure 4-16 Species of conservation importance

4.3.7.3 Seapens and Burrowing Megafauna

The “seapens and burrowing megafauna communities” biotope can be broadly defined as areas of “fine mud, at water depths ranging from 15 to 200 m or more”, which are heavily bioturbated by burrowing megafauna; burrows and mounds may form a prominent feature of the sediment surface with conspicuous populations of sea pens, typically *Virgularia mirabilis* and *Pennatula phosphorea*. The burrowing crustaceans present may include *Nephrops norvegicus, Calocaris macandreae* or *Callianassa subterranea* (OSPAR, 2010a). This habitat type is considered to be a FOCI habitat and is listed as a PMF, a Habitat of Principal Importance under the NERC Act 2006 and on the OSPAR (2008) List of Threatened and/or Declining Habitats. There are several publicly available records of seapens and burrowing megafauna within the vicinity of the Development, although none are located within the UKCS blocks that overlap with the Development, with the closest public record being > 10 km from the Development (Figure 4-16).

As discussed in Section 4.3.7.1, seapens are known to be present within the Fulmar MCZ which overlaps with the Development area, although this does not mean that the “seapens and burrowing megafauna communities” biotope will be present. The presence of burrows and mounds is a defining feature of this habitat (JNCC, 2021b).

Small burrows and a single seapen were observed in the survey undertaken along the proposed Affleck pipeline route in 2021 and seapens were recorded at a low abundance in the macrofaunal analysis. The burrows observed at the survey area were not considered to be consistent with, or in sufficient density to be, the seapen and burrowing megafauna communities habitat (Gardline, 2021b). Similarly, burrows recorded during the Talbot survey were not considered to be in sufficient density to qualify as the seapens and burrowing megafauna communities habitat and no visible burrowing megafauna were recorded during the survey (Gardline, 2019b). The density of burrows in the seabed imagery at the Talbot survey was 0.03 burrows per m^2 and interpreted as ‘rare’ on the SACFOR abundance scale (Gardline, 2019b).

4.3.7.4 Biogenic Reef

As described in Section 4.3.2, horse mussels were recorded across all camera and video sampling locations during the Talbot survey. Aggregations of horse mussel can form a horse mussel bed which is a type of Annex I biogenic reef under the Habitats directive. Biogenic reefs are hard compact substrata elevated from the sea floor, which are formed by biogenic concretions or encrustaceans which can support a diverse and rich faunal community (Morris, 2015). Horse mussel beds are also listed as an OSPAR threatened and/or declining habitat, as a UKBAP Habitat of Principle Importance and as a PMF (BRIG, 2007, Tyler-Walters *et al*., 2016).

The visual survey data obtained during the Talbot survey indicated that densities of horse mussel ranged from 0.01 individuals per m^2 to 0.19 individuals per m^2. Furthermore, horse mussel beds with a coverage > 25 m^2 were present at several of the sampling locations and these areas were associated with higher SSS reflectivity and an elevated seabed, providing ‘medium confidence’ that ‘likely’ Annex I biogenic reef was present (see Figure 4-17 and Figure 4-18). However, due to uncertainty in the acoustic signature, it could not be concluded that the horse mussels present at the Talbot site comprised Annex I biogenic reef (Gardline, 2019b).

No horse mussels were identifying in the visual data obtained from the Affleck pipeline survey in 2021 (Gardline, 2021b).

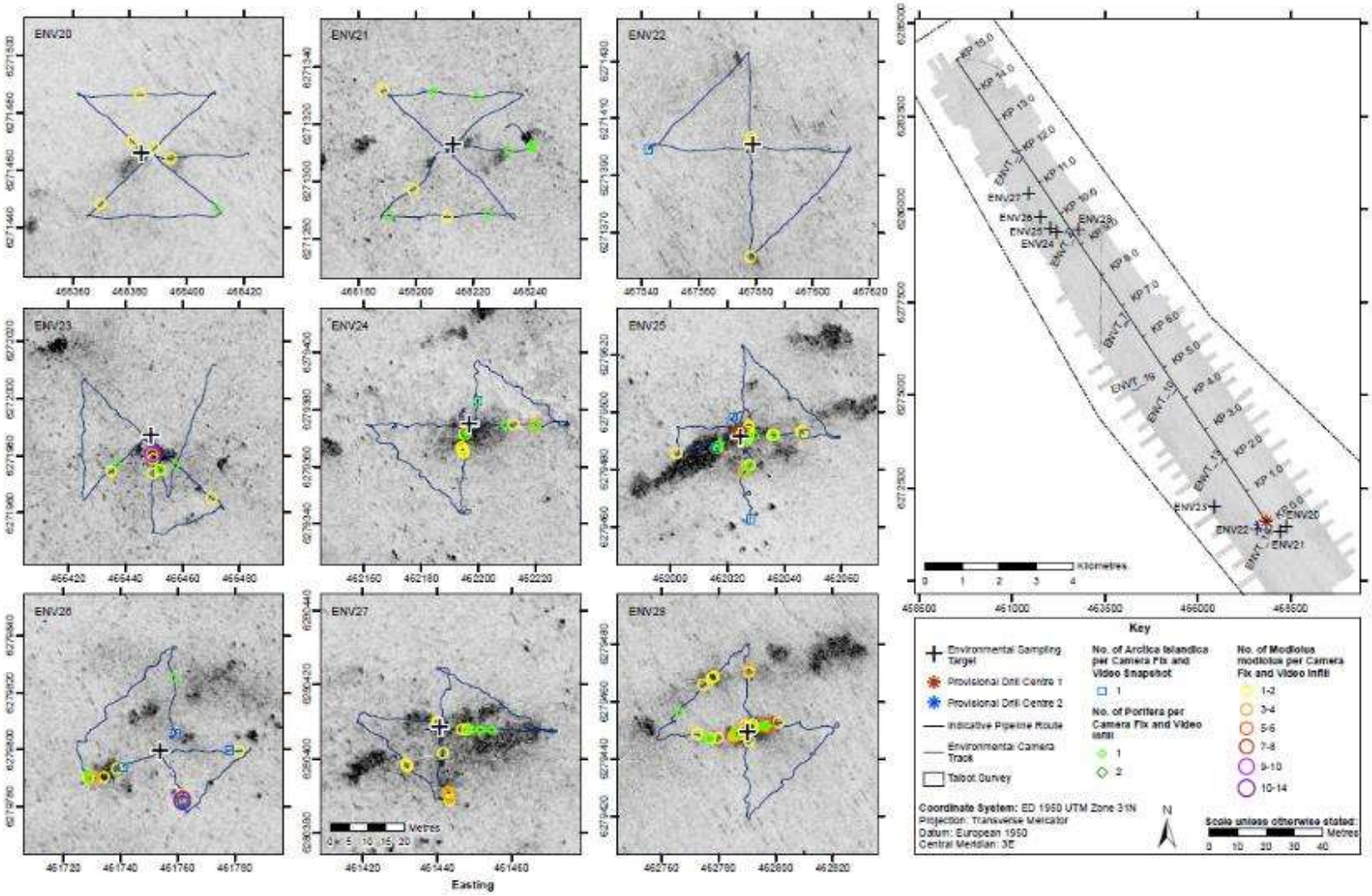

Figure 4-17 Distribution of Modiolus, Arctica islandica and Porifera (Gardline, 2019b) (1 of 2)

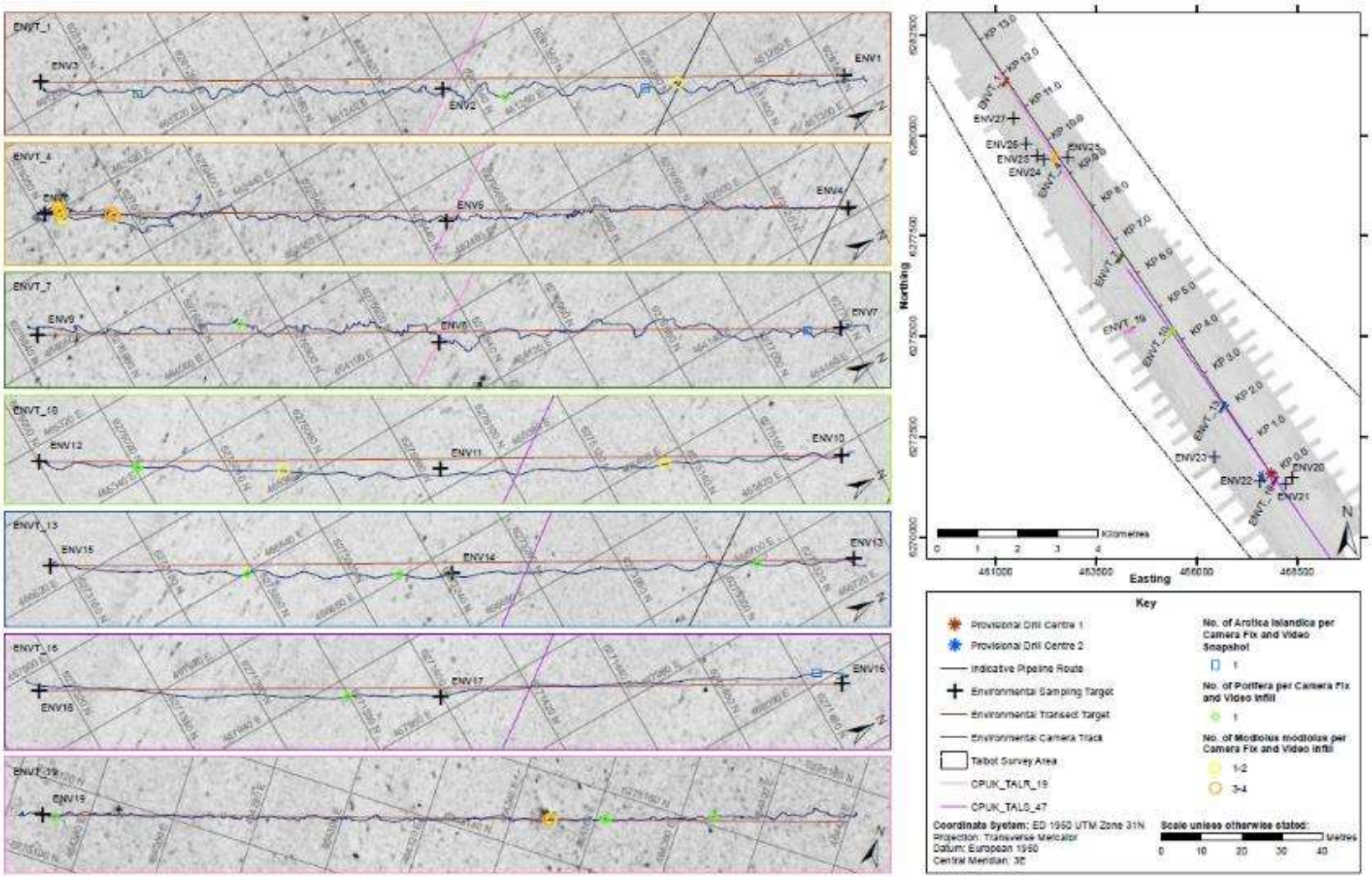

Figure 4-18 Distribution of Modiolus, Arctica islandica and Porifera (Gardline, 2019b) (2 of 2)

4.3.7.5 Deep-sea Sponge Communities

Deep-sea sponge communities are listed on the OSPAR (2008) list of threatened and/or declining habitats and as a PMF. Deep-sea sponges may be located on soft or hard substrates in water depths between 250 – 1300 m and can support a high faunal diversity (Henry and Roberts, 2014).

Sponges were observed in almost all of the sampling locations at the Talbot survey area. Across the survey, 11.2% of photographs contained a Porifera individual, however, the cover of the seabed was <0.1%, with a density of which ranged from 0.004 to 0.043 Porifera colonies per m^2 which is 'rare' on the SACFOR abundance scale (Gardline, 2019b).

Porifera were also observed in two of the sampling locations during the 2020 Affleck pipeline survey (Gardline, 2021b). This is not expected to constitute as a deep-sea sponge aggregation.

4.4 SOCIO-ECONOMIC ENVIRONMENT

4.4.1 Commercial Fisheries

The North Sea has important fishing grounds and is fished throughout by both UK and international fishing fleets, targeting both demersal, pelagic and shellfish fish stocks. The seas in the north-east Atlantic region have been divided into a series of administrative rectangles by the ICES. The Development is located within ICES rectangle 41F2 and 42F2.

Table 4-8 shows the average landings weight and sales value in ICES rectangles 41F2 and 42F2 of pelagic, shellfish and demersal fish over the previous five-year period (2016 – 2020). Both ICES rectangle 41F2 and 42F2 are primarily targeted for demersal fish in terms of landed value and weight, accounting for 91% of landed value and 95% of landed weight between 2016 and 2020 in ICES rectangle 41F2 and 95% of landed value and 88% of landed weight in ICES rectangle 42F2. No landings were recorded in ICES rectangle 41F2 for pelagic fish.

Species of most importance in terms of landed value and weight in ICES rectangle 41F2 were plaice, lemon sole, *Nephrops* and witch (*Glyptocephalus cynoglossus*). Plaice accounted for 62% of the average landings values and 68% of the average landings weights between 2016 and 2020. Species of most importance in terms of landed value and weight in ICES rectangle 42F2 were lemon sole, plaice, *Nephrops* and haddock (MMO, 2021).

To put landings and value into context, a total of £830,832,127 and 588,759 te were recorded as being landed in the UKCS in 2020. Within ICES rectangle 41F2, a total of £41,816 and 31 te were landed in 2020, representing < 0.01% of landed value and landed weight when compared to the UKCS totals. Within ICES rectangle 42F2, a total of £18,196 and 8 te were landed in 2020, also representing < 0.01% of the landed value and landed weight when compared to the UKCS totals.

Table 4-8 Fisheries statistics in ICES rectangles 41F2 and 42F2 (MMO, 2021)

Year	Species Type	41F2		42F2	
		Landed Value (£)	Landed Weight (Te)	Landed Value (£)	Landed Weight (Te)
2020	Demersal	27,947.7	27.3	5,528.6	4.3
	Pelagic	-	-	-	-
	Shellfish	13,868.7	3.6	12,667.2	3.4
	Total	**41,816.4**	**30.9**	**18,195.7**	**7.6**
2019	Demersal	136,894.9	79.8	32,599.6	18.3
	Pelagic	-	-	-	-
	Shellfish	35,95.3	2.6	448.8	<1
	Total	**140,490.2**	**82.4**	**33,048.4**	**18.4**
2018	Demersal	34,707.1	17.6	88,322.4	37.2
	Pelagic	-	-	-	-
	Shellfish	42.3	<1	105.1	<1
	Total	**34,749.4**	**17.6**	**88,427.4**	**37.3**
2017	Demersal	2,077.8	1.2	18,785.0	11.3
	Pelagic	-	-	74.6	<1
	Shellfish	<1	<1	3249.4	<1
	Total	**2,077.8**	**1.3**	**22,109.0**	**12.1**
2016	Demersal	27767.3	12.4	70339.3	46.9
	Pelagic	-	-	-	-
	Shellfish	5,508.2	1.1	12,583.3	2.2
	Total	**33275.5**	**13.5**	**82922.6**	**49.1**

Figure 4-19, Figure 4-20 and Figure 4-21 illustrate the average value (£) and effort (kWh) for demersal and pelagic vessels based on Vessel Monitoring System (VMS) data (MMO, 2021). The effort and value levels for UK vessels operating demersal trawls are locally high in the vicinity of the development compared to the remainder of ICES rectangles 41F2 and 42F2. However, at a regional and national scale, these level of fishing effort and value for demersal trawls in the vicinity of the development are considered to be low to moderate. The effort and value levels for UK vessels operating pelagic trawls is low in the vicinity of the development.

The only fishing methods operated by UK vessels within ICES rectangles 41F2 and 42F2 between 2016 and 2020 are demersal otter trawls and demersal seines of over 10 m in length.

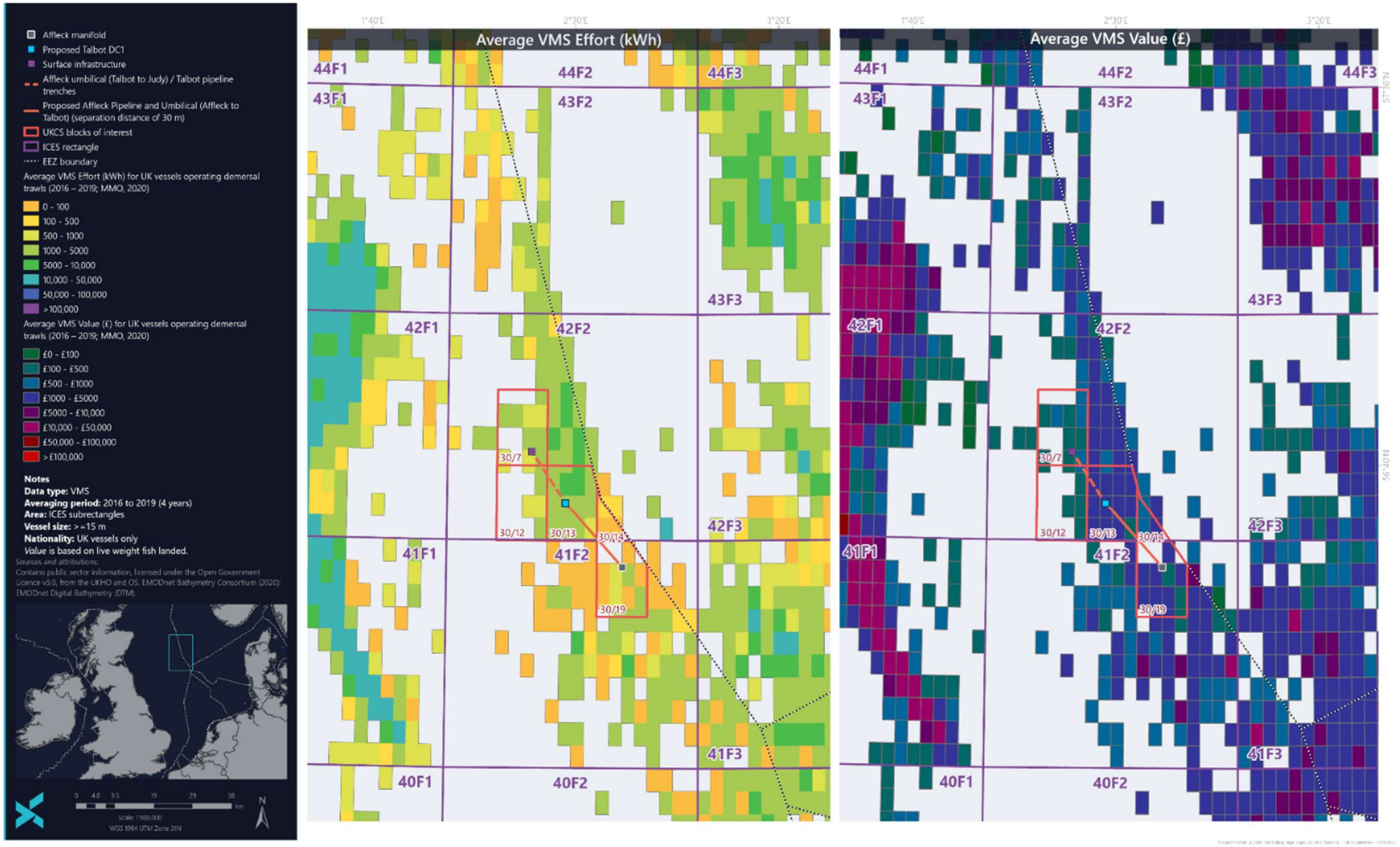

Figure 4-19 Average VMS value (£) and Effort (kWh) for UK vessels operating demersal trawls (2016 – 2019)

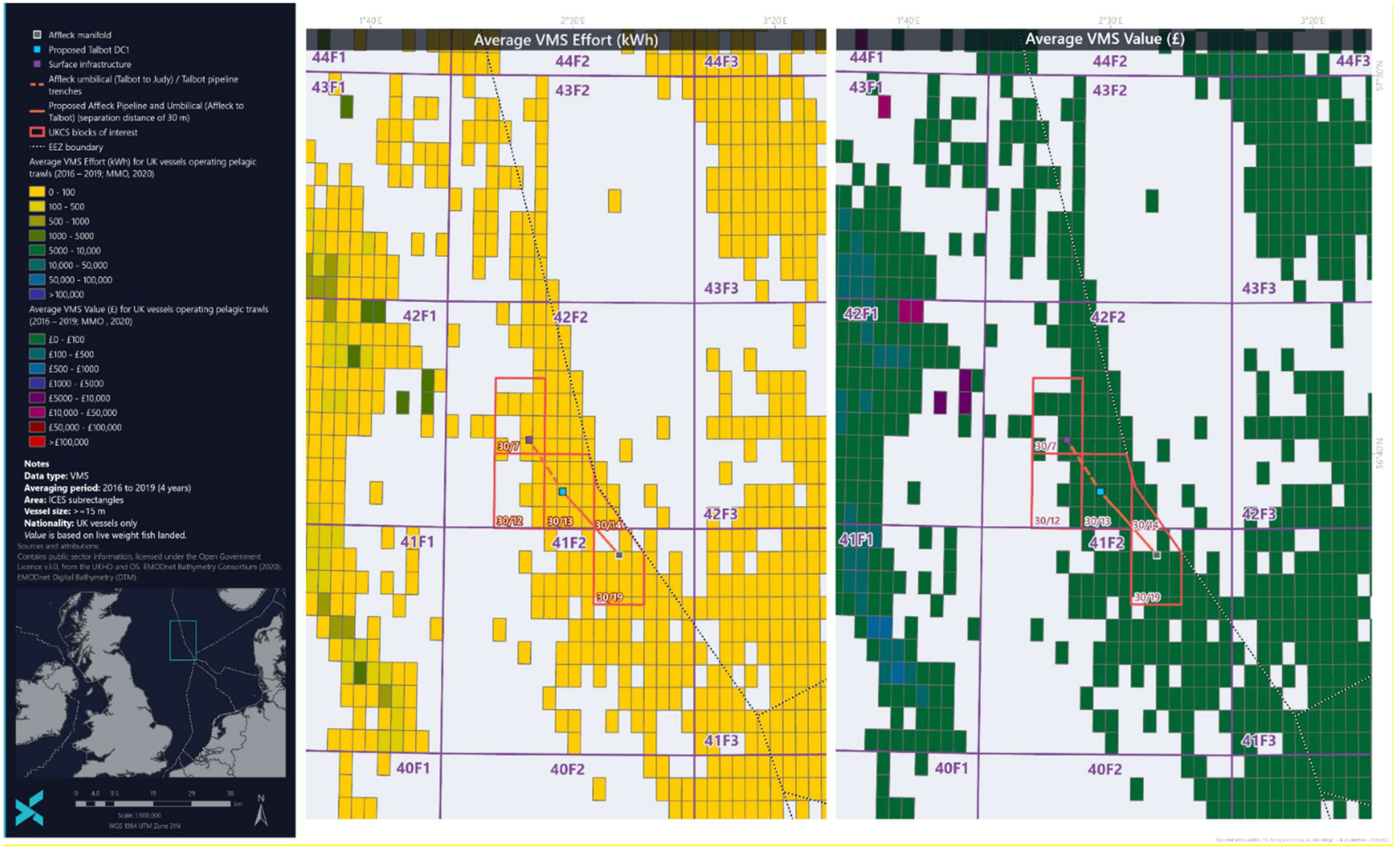

Figure 4-20 Average VMS value (£) and Effort (kWh) for UK vessels operating pelagic trawls (2016 – 2019)

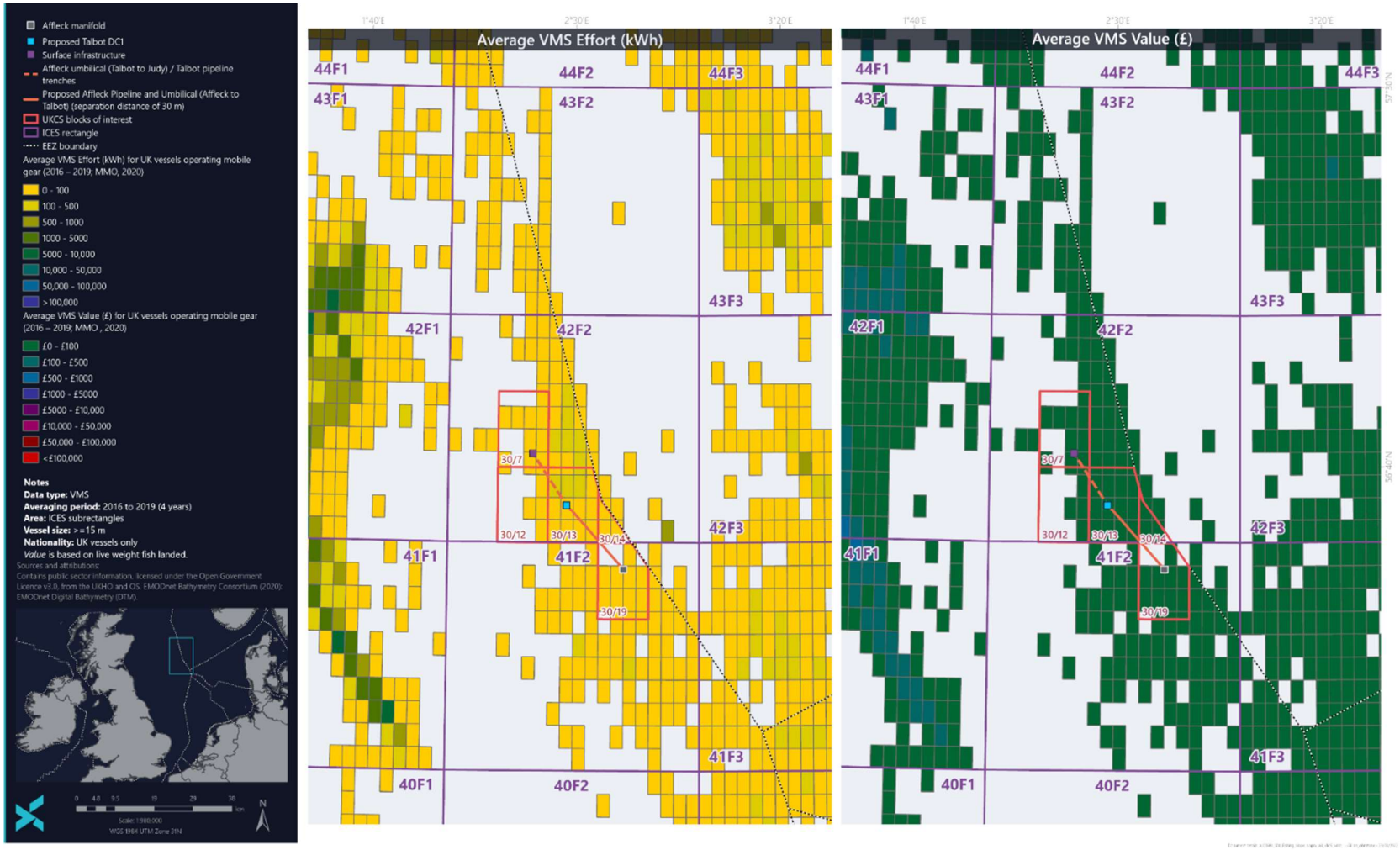

Figure 4-21 Average VMS value (£) and Effort (kWh) for UK vessels operating mobile gear (2016 – 2019)

Fishing effort (days fished) by UK over 10 m vessels in ICES rectangle 41F2 and 42F2 is presented in Table 4-9. Fishing effort is absent or disclosive across all months in these ICES rectangles. However, annual effort is lowest in ICES rectangle 41F2. Disclosive effort is recorded in the summer months in ICES rectangle 41F2 and 42F2 and very limited fishing effort is recorded over winter months (Scottish Government, 2021).

Table 4-9 Days fished (all gears) in ICES rectangles 41F2 and 42F2 between 2016 and 2020 (Scottish Government, 2021)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
41F2													
2016	-	-	-	-	-	D	D	-	D	D	-	-	D
2017	-	-	-	-	-	D	-	-	-	-	-	-	D
2018	-	-	-	-	-	D	-	D	-	-	-	-	D
2019	-	-	-	-	-	D	D	D	-	-	-	-	D
2020	-	-	-	D	-	D	D	D	-	-	-	-	7
42F2													
2016	-	-	-	D	D	D	D	D	D	-	-	-	33
2017	D	-	-	-	D	D	-	D	-	-	-	-	16
2018	-	-	-	-	D	D	D	D	-	-	-	-	D
2019	-	D	-	-	D	D	D	-	-	-	D	-	13
2020	-	-	-	D	D	D	D	D	-	-	-	-	10

Key: green: 0–100 days; yellow: 101–200 days; orange: 201–300 days; red: ≥301 days; D: Disclosive[10] data; - no data.

4.4.2 Aquaculture

Aquaculture in the North Sea is largely concentrated in Shetland and Orkney with several finfish aquaculture sites also located along the east coast of Scotland and England. The value of aquaculture in this region is lower than the west coast of Scotland where the aquaculture industry forms a key part of the economy (DECC, 2016). Aquaculture is primarily concentrated by the coast and considering the distance of the Development from the nearest coastline, potential significant impacts on aquaculture sites from the Development are unlikely.

4.4.3 Oil and Gas Activities

Other than fishing, the offshore oil and gas industry is the main activity taking place in the CNS region. There is a long history of oil and gas activity in the North Sea, with oil being discovered in the early 1960s and the first well coming online in the early 1970s. Whilst gas activities are most common in the SNS, both oil and gas are found in the central and northern areas. The Development, located in the CNS, in an area extensively used for oil development (DECC, 2016).

Oil and gas installations within a 40 km radius of the proposed Affleck pipeline and umbilical are summarised in Table 4-10. There are also a number of wells, pipelines, and other subsurface infrastructure within the region, as illustrated in Figure 4-22, which also shows the existing safety zones at Affleck and Judy, as well as the proposed safety zone at the Talbot DC1 manifold. The nearest surface infrastructure is the Judy platform.

The proposed Affleck pipeline crosses the Flyndyre-Cawdor EHC umbilical and pipeline, while the Affleck umbilical crosses the Stella oil export pipeline, the Judy 24-inch oil export pipeline, the 16-inch Gannet-A to Fulmar-A oil pipeline, and the inactive Janice to Judy 12-inch gas export pipeline.

[10] Disclosive data are provided for rectangles in which the records are from fewer than five vessels (>10 m); detailed records are not published for reasons of commercial confidentiality.

Table 4-10 Oil and gas surface infrastructure within 40 km of the Development

Asset	Surface Infrastructure	Operator	Approximate Distance and Position from the Affleck Pipeline	Approximate Distance and Position from the Affleck Umbilical
Jackdaw (yet to be constructed)	Platform	Shell	35.8 km NNW	22.8 km WNW
Ekofisk	Platform	ConocoPhillips Norway	34.0 km ENE	> 40 km
Stella Sal System (not in use)	Floating Producing Storage and Offloading (FPSO) system	Ithaca	33.6 km WNW	> 40 km
Auk A	Platform	Repsol Sinopec	32.5 km WSW	32.5 km NNW
Jade	Platform	Chrysaor	32.5 km NNW	17.7 km NNW
Auk A	Oceanographic Buoy	Shell	32.4 km SSW	32.4 km NNW
FPF1	FPSO system	Ithaca	31.3 km WNW	16.8 km WNW
Jasmine JLQ	Living Quarters	Chrysaor	22.7 km WNW	8.6 km WNW
Jasmine Wellhead Platform	Platform	Chrysaor	22.7 km WNW	8.6 km WNW
Fulmar AD	Platform	Repsol Sinopec	22.1 km WSW	22.0 km NNW
Fulmar A	Platform	Repsol Sinopec	22.1 km WSW	21.9 km WNW
Clyde	Platform	Repsol Sinopec	18.3 km SSW	18.6 km NNW
Judy JRP	Platform	Chrysaor	15.3 km NNW	0.2 km NNW
Judy	Platform	Chrysaor	15.2 km NNW	<0.01 km SSW

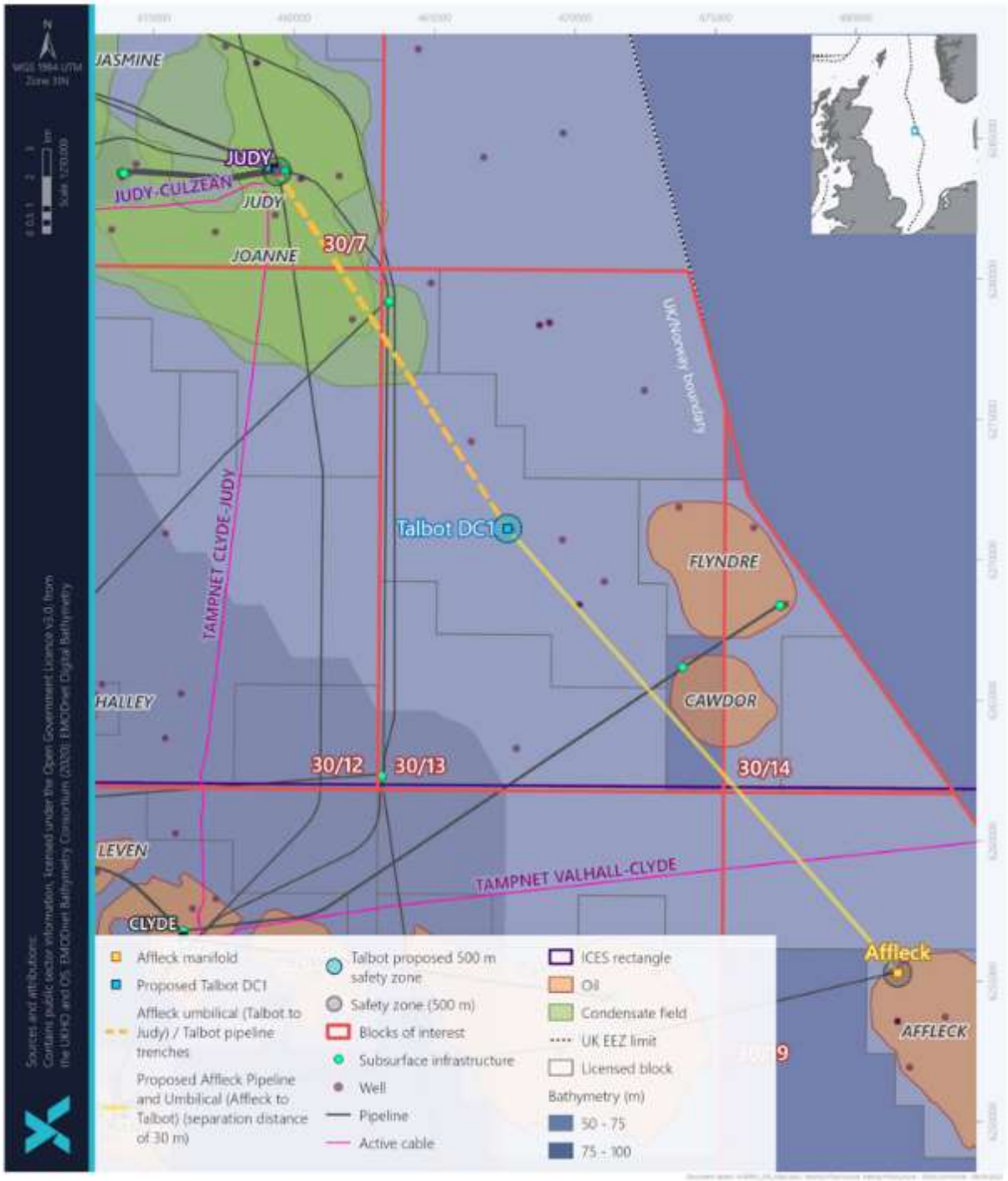

Figure 4-22 Oil and gas infrastructure and telecommunication cables in the vicinity of the Development Area

4.4.4 Offshore Windfarms

There are no offshore wind farms in the vicinity of the Development; the closest renewable site is the Berwick Bank option agreement area, located over 200 km south-west of the Development. In addition, the closest Sectoral Marine Plan (SMP) is the E1 site, located approximately 135 km to the west of the proposed Affleck pipeline and 125 km west of the umbilical. The Affleck umbilical is located within the Innovation and Targeted Oil and Gas (INTOG) E-a area, which is an area where projects targeting oil and gas decarbonization will be considered by the Scottish government.

4.4.5 Telecommunications Cables

The Tampnet Valhall-Clyde telecommunications cable, operated by Tampnet, crosses the pipeline (Figure 4-22). The next closest telecommunications cable is the Tampnet Clyde – Judy cable, which is approximately 0.5 km west of the umbilical and 9 km north of the pipeline.

4.4.6 Military Activities

Aircraft, surface craft and submarines from many countries use the North Sea as a training ground and for routine operations, but the distribution and frequency of these activities is unknown. There are no military restrictions on Blocks 30/7, 30/12, 30/13, 30/14 and 30/19 (Oil and Gas Authority, 2019).

4.4.7 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). Blocks 30/12, 30/13, 30/14 and 30/19 are located in an area that experiences very low shipping intensity (Oil and Gas Authority, 2016), with cargo ships and tankers the dominant vessel type in the Development area as illustrated in Figure 4-23. Block 30/7 is located in an area that experiences low shipping intensity.

Most of the vessel activity in the region is associated with oil and gas activities, with vessel tracks concentrated around nearby platforms and subsea infrastructure (EMODnet, 2019).

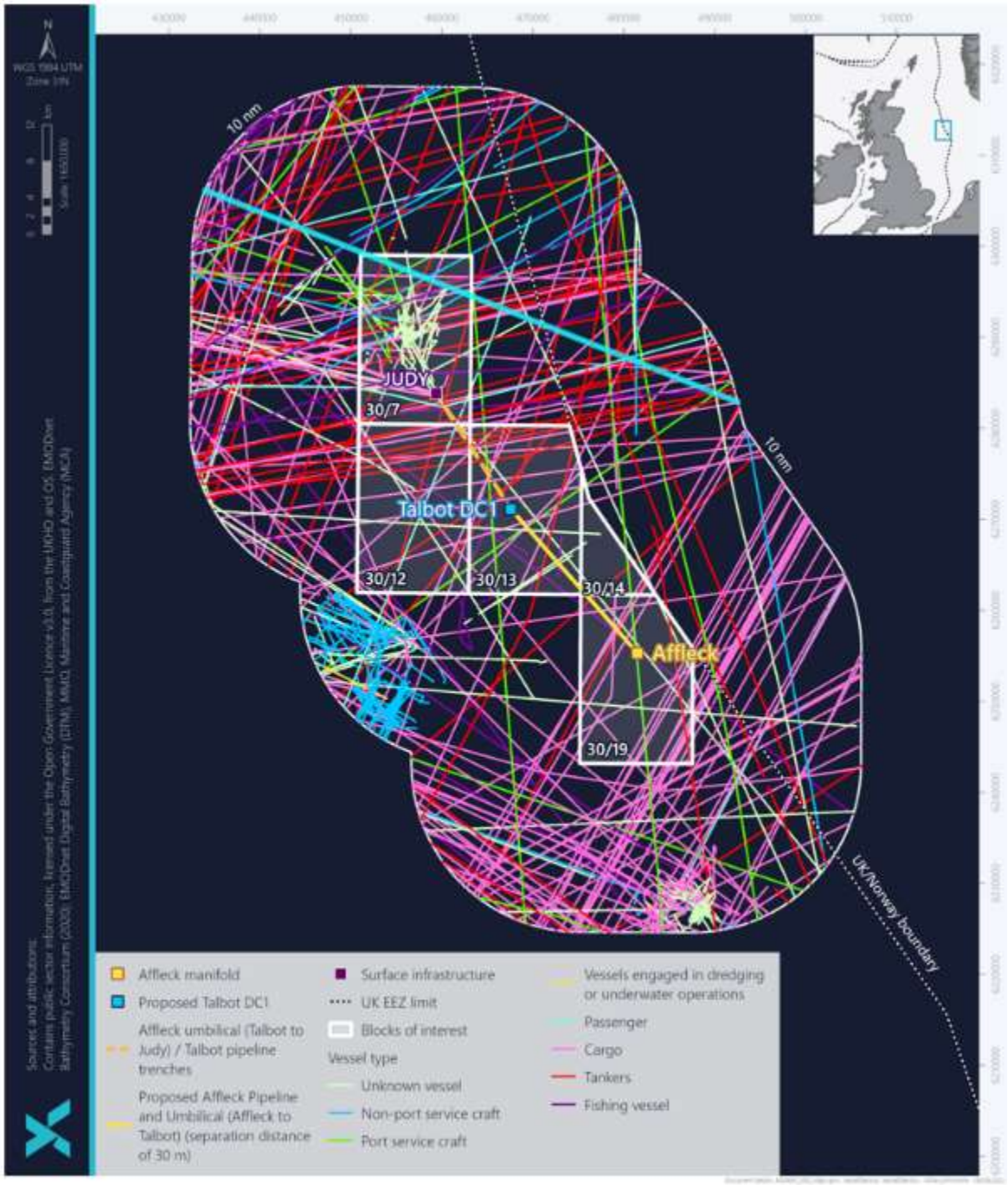

Figure 4-23 Vessel tracks in the vicinity of the Development area

4.4.8 Archaeology

There are a number of wrecks and areas of foul ground located in the vicinity of the Development, as illustrated in Figure 4-24. The wrecks located closest to the pipeline are unidentified wrecks, 1.8 km and 16.2 km, SSW and NNW, respectively. The closest wrecks to the umbilical are approximately 1.7 km and 2.2 km, WSW. The closest identified wreck to the pipeline is the Devotion (non-dangerous wreck), located 18 km N of the Affleck pipeline and 11.8 km NNE of the umbilical. This wreck site and other wrecks in proximity to the Development are listed in Table 4-11.

Table 4-11 Wreck sites located within the vicinity of the Development (UKHO, 2020)

Wreck type	Distance from Pipeline	Distance From Umbilical
Unidentified Non-Dangerous Wreck	1.8 km SSW	2.2 km WSW
Unidentified Non-Dangerous Wreck	16.2 km NNW	1.7 km WSW
Devotion	18 km N	11.8 km NNE
Unidentified Non-Dangerous Wreck	19.0 km WNW	12.2 km WSW
Unidentified Non-Dangerous Wreck	21.9 km WNW	8.6 km WNW
Unidentified Non-Dangerous Wreck	26.8 km SSE	> 40 km
Unidentified Non-Dangerous Wreck	29.3 km WSW	29.1 km WSW
Unidentified Non-Dangerous Wreck	29.6 km WSW	25.8 km WSW
Unidentified Non-Dangerous Wreck	31.1 km WNW	17.7 km WNW
Frisk (Possibly)	31.4 km WSW	31.4 km WSW
Unidentified Non-Dangerous Wreck	31.6 km WNW	16.8 km WNW
Viking Anton (Possibly)	35.0 km WNW	20.3 km WNW

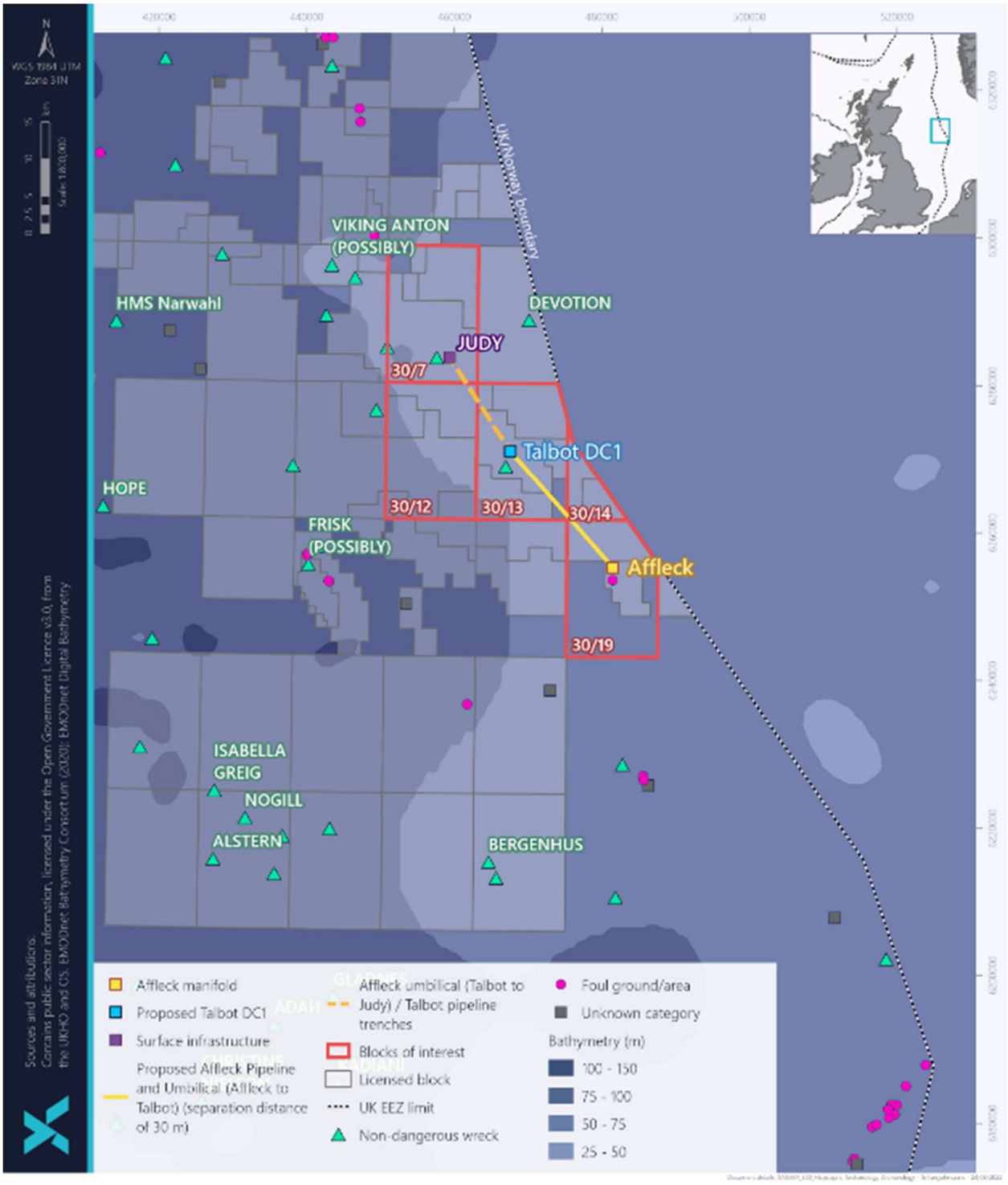

Figure 4-24 Wreck sites located in the vicinity of the Development

4.5 FUTURE MARINE CLIMATE

This section summarises the current evidence and future predictions for marine climate change, based on outputs from the Marine Climate Change Impacts Partnership (MCCIP) and other publicly available data sources. The MCCIP publishes evidence reviews and summaries on marine climate change, focussed on the UK, including regions such as the North Sea, the Celtic Sea, the Irish Sea, the English Channel and the North Atlantic (MCCIP, 2022).

The MCCIP reports summarise the current evidence for climate change, based on observed and modelled trends in climate data and the physical, biological and socio-economic environment. In addition, they also provide future predictions for the physical, biological and socio-economic environment, based on modelled climate projections. The climate projections for the based on different emissions scenarios or modelled predictions for the physical environment. The emissions scenarios used for climate projections differ between the different modelling studies reviewed within the MCCIP report. Details are provided within each topic section below. Generally, the future predictions are provided for 2100.

The key uncertainties / difficulties associated with predicting the impact of climate change on the physical, biological and socio-economic environment include:

- Uncertainty in the modelled predictions – based on the uncertainty around the future emissions scenario as well as an uncertainty in other model inputs (e.g., current conditions, parameters etc.);
- Uncertainty around the response of the physical, biological, and socio-economic environment to changes in climate variables; and
- Difficulties in attributing changes in the physical, biological, and socio-economic environment to climate change.

4.5.1 Physical Environment

4.5.1.1 Storms and Waves

Analysis of observed and modelled wind and wave data can be used to identify long-term trends in weather patterns. The frequency and intensity of storms within the north of the Atlantic Ocean is increasing, with a much weaker trend observed in the UKCS. However, there is a low confidence in attributing these changes in weather patterns to climate change and the high degree of variability in the data also creates difficulties in identifying trends over time. Time-series data on mean significant wave height, generally also shows an increase in wave heights in the northeast of the Atlantic Ocean, mainly attributed to Atlantic swell rather than increased wind speeds (Wolf *et al.*, 2020).

Future predictions for storms and waves are uncertain, and it is expected that natural variability will continue to account for trends observed in the frequency and intensity of waves and storms. In addition, the low confidence in attributing past trends in weather patterns to climate change also presents difficulties in adequately predicting future long-term trends. Nevertheless, it is possible that climate change may influence storm tracks with knock-on effects on winds and wave heights. Climate projections, under the Representative Concentration Pathway (RCP) 8.5 (high emissions scenario), indicate that there may be a reduced frequency in storms and a change in storm tracks, although there is considerable uncertainty in these predictions. It is also predicted that there will be an overall reduction in mean significant wave height, combined with an increase in the mean annual maximum wave height by 0.5 m (i.e., larger waves less frequently) and that wave heights to the north of the UK will increase as a result of a retreating Arctic sea ice (Wolf *et al*., 2020).

Overall, there is considered to be a low confidence in the future predictions for storms and waves (Wolf *et al.,* 2020).

4.5.1.2 Sea Surface and Near-bottom Temperature

Temperatures in the North Sea have generally been increasing since the 1980's. This warming has been interspersed with short-term regional trends of decreasing sea-surface temperatures; however, recent trends (between 2014 and 2017) have seen increases in sea-surface temperatures across all regions of the UKCS (Tinker and Howes, 2020).

Tinker and Howes (2020) analysed the warming of sea-surface temperatures over ~ 30 years (1988 – 2017) (Figure 4-25). The analysis indicates that observed increases in sea-surface temperatures were strongest in the waters to the North of Scotland (north of Caithness and Sutherland) and in the North Sea, where temperature have increased by up to 0.24 °C per decade (Tinker and Howes, 2020).

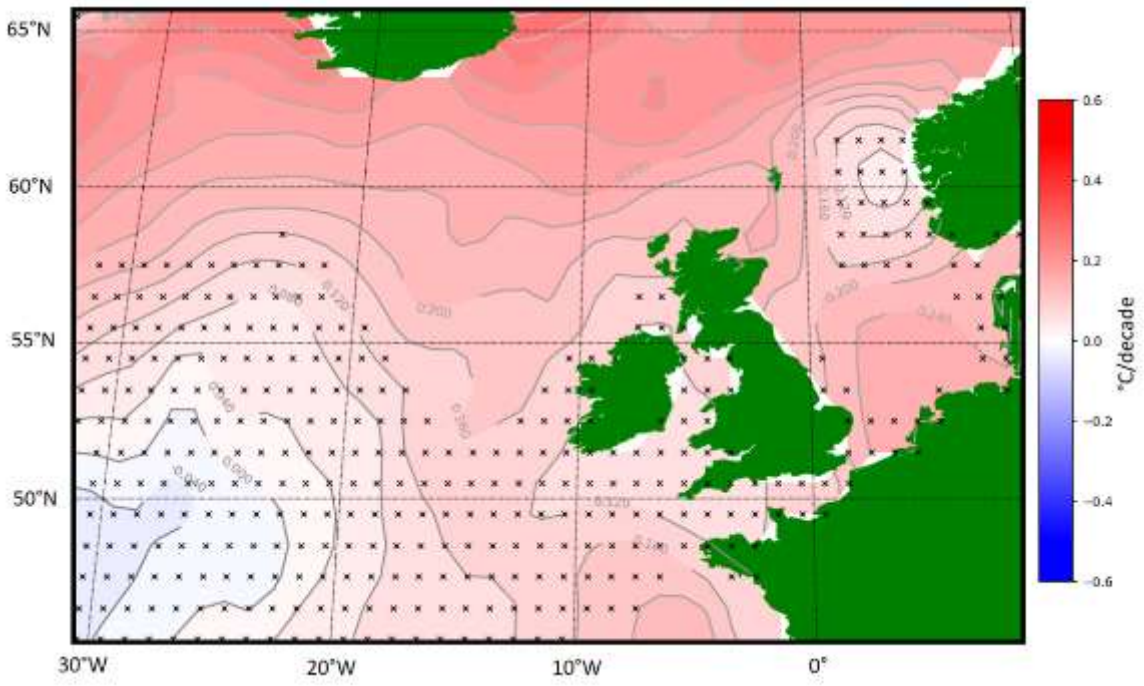

Figure 4-25 Trend in average sea-surface temperature (°C per decade) (1988 – 2017). Crosses indicate an insignificant increase in sea-surface temperature (Taken from Tinker and Howes, 2020)

It is predicted that increases in sea-surface temperatures by 2100 in the North Sea may range from 1 – 4°C (depending on the area and the climate model used). Tinker *et al.,* (2016) simulated increases in sea-surface and near-bottom temperature under 11 different Atmosphere-Ocean General Circulation Models, which represent the physical processes which drive climate change, focussing on the changes in temperature between the 1960 – 1989 and 2069 – 2098 periods under a medium emissions scenario (Special Report Emissions (SRE) A1B[11]). The purpose of this was to account for the uncertainty in model projections, by reporting the mean value across the different models along with the standard deviation across the projected simulations. The predicted increase in sea-surface temperature and near-bottom temperature for the North Sea is provided in Table 4-12. This increase represents the predicted difference between 1960 – 1989 and 2069 – 2098 (Tinker and Howes, 2020).

[11] *Details on the SRES A1B scenario are available here: https://www.ipcc.ch/site/assets/uploads/2018/03/emissions_scenarios-1.pdf. These have now been superseded by RCP emissions scenarios. SRES A1B is an 'on balance' emissions scenario in a world of rapid economic and population growth, where no one energy source is relied on too heavily.*

Table 4-12 Predicted increases in sea surface and near-bottom temperatures (comparing the 1960 – 1989 and 2069 – 2098 period) (Tinker et al., 2016)

Region	Sea Surface Temperature	Near-Bottom Temperature
Northern North Sea	2.75°C (±0.75°C)	2.53°C (±0.63°C)
Central North Sea	3.15°C (±0.75°C)	2.92°C (±0.63°C)
Southern North Sea	3.26°C (±0.72°C)	3.22°C (±0.71°C)

The confidence in these predictions is high (Tinker and Howes, 2020).

4.5.1.3 Stratification, Dissolved Oxygen and Salinity

There is some evidence that the timing of thermal stratification has changed over time, with a trend for earlier stratification (i.e., stratification beginning earlier in the year) across the North Sea. At present, there is no indication that this trend will be sustained or that this trend is beyond what would be expected from natural variability (Sharples *et al*., 2020). However, based on modelled climate projections based on the SRES A1B emissions scenario, it is predicted that stratification across UKCS will occur one week earlier by the end of 2100 and that the breakdown of seasonal stratification will occur five to 10 days later than present, mainly attributed to increases in air temperature. Additionally, when the RCP 8.5 emissions scenario is considered, it is predicted that the UKCS will become more strongly stratified, as a result of changes in seasonal heating cycles, and this could reduce upward mixing of nutrients and therefore lead to reduced primary production (Sharples *et al*., 2020).

Within the North Sea, declines in dissolved oxygen levels have been documented in late summer, although no hypoxic conditions have been observed. Ocean warming is expected to account for one third of the decrease in dissolved oxygen levels (due to reduced solubility of oxygen), with the remaining declines being attributed to increased biological oxygen consumption. Dissolved oxygen concentrations are expected to continue to decline through to the end of the century in the North Sea, by up to 11.5% when the period 2090 – 2100 is compared with the period 2000 to 2010 under the SRES A1B emissions scenario (Mahaffey *et al*., 2020).

Salinity has also shown a general decrease in the west of the UKCS in the last five years, although this trend is weaker in other regions of the UKCS, such as the North Sea, where there is no clear long-term trend (Dye *et al.,* 2020). When the SRES A1B emissions scenario is considered, it is predicted that waters will be less saline in the North Sea by 2100 due to ocean circulation changes driven by climate change (Dye *et al*., 2020). This trend is weaker in waters to the southwest of the UKCS in the Celtic Sea, Irish Sea and English Channel. The predicted change in salinity is presented in Table 4-13.

Table 4-13 Predicted increases in sea surface and near-bottom salinity (comparing the 1960 – 1989 and 2069 – 2098 period (Tinker et al., 2016)

Region	Surface Salinity (Change In Practical Salinity Unit (Psu))	Near Bottom Salinity (Change In Psu)
Northern North Sea	-0.51 (±0.61)	-0.49 (±0.58)
Central North Sea	-0.48 (±0.53)	-0.47 (±0.48)
Southern North Sea	-0.62 (±0.65)	-0.52 (±0.52)

The confidence in these predictions is medium for dissolved oxygen and salinity and low for stratification (Sharples *et al*., 2020; Mahaffey *et al*., 2020; Dye *et al*., 2020).

4.5.1.4 Ocean Acidification

Ocean acidification is also an impact of climate change which alters the physical properties of the ocean with potential impacts on marine biota. Ocean acidification occurs as increases in anthropogenic carbon dioxide (CO_2) absorbed by the ocean causes a decline in pH.

One quarter of atmospheric CO_2 is absorbed by the ocean. When CO_2 is absorbed by the ocean, hydrogen ions are released (which therefore reduces pH) and are available to bond to carbonate ions,

which consequently reduces the concentration of carbonate ions available for calcifying organisms. This also reduces the potential for the ocean to absorb and store atmospheric CO_2 in the future.

Atmospheric CO_2 now exceeds 400 ppm (increase of 2.3 ppm per year over between 2010 – 2020). Evidence of ocean acidification has been documented in the Atlantic Ocean which has sustained a decrease in pH at a rate of 0.0013 per year between 1995 and 2013. Measurements at Stonehaven, on the east coast of Scotland, between 2009 and 2013 showed that the pH declined by 0.1 in this time period, with the reduction being most evident in summer between March and August (Humphreys *et al.,* 2020).

Under a high-emissions scenario (RCP 8.5), pH in the UKCS could decrease at a rate of 0.0036 per year (pH in 2100 of 0.366). This decrease in pH is expected to vary by location, with the greatest decline occurring in coastal areas such as Bristol Channel, Moray Firth, Celtic Sea and the Inner Hebrides (Humphreys *et al.,* 2020).

The confidence in the predictions is medium (Humphreys *et al*., 2020).

4.5.2 Biological Environment

The biological environment may be affected by changes in the physical environment, including temperature increases and changes in storm frequencies. Indirect impacts of climate change may also arise through changes in habitats and predator-prey relationships.

Changes in species composition have been documented and may be linked to the thermal affinities of species (e.g., cold or warm-water species). For instance, declines in cold-water species, such as large brown algae, has occurred in the south of the UK, whereas warm-water kelp species (*Laminaria ochroleuca*) have increased in abundance (Mieskowsa *et al.,* 2020; Moore *et al*., 2020). A shift in the distribution of mobile species has also been observed in recent years, potentially linked to changes in temperature. The cold-water zooplankton species, *Calanus finmarchicus,* has declined by over 70% in the North Sea since the 1960's, whereas the distribution of warm-water species, such as *Calanus helgolandicus*, is shifting northwards (Edwards *et al*., 2020). Similarly, increases in warm-water fish species (e.g., bluefin tuna (*Thunnus thynnus*)) has been documented, as well as shifts in the timing of fish spawning, hatching and migration. Physiological impacts as a result of increased temperatures and reduced oxygen levels may also reduce fish growth as a result of increased metabolic costs (Wright *et al.,* 2020). The impacts on plankton and fish may indirectly affect predator species, such as seabirds and marine mammals (Mitchell *et al.,* 2020). Additionally, a shift in marine mammal distributions has also been observed with northward shifts of warm-water species such as short-beaked common dolphin (*Delphinus delphis*) (Evans *et al.,* 2020).

The species of conservation interest present at the Development include:

- Qualifying features of the Fulmar MCZ, including subtidal mixed sediments, subtidal mud and subtidal sand and ocean quahog.

The species associated with subtidal mixed sediments, subtidal mud and subtidal sand habitats may be sensitive to changes in temperature and salinity. As the Development is located offshore, the benthic fauna are unlikely to be adapted to conditions of low salinity. Additionally, some benthic fauna may be restricted to cooler waters, which may limit the spatial distribution of some species.

The sensitivity of ocean quahog to increased temperature, decreased salinity and de-oxygenation is presented in Table 4-14. Increased temperatures may affect ocean quahog recruitment, and ocean quahog are mainly found in northerly latitudes. It is expected that larvae and juveniles are tolerant to temperatures up to 20°C and adults are tolerant of temperatures up to 16°C. Long-term increases in temperature may result in increased mortality in the summer months (MarLin, 2022). The approximate near-bottom temperature at the Development is 8 – 10 °C and with an expected 2.8°C increase in temperatures in the North Sea for the 2069 – 2098 period when compared to 1960 – 1989 (see Section 4.5.1.2), the near-bottom temperature is still expected to be below 16°C by the end of the century.

Furthermore, within the timeframe of the Development (20 years) the magnitude of climate change is expected to be less than what was described in Section 4.5.1.2.

Table 4-14 Sensitivity of Ocean Quahog to Increased Temperature, Decreased Salinity and De-oxygenation (MarLin, 2022)

Pressure	Sensitivity
Temperature increase	Medium
Salinity decrease	Not sensitive
De-oxygenation	Not sensitive

4.5.3 Socio-Economic Environment

Impacts on the physical and biological environment may also affect human activities in the marine environment. For instance, any impacts on fish stocks will indirectly impact commercial fishing activity, potentially reducing the abundance of species or altering species composition. However, determining the causal factors for these changes is difficult when other factors also influence fish stocks (Pinnegar *et al*., 2020).

5 EIA METHODOLOGY

5.1 OVERVIEW

Offshore activities can involve a number of environmental interactions and impacts due, for example, to operational emissions and discharges and general disturbance. The objective of the EIA process is to incorporate environmental considerations into the Development planning, to ensure that best environmental practice (BEP) is followed and, ultimately, to achieve a high standard of environmental performance and protection. The process also allows for any potential concerns identified by stakeholders to be addressed appropriately. In addition, it ensures that the planned activities are compliant with legislative requirements and NEO's HSE policy.

5.2 IDENTIFICATION OF ENVIRONMENTAL IMPACTS

An EIA is to be focused on the key issues related to the specific activities proposed; the impact assessment write-up should be proportionate to the scale of the development and to the environmental sensitivities of the development area. NEO undertook an impact identification exercise to identify key environmental sensitivities, discussed sources of potential impact (including an environmental issue identification (ENVID) workshop and identified those sources which required further assessment (Appendix B). The decision as to which issues required further assessment was based on the specific proposed activities and environmental sensitivities, a review of industry experience of EIA outcomes and on an assessment of wider stakeholder interest. The key issues identified are summarised below and described in more detail in Section 5.7:

- Discharges to sea;
- Seabed disturbance;
- Underwater noise;
- Impact of the physical presence of the Development and associated vessels or environmental and societal receptors;
- Atmospheric emissions; and
- Accidental events.

The impact identification process was kept under review throughout the EIA, with mitigation revised as understanding of the Development increased.

5.3 SCOPING AND CONSULTATION

To solicit feedback on the Development, NEO issued a Scoping Letter to relevant stakeholders, which outlined the proposed activities and EIA scope and requested feedback on the proposals. Marine Scotland, JNCC and OPRED also provided written comments to NEO. OPRED, Marine Scotland and JNCC attended Scoping Meetings in January 2022.

Overall, OPRED, JNCC and Marine Scotland are satisfied with the proposed approach to the EIA, the key environmental issues and potential impacts identified for assessment, and the supporting studies proposed to facilitate the assessment. The issues raised by the consultees have been considered and addressed during the course of the EIA to date. A complete list of scoping comments and responses are provided in Appendix A.

The ENVID process was kept under review through the EIA, with mitigation revised as understanding of the Development increased and based on consultee feedback.

5.4 HUMAN HEALTH

Human health impacts from routine and accidental events were considered during the EIA and were determined to largely require no further assessment within the EIA process, especially since activities are so far offshore and will be managed to meet industry requirements for safe operations. Section 10 describes possible local air quality issues associated with the Development.

5.5 ENVIRONMENTAL SIGNIFICANCE

5.5.1 Overview

The decision process related to defining whether a development is likely to have significant impacts on the environment is the core principle of the EIA process; the methods used for identifying and assessing potential impacts should be transparent and verifiable.

The method presented here has been 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., 2001) and guidance provided by NatureScot (previously Scottish Natural Heritage (SNH), 2018) and by The Institute of Environmental Management and Assessment (IEMA) (IEMA, 2016).

The EIA provides an assessment of the environmental effects that may result from a development's impact on the receiving environment. The terms impact and effect have different definitions in an EIA 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). Effects (the consequences of those impacts) consider the response of a receptor to an impact. 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 level of impact. 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 Development. This process also identifies aspects of the Development that may require monitoring, such as a post-decommissioning survey upon 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 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.

5.6 BASELINE CHARACTERISATION AND RECEPTOR IDENTIFICATION

In order to make an assessment of 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 has been described in Section 4 and is based on regional studies combined with site-specific surveys.

Where data gaps and uncertainties remained (e.g., where there were no suitable options for filling data gaps), as part of the EIA process these have been documented and taken into consideration as appropriate, as part of the assessment of impact significance.

The EIA process requires identification of the potential receptors that could be affected by the Development (e.g., marine mammals, seabed species and habitats). High level receptors are identified within the impact assessments (Sections 6-11).

5.6.1 Impact Definition

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

- Nature of impact, whether it will be beneficial or adverse;
- Type of impact, is it direct or indirect etc.;
- Size and scale of impact, i.e., the geographical area;
- Duration over which the impact is likely to occur, i.e., days, weeks;
- Seasonality of impact, i.e., is the impact expected to occur at any time of year or during specific times of the year e.g., spring or summer; and
- Frequency of impact i.e., how often is the impact expected to occur.

Each of these variables are expanded upon in the tables below and provide consistent definitions across all EIA 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 ES are adverse, unless explicitly stated.

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 Development and the receptor. Impacts that are caused by the introduction of the Development activities into the receiving environment, e.g., the direct loss of benthic habitat.
Indirect	Reasonably foreseeable impacts that are caused by the interactions of the Development, but which occur later in time than the original, or at a further distance from the Development location. Indirect impacts include impacts that may be referred to as 'secondary', 'related' or 'induced' (e.g., the direct loss of benthic habitat could have an indirect or secondary impact on by-catch of non-target species due to displacement of these species caused by loss of habitat).

Table 5-3 Duration of Impact

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 proposed 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 proposed activities and which continue through the monitoring and maintenance, but will eventually cease.
Permanent	Impacts that are predicted to cause a permanent, irreversible change.

Table 5-4 Geographical Extent of Impact

Extent of Impact	Definition
Local	Impacts that are limited to the area surrounding the Development footprint and associated working areas. Alternatively, 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

Impact Frequency	Definition
Continuous	Impacts that occur continuously or frequently.
Intermittent	Impacts that are occasional or occur only under a specific set of circumstances which occurs several times during the course of the Development. This definition also covers such impacts that occur on a planned or unplanned basis, and those described as 'periodic' impacts.

5.6.2 Impact Magnitude Criteria

Overall impact magnitude requires consideration of all 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 professional 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 short to medium-term 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 expert judgement is used to determine the most appropriate magnitude ranking and this is explained through the narrative of the assessment.*

5.6.3 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. For some types of incident there are historical data available that allows a quantitative estimate of incident likelihood to be calculated; for other impacts, professional judgement must be used to resent a qualitative estimate. The quantitative and qualitative terms used to describe impact likelihood in the impact assessment chapters are defined in Table 5-7.

Table 5-7 Likelihood for Unplanned and Accidental Events

Likelihood	Quantitative definition	Qualitative definition
Likely	More than once per year	Event likely to occur more than once on the facility.
Possible	Once in 10 years	Could occur within the lifetime of the development.
Unlikely	Once in 100 years	Event could occur within lifetime of 10 similar developments. Has occurred at similar facilities.

Likelihood	Quantitative definition	Qualitative definition
Remote	Once in 1,000 years	Similar event has occurred somewhere in industry or similar industry but not likely to occur with current practices and procedures.
Extremely remote	Once in 10,000 years	Has never occurred within industry or similar industry but theoretically possible.

5.6.4 Receptor Definition

5.6.4.1 Overview

As part of the assessment of impact significance it is necessary to differentiate between receptor 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 a 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.

5.6.4.2 Receptor Sensitivity

Example definitions for assessing the sensitivity of a receptor are provided in Table 5-8.

Table 5-8 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.

5.6.4.3 Receptor Vulnerability

Information on both impact magnitude and receptor sensitivity is required to be able to determine receptor vulnerability. These criteria, described in Table 5-6 and Table 5-8, are used to define receptor vulnerability as per Table 5-9.

Table 5-9 Vulnerability of Receptor

Receptor vulnerability	Definition
Very high	The impact will have a permanent effect on the behaviour or condition of 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 of 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 temporary effect on the behaviour or condition of a receptor such that the character, composition, or attributes of the baseline, receptor population or

Receptor vulnerability	Definition
	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/ 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 section, in Sections 6-11.

5.6.4.4 Receptor Value

The value or importance of a receptor depends on a pre-defined judgement based on legislative requirements, guidance or policy. Where these may be absent, it is necessary to make an expert judgement on receptor value based on the perceived views of key stakeholders, experts and specialists. Examples of receptor value definitions are provided in Table 5-10.

Table 5-10 Value of Receptor

Value of receptor	Receptor type	Definition (example only – does not cover all receptors)
Very high	Environmental receptors	Receptor of very high importance or rarity, e.g., species that are globally threatened e.g., IUCN Red List of Threatened Species ('Red List') including those listed as endangered or critically endangered and/ or a significant proportion of the international population (> 1%) is found within the Development site.
	Cultural and socio-economic receptors	Receptor has no alternative to utilise an alternative area. Receptor is entirely dependent on the Development area for all income/activities. Receptor is the best known/only example to contribute to knowledge and understanding and/or outreach.
High	Environmental receptors	Receptor of high importance or rarity, such as species listed as near-threatened or vulnerable on the IUCN Red List. Habitats and species protected under the European Union (EU)'s Habitats Directive. Bird species protected under the EU Birds Directive. Habitats and species (including birds) that are a qualifying interest of a SAC, SPA or Ramsar site and a significant proportion of the national population (>1%) is found within the Development site. Conservation interests (habitats and species) of Marine Protected Areas (MPAs), Heritage MPAs and MCZs.
	Cultural and socio-economic receptors	Receptors and sites of international cultural importance (e.g., United Nations Educational, Scientific and Cultural Organisation (UNESCO) World Heritage Sites (WHSs). Receptor has little flexibility to utilise an alternative area. Receptor generates the majority of income from the Development area. Receptor is an above average example and/or has high potential to contribute to knowledge and understanding and/or outreach.

Value of receptor	Receptor type	Definition (example only – does not cover all receptors)
Medium	Environmental receptors	Receptor of least concern on the IUCN Red List, listed as a breeding species on Schedule 1 of the Wildlife and Countryside Act 1981, form a cited interest of a SSSI, are listed in the UK Biodiversity Action Plan or on the Birds of Conservation Concern (BOCC) 'Red list' and a significant proportion of the regional population (>1%) is found within the Development site.
	Cultural and socio-economic receptors	Receptor has some flexibility to utilise an alternative area. Receptor is active in the Development area and utilises it for up to half of its annual income/activities. Receptor is average example and/or has moderate potential to contribute to knowledge and understanding and/or outreach.
Low	Environmental receptors	Any other species of conservation interest (e.g., BOCC Amber listed species).
	Cultural and socio-economic receptors	Receptor has high flexibility to utilise an alternative area. Receptor is active in the Development area and other areas and is reliant on Development area for some income/activities. Receptor is below average example and/or has low potential to contribute to knowledge and understanding and/or outreach.
Negligible	Environmental receptors	Receptor of very low importance, such as those which are generally abundant around the UK and Ireland with no specific value or conservation concern.
	Cultural and socio-economic receptors	Receptor is very active in other areas and not typically present in the Development area. Receptor does not generate any income/activities from the Development area. Receptor is poor example and/or has no potential to contribute to knowledge and understanding and/or outreach.

5.6.5 Consequence and Significance of Potential Impact

5.6.5.1 Overview

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 (in accordance with EIA regulations) based on assessment consequence;
- Mitigation; and
- Residual impacts.

5.6.5.2 Assessment Of Consequence and Impact Significance

The sensitivity, vulnerability and value of receptor are combined with magnitude (and likelihood, where appropriate) of impact using expert judgement to arrive at a consequence for each impact, as shown in Table 5-11. The significance of impact is derived directly from the assigned consequence ranking.

Table 5-11 Assessment of Consequence

Assessment consequence	Description (consideration of receptor sensitivity and value and impact magnitude)	Impact significance (EIA regulations)
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 lasting 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

5.6.5.3 Mitigation

Where potentially significant impacts (i.e., those ranked as being of moderate impact level or higher in Table 5-11) are identified, 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. Appendix D provides detail on these commitments and how any mitigation measures identified during the impact assessment will be managed.

5.6.5.4 Residual Impacts

Residual impacts are those that remain once all options for removing, reducing or managing potentially significant impacts (i.e., all mitigation) have been taken into account.

5.7 ISSUES ASSESSED

The ENVID process, consultation and technical review phases resulted in the following issues being considered and agreed for assessment in the EIA:

- Discharges to sea (Section 6):
  - Routine chemical use and discharge to sea during pipeline and subsea structure commissioning, resulting in changes in water quality, localised and temporarily

increased suspended solid concentrations, and possible impacts to organisms in the water column and to habitats and communities on the seabed; and
  - Treatment and disposal of produced water from Affleck, within existing consent limits, which may cause detrimental impacts on local water quality and marine flora and fauna.

- Seabed disturbance (Section 6.1):
  - Direct loss of benthic species;
  - Direct loss of existing seabed habitat;
  - Introduction of novel habitat types; and
  - Wider indirect disturbance to the benthic environment through the suspension and re-settlement of sediments.

- Underwater noise (Section 8):
  - Injury and disturbance to marine mammals and fish through noise emissions generated by installation, trenching and associated vessel activities (including operations).

- Physical presence (Section 9):
  - Interference with shipping and fishing activities that may occur in the area;
  - Loss of access to the area for other vessels on a temporary or permanent basis; and
  - Increased risk of vessel collisions through the presence of vessels during subsea installation activities.

- Atmospheric emissions (Section 10):
  - Climate change due to GHGs and CO_2.

- Accidental events (Section 11):
  - Possible toxicity and smothering impacts to birds, other marine species (e.g. marine mammals), coastal and benthic environments through the release of hydrocarbons and chemicals from a well blowout or other loss of pipeline.

5.8 IMPACTS SCOPED OUT

During the ENVID workshop and as the EIA developed the following issues were reviewed, but it was considered that the potential impacts were too small and likely to be insignificant; it was therefore agreed they would be scoped out of further assessment in the EIA:

- Discharges to sea:
  - Routine chemical use and discharge during the operational phase of the Development – scoped out as the volumes which will be discharged will be incremental, small and limited in nature and extent, and will be addressed within the MATs/SATs system;
  - Routine blackwater production (i.e., sewage), grey water (i.e., from showers, laundry, hand and eye wash basins and drinking fountains) and food waste (macerated) disposal (from vessels and drilling rig) – scoped out due to existing, effective management controls in place at Affleck and adherence by all vessels to the Convention for the Prevention of Pollution from Ships (MARPOL) Annex IV; and
  - Ballast water and removal/ fall-off of fouling growth from vessels – scoped out as no major international movement of vessels expected for construction resulting in introduction of non-native species from outwith the North Sea, and no dedicated removal is planned thus fall-off is expected to be intermittent and of low volume.

- Physical presence (Section 9):

  - Disturbance to ornithological features from vessels – scoped out as the use of artificial light will be reduced as far as practicable and the presence of vessels will be temporary and short-term (approximately 5 months over the course of the Development installation) so light emissions will only be for a short duration and incrementally indistinguishable against the background of lights already present on existing structures in the region and on passing shipping;
  - Disturbance to marine species in the Affleck area from interactions between vessels and animals – scoped out as the Affleck field is in open sea, the installation campaign is a temporary short-term activity, and thus vessel use is minimised; and
  - Impact on seascape – scoped out as there is no surface infrastructure associated with the Development and limited vessel presence will be far enough offshore not to affect visual amenity.

- Atmospheric emissions (Section 10):
  - Emissions of Volatile Organic Compounds (VOCs) and methane (CH_4) due to an increase in venting rate of unburnt hydrocarbons at the Judy platform as a result of Affleck well production – scoped out due to demonstration of Best Available Technique (BAT), creation of a venting management plan which will ensure venting operations will be limited as far as possible.

- Waste:
  - Routine generation and disposal of non-hazardous waste streams – scoped out due to existing, effective management controls in place for waste;
  - Routine generation and disposal of wastes for recycling, e.g., paper, card, toner cartridges, fluorescent tubes, wood, and clean metal drums – scoped out due to existing, effective management controls in place for waste, use of licensed waste contractors/sites, waste transfer notes etc.;
  - Routine generation and disposal of special/ hazardous wastes, e.g., oily rags, medical waste, solvents, batteries, computers, fluorescent tubes, oil/grease/chemical cans/drums/sacks, contaminated produced sand, contaminated cuttings, pigging waste – scoped out due to existing, effective management controls in place for waste; and
  - Routine generation and disposal of radioactive wastes (disposal onshore) (e.g., naturally occurring radioactive material (NORM), contaminated cuttings, radiation sources in safety/detection equipment etc.) – scoped out due to existing, effective management controls in place for waste, use of licensed waste contractors/sites, waste transfer notes etc.

- Accidental events (Section 11):
  - Accidental deposit of materials on the seabed (e.g., dropped objects, ROV etc.) – scoped out due to existing, effective management controls in place for dropped objects; and
  - Limited unplanned oil and/or chemical releases, such as resulting from an overfill of the diesel tank bund – scoped out due to limited volumes and very low likelihood of occurrence.

5.9 CUMULATIVE AND IN-COMBINATION IMPACT ASSESSMENT

The European Commission has defined cumulative impact as being those resulting “from incremental changes caused by other past, present or reasonably foreseeable actions together with the project” (European Commission, 1999). As outlined in studies by the European Commission (1999) and the United States Council on Environmental Quality (US CEQ, 1997), identifying the cumulative impacts of a project involves:

- Considering the activities associated with the Development;
- Identifying potentially sensitive receptors/resources;
- Identifying the geographic and time boundaries of the cumulative impact assessment;
- Identifying past, present and future actions which may also impact the sensitive receptors/resources;
- Identifying impacts arising from the proposed activities; and
- Identifying which impacts on these resources are important from a cumulative impacts' perspective.

To assist the assessment of cumulative and in-combination impacts, a review of existing developments (including oil and gas, cables and renewables) that could have the potential to interact with the Development was undertaken; the output of this review is reported in the Environment Baseline (Section 4). The impact assessment has considered these projects when defining the potential for cumulative and in combination impact (Sections 6 to 11).

5.10 TRANSBOUNDARY IMPACT ASSESSMENT

The impact assessment presented in Sections 6-11 contains sections which identify the potential for, and where appropriate, assessment of transboundary impacts. The Development lies approximately 5 km away from the UK/Norway EEZ.

5.11 HABITATS REGULATIONS APPRAISAL (HRA) AND NATURA CONSERVATION APPRAISAL

The Conservation of Offshore Marine Habitats and Species Regulations 2017 (amended by the Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019) provides protection to sites known as Special Areas of Conservation (SACs), and sites important for wild bird populations known as SPAs. In the UK, these sites form part of the national site network.

In addition, under the Offshore Petroleum Activities (Conservation of Habitats) Regulations (2001), require that the impacts of an oil and gas project on the integrity of a site from the UK national site network are assessed and evaluated as part of the HRA process.

It is the responsibility of the Competent Authority to make an Appropriate Assessment of the implications of a plan, programme or in this case project, alone or in combination, on a European site (SAC or SPA) which is part of the national site network, in view of the site's conservation objectives and the overall integrity of the site.

As part of the assessment of impacts on key receptors, for those receptors that are a qualifying feature of a European site, relevant information on SACs or SPAs has also been provided as part of the impact assessment process. This information will then be used by the Competent Authority to determine the need for, and subsequently carry out (if required), an appropriate assessment of the Development.

For offshore areas (12 – 200 NM) the requirements of the Habitats Directive are transposed through the Conservation of Offshore Marine Habitats and Species Regulations 2017. In accordance with these Regulations, the impacts of a project on the integrity of a European site are assessed and evaluated as part of the HRA process. In an analogous process, the Marine (Scotland) Act 2010 and the Marine and Coastal Access Act 2009 require the potential for significant risk to the conservation objectives of NCMPAs and MCZs (respectively) being achieved to be assessed.

5.12 DATA GAPS AND UNCERTAINTIES

The North Sea has been extensively studied, meaning that this EIA has been able to draw on a significant volume of published data. This bank of published data has been supplemented by a site survey programme and studies undertaken on behalf of NEO to collect Development specific

environmental data, ensuring a robust baseline is available against which to assess impact. Where appropriate, studies have been commissioned to inform the impact assessment. Studies have included:

- Oil spill modelling, to facilitate assessment of the impacts from worst case scenarios regarding accidental spills of either hydrocarbons or diesel fuel. Although the expected hydrocarbon is oil, there will be some accompanying condensate; and
- Underwater noise modelling in order to estimate underwater noise levels, impact zones for injury and disturbance to marine mammals (European Protected Species) and potential mitigation strategies (as appropriate).

When evaluating and characterising potential impacts that could be associated with the Development, a variety of inputs are used, including baseline environmental data, modelling results, estimation of emissions and Development footprint. These inputs carry varying levels of uncertainty and conservatism and although potential impacts may occur, they are not certain to occur (for example, there is some uncertainty in marine mammal response to certain noise emissions). To account for this uncertainty, worst case assumptions have been made, and where key uncertainties exist, they have been outlined within the impact assessment chapters.

6 DISCHARGES TO SEA

6.1 INTRODUCTION

This chapter identifies and quantifies the discharges to sea associated with the Development. It describes the management and mitigation measures employed to adhere to the legislation and achieve NEO's environmental standards as set out in NEO's Environment Policy in Section 12. The residual potential impacts are assessed for discharges during installation, pre-commissioning and operation of the Development.

The discharges to sea that will occur throughout the Development can lead to potential impacts to the seabed and the water column through the following mechanisms:

- Increased dissolved and dispersed hydrocarbons in the water column and increased hydrocarbons and heavy metals content in seabed sediments; and
- Increased dissolved chemicals in the water column.

The pipeline and umbilical that will be installed will pass through a series of pre-commissioning operations. The commissioning of the pipelines will involve chemical use and discharge to flood, clean, gauge, hydrotest, and gel-fill the new pipeline. Barrier testing, installing spools and de-watering will also require the use and discharge of chemicals.

After pipelay, the pipeline and umbilical shall be flooded, trenched and thereafter tied-in at their respective ends. A post tie-in hydrostatic leak test (or a series of leak tests) will then be performed to verify the integrity of all subsea joints.

The largest commissioning discharges will be associated with pipeline dewatering operations. The chemicals currently proposed for use (and discharged to sea) for the pre-commissioning of the pipeline include a biocide (RX-5208), corrosion inhibitor (RX-5254), dye (RX-9034A), pipeline hydrotest chemical (RX-9022), pigging chemical (Debris Pick up Gel), and a completion chemical (MEG). The proposed chemicals are CEFAS registered chemicals for offshore use in the UK and are listed as Gold, thus posing a low hazard for their registered use.

Additionally, chemicals will be used to support operation at the Affleck tree and manifold. These chemicals include methanol for hydrate control, wax inhibitor to mitigate the risk of wax formation and build up (which causes operational issues), scale inhibitor to mitigate produced water self-scaling risk in the pipeline, and corrosion inhibitor. The chemical injection requirements at the Affleck manifold and tree are detailed in Section 3.3.7. It is not anticipated that any well control fluids will be discharged during commissioning and/or operation, as these will be operated in a closed loop system. All mono-ethylene glycol (MEG) from the umbilical will be received back at the existing Judy platform before being treated and discharged to sea via the Judy caisson.

There will not be a single discharge event or location, but a series of discrete discharges throughout the different stages of the subsea pre-commissioning programme.

Any potential environmental impact which results from the discharge of chemicals entrained in the hydraulic fluids used during pre-commissioning activities will be assessed in a chemical permit prior to commencement of operations.

During the operational phase, the principal discharge of potential concern to the environment is produced water. It will be treated by the existing produced water system at the Judy platform to meet the 30 mg/L oil-in-water concentration threshold and then discharged to sea via the caisson at the Judy riser platform, (approximately 41.9 m below sea level), and occasionally from the sea surface from the Judy platform, as per the existing platform permit. There will be a minor increase to baseline operational chemical use and discharge at Judy as a result of the Development.

Discharges associated with routine vessel operations (sewage, drainage, etc.) are considered to have a minor environmental impact and are therefore not considered further in this section.

6.2 REGULATORY CONTROLS

The key regulatory controls that relate to the proposed Development activities are:

- Offshore Chemicals Regulations 2002 (as amended): The OSPAR Decision relating to the Harmonised Mandatory Control System for the use and discharge of offshore chemicals is implemented on the UKCS by BEIS under the OCR. Under these Regulations, operators using or discharging chemicals in connection with offshore activities will need to apply to BEIS for one of two types of permit to cover both their use and discharge. Uses and discharges at producing offshore installations in UKCS waters or active storage or unloading installations in the UK territorial waters will be covered by 'Production Permits', 'Storage Permits' or 'Unloading Permits', which will be open ended and subject to review every three years. Time-limited uses and discharges during offshore activities such as the drilling and maintenance of wells, the commissioning, maintenance and decommissioning of pipelines, and the decommissioning of installations, will be covered by 'Term Permits' (DECC, 2011);
- Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005 (as amended) (OPPC): The OPPC Regulations were introduced to meet the OSPAR goal of reducing discharges of oil to the marine environment from the offshore oil and gas industry. The Regulations require a permit to be in place prior to the discharge of any oil to sea and any unpermitted discharges to be formally reported to BEIS. During drilling operations, the Regulations will apply where any drill cuttings contain reservoir hydrocarbons, or during well clean-up if there are discharges of oil in water. Any planned, or potential, discharges of oil to sea during the proposed Development will require the relevant Oil Discharge Permit application to be submitted by NEO to BEIS at the appropriate time;
- Merchant Shipping (Prevention of Oil Pollution) Regulations 1996 (as amended): The Regulations implement MARPOL Annex 1 in the UK and control oily discharges from any vessel activity including machinery space drainage. The Regulations require all vessels to have in place a UK or International Oil Pollution Prevention Certificate to demonstrate compliance; and
- The Merchant Shipping (Prevention of Pollution by Sewage and Garbage from Ships) Regulations 2008: The Regulations control sewage treatment and discharge and apply to offshore installations and vessels. The main requirement is that all discharges are monitored and recorded.

6.3 ASSUMPTIONS AND DATA GAPS

There were no data gaps that affected the assessment of potential impacts from discharges to sea during installation, commissioning and operation of the Development. While the precise incremental volumes of chemicals to be used and discharged at Judy due to Affleck production are not known at the time of writing, these will remain minor.

6.4 DESCRIPTION AND QUANTIFICATION OF POTENTIAL IMPACTS

6.4.1 Produced Water and Commissioning Discharges

There are likely to be a number of discharges of inhibited seawater during pre-commissioning operations associated with pipeline dewatering operations. These will be limited in quantity and will occur only intermittently. There will also be some discrete, localised discharges of Christmas tree preservation fluid at the seabed, (at the A1 and A2 trees). These are likely to be rapidly dispersed in the offshore environment.

Produced water may contain residues of reservoir hydrocarbons (oil), dissolved organic and inorganic compounds present in the geological formation and chemicals added during the production process.

Produced water from Affleck shall be treated in addition to Judy produced water discharges by the existing Judy PW system whereby it will be discharged to sea via the caisson with an oil-in-water concentration of <30 mg/l. At present all produced liquids (i.e., oil and water) are routed to the LP Separator for liquid-liquid separation. The LP Separator operates as a 3-phase separator routing oil to

the export booster pumps, produced water to Judy LP hydrocyclones and gas to the Judy Riser Platform FGC. The produced water treatment system on the Judy platform is designed to remove residual hydrocarbons and at least achieve permitted Oil in Water (OIW) regulatory thresholds. However, the produced water treatment system is not expected to have any impact on any chemicals or naturally occurring substances which have dissolved in the water phase.

The Affleck produced water in the high case is initially low for the first years of production and remains above 1,700 bbl/d for the remaining life of the field in the high production scenario, reaching a peak of around 682 m^3/day (4,288 bbl/d). However, in the low production case, produced water production could reach around 1081 m^3/day (~6,800 bbls/day). The produced water treatment modifications proposed increase the produced water capacity on Judy.

The Development (along with the Talbot development) will incorporate modifications to the existing Judy facilities, including separator internal modifications and upgrades to the hydrocylones, CFU and Degasser to accommodate the increase in produced water rates. The Development upgrades will increase the Judy platform produced water handling capacity from around 17,200 bbl/day to around 20,000 bbl/day which will accommodate both Affleck and Talbot produced water.

Due to the modifications, an increase to the existing produced water discharge stream caused by the addition of Affleck fluids is not considered to be likely to adversely impact the discharge.

6.4.2 Potential Water Column Impacts

Discharges from the installation and the commissioning as well as the produced water have the potential to affect water quality with potential effects on plankton and animals in the water column.

The potential for impacts on water column receptors from pre-commissioning and commissioning discharges and produced water discharges depends on many factors. These include the sensitivity of the receptor organisms (which can vary widely between species), the nature of the chemicals used, and the concentration of the chemicals and hydrocarbons in the discharge stream. Most studies on produced water toxicity and dispersion have concluded that the necessary dilution to achieve a No Effect Concentration (NEC) would be reached at <10 to 100 m, and usually less than 500 m from the discharge point (IOGP, 1994; OLF, 1998; Riddle *et al*., 2001; Berry and Wells, 2004; DECC, 2016).

Plankton abundance is influenced strongly by the physical environment and variables such as water temperature, current velocity, stratification in the water column, and nutrient concentration. As a result, they are particularly vulnerable to the introduction of chemicals and hydrocarbons to the water column. Plankton may be exposed to these contaminants through passive diffusion, active uptake, or through eating contaminated prey. As plankton spend most of their lives in the water column, they will be exposed to those contaminants that remain in solution (Sheahan *et al*., 2001). Produced water can affect recruitment in calanoid copepods (Hay *et al*., 1988), with lowered fecundity and increased offspring mortality reported for some plankton, as outcomes of hydrocarbon contamination (Van Beusekom & Diel-Christiansen, 1993). Strømgren *et al*. (1995) found that acute toxicity in the diatom Skeletonema spp. was only likely in individuals in the immediate vicinity of the source of produced water, where concentrations of contaminants are highest.

The OSPAR (2010b) Quality Status Report (QSR) noted that water column monitoring to determine possible effects from PAHs and other chemicals such as alkyl phenols discharged with produced water has been carried out to a limited extent in the OSPAR area. Monitoring with caged mussels in the Netherlands and Norwegian sectors of the North Sea has shown that mussels exposed to produced water discharges may accumulate PAH and show biological responses up to 1,000 m from the discharge. Concentrations of PAHs and alkyl phenols and measured biological responses in wild fish such as cod and haddock caught in the vicinity of offshore installations from Norwegian waters in 2002 and 2005 showed a mixed pattern mostly with no increased concentrations, but some elevated biological responses suggesting past exposure. Exposure of cod sperm cells to environmentally relevant concentrations (100, 200, 500 ppm) of produced water from the Hibernia platform,

Newfoundland, did not result in a strong toxicity to the cells (only subtle changes were observed) or a significant change in fertilisation rate (Hamoutene *et al*., 2010 in DECC, 2016).

The largest discharges to the water column during pre-commissioning and commissioning will be associated with pipeline dewatering operations, which will be discrete discharges. Whilst a range of chemicals (e.g., biocide, corrosion inhibitor, oxygen scavenger) used to inhibit the seawater, are used to fill the pipe during storage and hydrotest, these chemicals are used up and degraded by the reactions involved in providing their primary function of protecting the pipeline. Small discharges occur shortly after the chemicals are added to the pipeline (e.g., hydrotest), however, the dewatering discharge is by far the largest discharge during commissioning and will involve the discharge of inhibited anaerobic seawater with low residual chemical concentration. These discharges are likely to be rapidly dispersed in the turbulent offshore environment meaning that there is no possibility of minor impact to species in the water column.

Bakke *et al*. (2013) reviewed research on the biological effects of offshore produced water discharges, with focus on Norwegian waters. Produced water discharges are a continuous source of contaminants to continental shelf ecosystems, and alkylphenols and PAH were found to accumulate in cod and mussels caged near the discharge points, but these compounds are rapidly metabolized in cod. Such compounds may affect reproductive functions, and various chemical, biochemical and genetic biomarkers, but Bakke *et al*. (2013) concluded that the risk of widespread impact from such operational discharges is low.

During production, NEO aim to achieve as low an OIW concentration as possible (<30 mg/l) in produced water that will be re-injected or discharged after treatment. Affleck discharges will add to existing Judy discharges in which produced water treatment modifications will account for this increase in produced water. Considering the above, no major impact is foreseen in relation to these categories.

6.5 MANAGEMENT AND MITIGATION

A number of mitigation measures will be applied to the Development to limit, where practicable, the potential environmental impacts of discharges to sea, including:

- The main form of mitigation for water column impacts from pipeline installation and commissioning discharges, which include pipeline flooding and dewatering, lie in ensuring good mixing of dewatering discharges as the main risk from these types of discharges is the large volume of anaerobic water released;
- The oil content of the produced water at the Judy platform due to the additional produced water from Affleck will be less than the 30 mg/l oil-in-water concentration threshold prior to discharge to sea. Judy currently already achieves less than the 30 mg/l threshold which NEO will continue to aim to achieve as low OIW (30 mg/l) as possible; and
- Once the final chemical requirements are known, and prior to the commencement of operations, NEO will submit the relevant permit applications, supported by appropriate detailed chemical risk assessments, to OPRED under the OCR to obtain approval prior to chemical use and discharge.

6.6 CUMULATIVE AND TRANSBOUNDARY IMPACTS

Impacts to the water column include the effects from discharges from pipeline installation and commissioning, and from operational discharges. These discharges will be transient. Residual hydrocarbons and chemicals associated with these are expected to disperse rapidly through the water column therefore no cumulative impacts are expected on the water column from other activities occurring in the area, such as other oil and gas activities, commercial fisheries or shipping.

Pipeline dewatering operations during commissioning are expected to cause a small and short-lived plume which could potentially contain residual levels of some of the chemical(s) used during the installation of the pipeline. However, exposure of organisms in the water column to toxicity will be short-term and spatially limited and no impact to the benthic environment is expected.

Affleck production will contribute to cumulative produced water discharges from the Judy platform. The produced water rate from the Affleck field will amount to approximately 30% of the total water processing capacity on the Judy platform, based on the proposed topsides processes increase of produced water capacity from ~17,200 bbl/day to 20,000 bbls/day.

The produced water discharges will be effectively managed to ensure that discharges remain within the required discharge specifications (<30 mg/l of oil). The Affleck production chemicals selected for use have been checked to ensure compatibility for the combined Judy production, thus reducing risk of process upsets. Where possible, chemicals with best environmental performance (e.g., PLONOR) have been selected.

The limited quantity of chemicals discharged during the life of the Development and the use of appropriate management and mitigation measures reduces the likelihood of any measurable cumulative impacts to the benthic environment. Additionally, dilution of the releases during the field life will likely be rapid and the potential impacts will be transient in nature. Considering this, no significant cumulative impacts are expected with regards to the water column.

Considering that the discharge to sea will occur approximately 5 km from the UK/Norway EEZ, no transboundary impacts are expected.

6.7 PROTECTED SITES

The Development is partially located within the Fulmar MCZ, which has been designated for the presence of subtidal sand, subtidal mud, subtidal mixed sediments, and ocean quahog (*A. islandica*) (JNCC, 2018a). However, no discharges will take place within the MCZ. Discharges to sea during pipeline commissioning will take place at either ends of the pipelines and will comprise very low concentrations of oil in water. Produced water will be discharged to sea via the Judy caisson following treatment, and oil in water concentrations will be below 30 mg/l, with dispersion occurring throughout the water column, therefore no significant impacts on the MCZ features are anticipated.

6.8 RESIDUAL IMPACTS

Water column residual impacts relate to both the physical and chemical effects experienced predominantly by biota within the water column, including marine mammals, fish, and planktonic species. Plankton are particularly susceptible to impacts from contamination of the water column because they are generally non-motile, depending upon currents within the water column to travel, and cannot move away from an affected area.

Considering the relatively limited area over which the water column is predicted to be affected, pipeline pre-commissioning, commissioning and produced water discharges at Affleck are not considered to represent a significant residual impact to the water column. Plankton species are considered low sensitivity to water column contamination (see section 0).

Whilst there are likely to be a number of localised discharges of inhibited seawater during pre-commissioning operations discharged from Judy, and Christmas tree preservation fluid discharged to the seabed, these will be limited in quantity and occur only intermittently. These discharges to sea are likely to be rapidly dispersed in the offshore environment meaning that there is no possibility of measurable impact to species in the water column.

Produced water will be treated and discharged via the Judy caisson. The oil content of the produced water will be less than 30 mg/l prior to discharge to sea.

Receptor	Sensitivity	Vulnerability	Value	Magnitude
Water Column	Low	Low	Negligible	Minor

Rationale

Plankton are particularly susceptible to impacts from water column contamination because they are generally non-motile and cannot move away from an affected area. Produced water will be treated to an acceptable level within the legislative requirement of 30 mg/l, which is not expected to result in significant impacts to plankton. Plankton occur in large numbers, are borne in large moving water masses, and have extremely high natural mortality rates. Therefore, due to the regulated conditions of chemical use, the small discharge volumes in relation to the receiving environment, and the large dilution and dispersion available, impacts are expected to be largely non-measurable. Thus, sensitivity and vulnerability are considered to be low.

Discharges of inhibited seawater during pre-commissioning operations associated with pipeline dewatering operations will occur. These will be limited in quantity and occur only intermittently There may also be some discrete, localised discharges of preservation fluid at the seabed. These are likely to be rapidly dispersed in the offshore environment meaning that there is no possibility of minor impact to species in the water column.

The predicted discharges of the Development will be rapidly dissipated within the water column; therefore, the extent of any change is expected to be small and transient and therefore the magnitude is negligible.

No water column species of conservation concern are expected to occur in the proximity of the Development; therefore, the value of the water column receptor is therefore considered to be negligible.

Consequence	Impact Significance
Low	Not significant

7 SEABED DISTURBANCE

7.1 INTRODUCTION

This chapter describes the nature of potential impacts from seabed disturbance arising from the Development activities and assesses the significance of these impacts.

The key Development activities that may interact with the seabed area are:

- Installation of the new Affleck tie-in structure;
- Installation of tie-in spools at Affleck and Talbot;
- Trenching and laying of pipeline and electro-hydraulic control umbilical; and
- The placement and presence of subsea infrastructure protection materials including concrete mattresses and rock placement.

The above activities have the potential to lead to changes in the seabed and potential negative impacts on the biota, including:

- Direct loss of benthic species;
- Direct loss of benthic habitat;
- Introduction of new hard substrate;
- Wider indirect disturbance to the benthic environment through the suspension and re-settlement of sediments.

7.2 REGULATORY CONTROLS

In addition to the EIA regulations detailed in Section 1.3, there are other requirements of UK legislation, international treaties and agreements relevant to the assessment of impacts on disturbances of the seabed.

The following legislation is key in relation to seabed disturbance from the proposed Development in terms of the potential impacts to the seabed and benthic habitats offshore:

- Marine (Scotland) Act 2010;
- Marine and Coastal Access Act (2009);
- Petroleum Act 1998;
- The Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007 (as amended);
- The Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 (as amended);
- The Conservation of Offshore Marine Habitats and Species Regulations 2017 (as amended), which implement the provisions of the EU Directive 92/43 on the conservation of natural habitats and of wild fauna and flora;
- The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019;
- The Convention for the Protection of the Marine Environment of the North-East Atlantic (The OSPAR Convention);
- Convention on Biological Diversity; and
- The Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention).

On behalf of the Scottish Government, JNCC, NatureScot and Marine Scotland have together developed recommended lists of PMFs in Scotland's seas (SNH, 2014; Tyler-Walters *et al*., 2016). The lists have not been developed in accordance with any specific legislation, agreement or convention; but were developed to guide policy decisions regarding the conservation of Scotland's seas through the identification of priority species and habitats. The list of recommended PMFs in Scotland's offshore

waters was adopted in 2014 and contains 81 habitats and species considered to be of conservation importance.

7.3 ASSUMPTIONS AND DATA GAPS

Throughout the installation, pre-commissioning and operation phases of the Development, the activities that will result in physical disturbance to the seabed include the installation of the pipeline, control umbilical, tie-in structure, and the placement of protection materials. The impact on the seabed has been assessed based on the following:

- The production PiP line and umbilical will be trenched and buried in two separate trenches. The respective lengths of the pipeline and umbilical are 21 km and 37 km. The trench may be cut using a plough; however, there is potential for jet trenching to be used. Trenching using a plough will impact a 3.5 m wide corridor and this estimate has been used throughout this impact assessment as it represents the worst case for seabed disturbance;
- 212 Mattresses will be required for the Development, each mattress will be of the dimensions 6 m x 3 m 0.3 m. The proposed number of mattresses includes a contingency of +50%;
- There will be the requirement for rock placement along both the pipeline and umbilical at crossings and along sections of trench transition. These rock berm lengths and widths are variable. All berms for crossings will have a maximum width of 14 m and berms for trench transitions will have a width of 6 m on the seabed; and
- All subsea installation vessels shall operate using dynamic positioning (DP).
- Description and Quantification of Seabed Impacts.

7.3.1 Physical Loss or Abrasion of Benthic Habitats or Species

The installation of the pipeline, umbilical, tie-in structure, and the placement of associated protection materials may cause mortality or displacement of benthic species due to habitat loss within the direct footprint of installation. The significance of habitat loss and mortality of seabed organisms depends on the area of disturbance, the level of tolerance of the affected habitat and species to physical disturbance, the conservation value of the affected habitat or species and their uniqueness to the area. With the exception of pipelines, the installation of all structures and spools will result in a small area of seabed being impacted, estimated at 150 m^2; this impact will persist in the long-term but it will be temporary as it is anticipated that these structures will be removed at the end of field life.

The seabed area likely to be directly impacted by the proposed Development is provided in Table 7-1.

Table 7-1 Footprint of the proposed Development activities

Structure	Parameters	Direct footprint (m^2)	Direct footprint (km^2)	Indirect footprint (km^2)
Production pipeline	21 km length 3.5 m wide trench	73500	0.073500	0.147000
Electro-hydraulic control umbilical	37 km length 3.5 m wide trench	129500	0.129500	0.259000
Affleck tie-in structure	10.8 m x 8.3 m	89.64	0.000090	0.000179
Affleck production manifold piping	5 m 6”	0.75	0.000001	0.000002
Affleck A1 well spool (from Affleck A1 well to existing Affleck manifold)	47 m 6”	7.05	0.000007	0.000014
Well spools (from Affleck A2Y to existing Affleck manifold)	27 m 6”	4.05	0.000004	0.000008
Rigid tie-in spools (from existing Affleck manifold to proposed Affleck pipeline)	100 m length 8” (~20 cm) diameter	20	0.000020	0.000040

Structure	Parameters	Direct footprint (m^2)	Direct footprint (km^2)	Indirect footprint (km^2)
Rigid tie-in spool (from proposed Affleck pipeline to proposed Affleck tie-in structure)	100 m length 8" (~20 cm) diameter	20	0.000020	0.000040
Rigid tie-in spool (from proposed Affleck tie-in structure to Talbot DC1 manifold)	25 m length 10" (~25 cm) diameter	6.25	0.000006	0.000013
Total footprint of subsea installations		**203147.74**	**0.203148**	**0.406295**
Mattresses	212 mattresses (this is the worst-case and includes +50% contingency) 6 m x 3 m	3816	0.003816	0.007290
Grout bags	50 grout bags 1 Te bags (1 m^2 footprint each)	50	0.000050	0.000100
Rock requirements along pipeline	Crossings and trench transitions 14 m wide rock berm for Crossings 6 m wide rock berm for transitions.	7,820	0.007820	0.015640
Rock requirements along umbilical	Crossings and trench transitions 14m wide rock berm for crossings, 6 m wide rock berm for transitions.	33,768	0.033768	0.067536
Contingency rock requirements for UHB along Pipeline	Up to 24,000 Te of rock may be required for UHB. The location and extent of this rock placement is not known so a conservative area estimate has been made based on pro-rated rock required for the pipeline).	12,876	0.012876	0.025752
Total footprint of protection materials		**58,330**	**0.058330**	**0.11666**
Total Development footprint		**261,478**	**0.2614478**	**0.522956**

Whilst there is little quantitative information on the likely recovery time of the seabed from physical disturbance studies have been carried out for seabed disturbance by towed fishing gear (as review by Løkkeborg, 2005). These fishing gear studies suggest that some level of recovery will occur in the sediments; the same can be assumed for any short-term impacts associated with the Development. The longevity of physical scars on the seabed is dependent on the sediment type and energy of the local benthic environment. Scars in higher energy, sandy or shallow environments may disappear within days or months of initial disturbance, whilst those in lower-energy silty and deeper areas may still be faintly visible after 18 months (Marine Scotland, 2013). Surveys of the Affleck area found that the seabed sediments in the vicinity of the Development constitute medium to fine sand, which reveal a low energy environment where fine sediments deposit on the seabed. This is consistent with the low mean residual currents predicted for this area of the North Sea (see Section 4.2.2), which suggests that the recovery of the seabed in the wake of trenching activities may not occur quickly. However, the review by Løkkeborg (2005) notes that biological communities in physically disturbed seabed typically show recovery well before the scars themselves have disappeared.

The sediments in the Talbot area may be suitable for sandeel spawning; however, this does not apply to the seabed along the Affleck pipeline where the fines content of the sediment is generally too high (8.3–16.1%; see Section 4.3.3). A small number of demersal fish and their spawning grounds might be temporarily disturbed by the removal of the structures. However, fish are highly mobile organisms and are likely to avoid areas of re-suspended sediments and turbulence during the activities. Overall, given the localised area of impact associated with the Development activities, and the largely transient nature of the disturbance to benthic sediments, the disturbance to fish and shellfish is not expected to be

significant. Furthermore, the area is unlikely to be used by benthic spawners during the proposed operational period; sandeel spawn in the winter months and therefore is unlikely to coincide with Development activities (Table 1-2).

The environmental baseline and habitat assessment survey conducted at Affleck in 2021 only observed a single seapen and three faunal burrows, therefore the area does not resemble the habitat 'seapen and burrowing megafauna communities' (Gardline, 2021b). Surveys within the Talbot field similarly concluded that the habitat was not present as the density of burrows observed in the seabed images was 'rare', and there was an absence of any visible burrowing megafauna (Gardline, 2019b; Section 4.3.2). Additionally, surveys at both Affleck and Talbot identified the presence of sponges; however, at Talbot they were considered 'rare' and neither survey considered their presence to constitute a deep-sea sponge aggregation (Gardline, 2019c; Gardline 2021b). Therefore, the habitats 'seapen and burrowing megafauna communities' and deep-sea sponge aggregations are considered absent from the Development area, thus have been discounted from further consideration.

Other species and of conservation interest which may be located within the Development area are ocean quahog and biogenic reef in the form of horse mussel beds.

The Development lies near the boundary of the Defra *A. islandica* general distribution area (Figure 4-15). The closest ocean quahog record to the Affleck pipeline is approximately 5.5 km northwest. However, there are several records in close proximity to the umbilical to Judy (Gardline, 2021b). Evidence of siphons and broken shells were also observed in 2019 along the Talbot pipeline, in addition to juvenile *A. islandica* appearing in a number of macrofaunal samples within the Fulmar MCZ (Gardline, 2019c), which is designated for the species. The impact of the Development on ocean quahog within the MCZ is discussed in Section 7.7.

Ocean quahog feed at the seabed surface and can burrow to depths of 14 cm; therefore, they are vulnerable to physical abrasion and penetration of infrastructure into the sediments. Ocean quahog are a long-lived bivalve which take five to 15 years to reach sexual maturity and spawn over a short period each year. Recruitment is sporadic and variable (Tyler-Walters and Sabatini, 2017). As such, the recoverability of ocean quahog to physical abrasion and disturbance is very low. While it is likely that this species is present in the vicinity of the proposed development, the area of impact associated with the Development is likely to be so limited in the context of the wider available habitat that a significant proportion of the species will not be affected, nor will a large area of suitable habitat be affected. Furthermore, survey evidence does not indicate that the species occurs in significant densities constituting an aggregation.

As noted in Section 4.3.7.4, surveys in the Talbot area recorded areas of 'medium confidence' horse mussel *Modiolus* beds; however, uncertainty in the acoustic signature prevented the confirmation Annex I biogenic reef presence (Gardline, 2019b). The transects along which these mussels were identified were primarily located to the north of Talbot. Therefore, only the proposed Affleck umbilical to Judy may impact this habitat. The most prominent mussel beds were located approximately 100 m southeast of the Talbot pipeline 3.5 km from the Judy approach (see Figure 4-18 for the location of the transects in relation to the Talbot infrastructure) and are therefore further still from the Affleck umbilical. Thus, it is considered unlikely that the Affleck infrastructure will incur a direct impact on horse mussel beds.

Horse mussels are large and relatively tough. Horse mussel beds are not particularly fragile, however clumps of horse mussels on muddy substrata may be more intolerant to physical disturbance (Holt *et al*., 1998). These clumps are more akin to the levels of horse mussel presence observed during the Affleck surveys. Towed fishing gear is known to flatten clumps and aggregations and may break off sections of raised reefs (Holt *et al.,* 1998). However, this level of disturbance is not expected to be associated with the Development. Overall, horse mussel beds are considered highly sensitive and intolerant of abrasion and direct physical disturbance (Tyler-Walters, 2007).

In addition to the physical loss and/or disturbance of benthic habitats, the disturbance of the seabed sediments during subsea infrastructure installation will also potentially lead to the smothering of benthic

species due to sediment suspension and re-settlement; this is known as an indirect impact. The quantification of indirect impact is also provided in Table 7-1 and a description of indirect impacts and how these estimates have been calculated are described further in Section 7.3.2.

The proposed pipeline between the existing Affleck manifold and proposed Talbot DC1 manifold, and the proposed umbilical from Affleck to Judy via Talbot, will both lie partly within the Fulmar MCZ; approximately 4 km of the pipeline and 7 km of the umbilical will be within the site. The MCZ is designated for subtidal sand, subtidal mud, subtidal mixed sediments, and ocean quahog. Potential impacts within the MCZ will be fully addressed in Section 7.7.

7.3.2 Smothering of Benthic Habitats and Species

The second impact mechanism, indirect disturbance, is that which occurs outside of the physical infrastructure footprint. It is typically caused by the suspension and re-settlement of natural seabed sediments disturbed during activities, including subsea installation, trenching and pipelay. This secondary impact pathway is considered temporary. In the context of the Development activities, indirect seabed disturbance may occur during subsea infrastructure installation, resulting in the smothering of benthic fauna in the immediate vicinity due to sediment suspension and re-settlement. The scale of indirect disturbance has been estimated based on the expected area of direct disturbance from any activity and is assumed to be double the direct disturbance area for all structures and activities taking place (Table 7-1).

Exposure to higher than normal loads of suspended sediment has the potential to negatively affect adjacent fauna and biotopes. The re-settlement of sediments can result in smothering (Gubbay, 2003), with the degree of impact related to the ability of buried species to return to the surface of sediments or to clear particles from their feeding and respiratory surfaces. However, DEFRA (2010) states that the impacts arising from sediment re-suspension are short-term (generally over a period of a few days to a few weeks); in addition, infaunal communities are naturally habituated to sediment transport processes and are therefore less susceptible to the direct impacts of increased sedimentation rates and will work their way back to the seabed surface through blanket smothering.

Ocean quahog, which were observed in relatively low numbers within the Talbot and Affleck surveys (Gardline, 2019c; Gardline, 2021b), are highly resilient to smothering and increases in siltation rates. In field studies, *A. islandica* was able to burrow to the surface of 40 cm of sediment and no effect on its growth or population structure was evident (Powilliet *et al.*, 2009). The sediments disturbed during subsea installation activities will deposit in the immediate vicinity of the location of disturbance and the thickness of deposits will decrease with the distance from the location of disturbance. Deposits of fine material are unlikely to have a negative impact on ocean quahog, which show a low vulnerability and high resistance to smothering (Tyler-Walters and Sabatini, 2017; Hill and Tyler-Walters, 2018). Some individuals may be buried deeper in sediment berms that may form during trenching activities; however, given the low abundance of ocean quahog expected to occur in the Development area, and the small footprint of the Development activities, only a very small number of individuals are likely to be lost. This will not impact the population structure and will not compromise the conservation objectives of A. islandica, which include strengthening the protection of the ocean quahog at all life stages to allow population recovery, improving its status and to ensure that the population is effectively conserved in Region II of the OSPAR maritime area (i.e., the Greater North Sea area; OSPAR, 2009).

Horse mussels are found in a variety of turbid and clear water conditions (Holt *et al.,* 1998). Although high levels of suspended sediment may interrupt feeding, horse mussels are probably able to tolerate increases in suspended sediment. In fact, increases in organic suspended particulates may increase food availability. *Modiolus* is adapted to a benthic sediment habitat and is probably capable of rejecting excess silt or particulates, therefore are considered to be able to recover immediately from increases in suspended sediment (Tyler-Walters, 2007). However, they are considered moderately intolerant of smothering, as studies have found that smothering can affect recruitment for a number of years in the aftermath. Consequently, horse mussels are considered to exhibit low recoverability to smothering (Tyler-Walters, 2007). Overall, the area of indirect disturbance associated with the Development

activities is 0.52 km^2, and the area likely to be affected by smothering will be even smaller within this extent.

7.3.3 Introduction of Hard Substrata

Introduction of hard substrata on a soft seabed type, such as sand within the Affleck area, may affect the seabed species that depend on this habitat.

Where subsea installations, jumpers, and protection materials (concrete mattresses and sandbags, and potentially rock) will be installed at the seabed surface, the sedimentary substrata will be replaced with hard substrata. However, given the relatively small area of seabed footprint associated with the introduced hard substrata (0.058 km^2; Table 7-1), and the wide distribution of ocean quahog and horse mussels in the North Sea, the direct impact on these sedimentary habitats is considered negligible and has not been assessed further. In addition, these subsea structures (with the exception of rock) will be removed from the seabed at the end-of-field-life, thereby returning some area to suitable habitat for species reliant on softer substrates.

7.4 MANAGEMENT AND MITIGATION MEASURES

The measures that will be in place to mitigate potential seabed impacts associated with subsea installation include:

- The number of mattresses, volumes of sandbags to be placed over crossings and tie-in-points and the potential requirement for rock placement will be refined during detailed design to reduce the footprint on the seabed to the extent practicable;
- Environmental survey data will be used to inform the placement of concrete mattresses/grout bags;
- The pipelines and umbilical shall be trenched and buried over the majority of their lengths with protection mattresses only being used where necessary. Overall, rock placement will be limited to as low a volume as reasonably practicable;
- All rock would be installed by a dedicated rock placement vessel will fall pipe, ensuring accurate placement and optimised use of the rock material; and
- Consultation will be undertaken with relevant authorities, organisations and stakeholders, including Marine Scotland, JNCC and NatureScot.

7.5 CUMULATIVE AND TRANSBOUNDARY IMPACTS

DECC (2016) identifies the following oil and gas activities as sources of cumulative physical disturbance to the seabed: drilling rig placement, wellhead placement and recovery, subsea template and manifold installation and piling, umbilical and pipeline installation and trenching and decommissioning of infrastructure. Of these, pipelay is considered to account for the largest spatial extent. The Development will result in a predicted direct total disturbance of approximately 0.26 km^2, with an indirect impact of approximately 0.52 km^2 from the suspension and resettlement of sediments in the immediate vicinity of the subsea installation activities, as detailed in Table 7-1.

The majority of this area is considered to be short-term disturbance and this area of seabed is small relative to the available similar habitat in the vicinity of the Development and in the wider CNS. Outside of the Fulmar MCZ, the seabed habitat in the Affleck area does not host any protected habitats. Furthermore, the sandy seabed habitat, as described in Section 4.2.2, is widely distributed in the region and the loss of fauna and habitat for this biotope is expected to be minimal due to the small area of seabed directly disturbed.

There are a number of other oil and gas assets within a 40 km radius of the Development, as listed in Table 4-10, the closest of which is currently the Judy platform (15 km northwest of Talbot). Given that the footprints of these developments are all similarly small, do not overlap with the Development and

that the seabed type in the region is extensive and relatively homogenous, the cumulative impact of the Development on the seabed is considered to be negligible.

Once complete, the Development will tie-back to the Talbot Field Development. As such, there will be some overlap spatially between these projects. The Talbot Field Development ES states an anticipated 0.18 km^2 of seabed will be occupied through the installation of subsea infrastructure and pipelines. Of this total footprint, 0.0042 km^2 of area would undergo permanent habitat alteration through the addition of rock (Chrysaor, 2021). All suspended sediment impacts will affect areas of seabed immediately adjacent to the activities. At the time of writing, activities associated with the Talbot Field Development are set to begin in Q3/Q4 2022, with Talbot first oil in 2024. The Affleck works are set to begin in 2023/2024 therefore it is unlikely that there will be any temporal overlap between the projects. However, there will be a combined area of impact from the Affleck and Talbot developments equating to 0.44 km^2. There are no other known planned developments in the area.

Cumulative impacts from the Development and other project activities within the MCZ are fully considered within Section 7.7.

The OESEA for UKCS waters (DECC, 2009) states that seabed impacts are unlikely to result in transboundary effects and even if they were to occur, the scale and consequences of the environmental effects in the adjacent state territories would be less than those in UK waters and would be considered unlikely to be significant. Given the distance of the proposed Development to the UK/Norway EEZ line (approximately 5 km away), transboundary impacts to the seabed are very unlikely.

7.6 DECOMMISSIONING

Any potential impacts as a result of decommissioning operations (e.g., removal of the Development subsea infrastructure) will occur in the area that experienced seabed disturbance during the installation operations.

7.7 PROTECTED SITES

There are no SACs located close to the Development where benthic habitats or species are a qualifying interest. It can therefore be concluded that there will be no Likely Significant Effects (LSE) on any SACs designated for benthic habitats or species (either directly from the Development or cumulatively with other activities). SPAs are also excluded with regard to seabed impacts as such sites are designated for bird interests.

However, approximately 4 km of the proposed Affleck pipeline and 7 km of the umbilical will pass through the Fulmar MCZ. As stated in Section 4.3.7, the qualifying features for the site are as follows:

- Subtidal mixed sediments;
- Subtidal mud;
- Subtidal sand; and
- Ocean quahog.

As shown in Figure 7-1, the proposed pipeline will pass through the northeastern most corner of the MCZ where the seabed predominantly consists of subtidal mud, with a small area of subtidal sand found along the northern site border. It is worth noting that the seabed characterisation within the site as per Figure 7-1 (Defra, 2016), does not strictly correspond to the findings of the more recent site-specific surveys outlined in Section 4.1. Information from Affleck and Talbot both described the seabed as largely loose silty sand with occasional shell fragments consistent with EUNIS habitat A5.27 ‘deep circalittoral sand’ or EUNIS habitat A5.45 ‘deep circalittoral coarse sediment’ (Gardline, 2019b; 2021b), as shown in Figure 4-6. Conversely, Figure 7-1 suggests the seabed is predominantly mud.

In the interest of completeness, despite the discrepancy between the Defra (2016) data and site-specific information, it is considered a possibility that the Development activities have the potential to impact both the subtidal muds and subtidal sand features of the site.

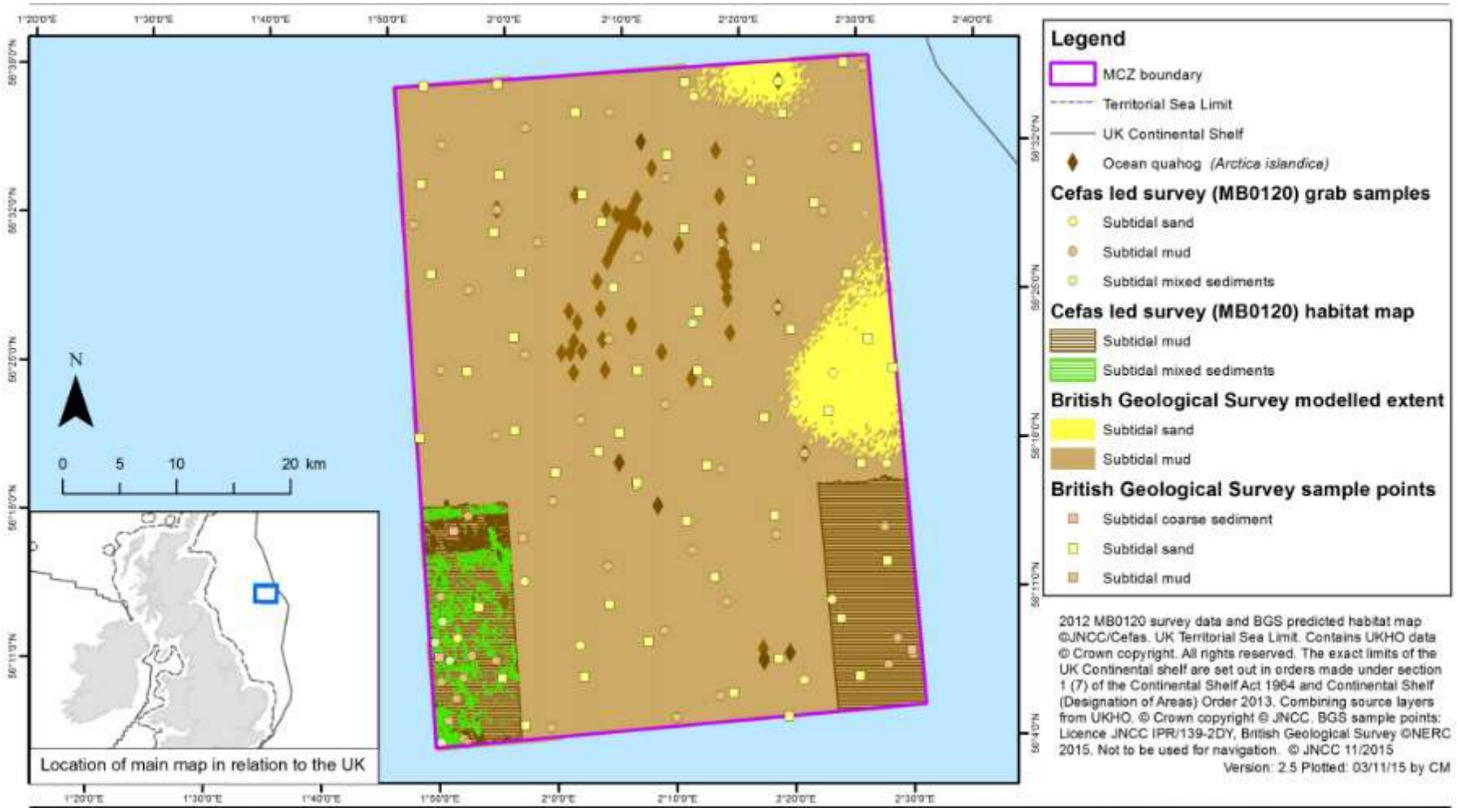

Figure 7-1 Map of designated features within the Fulmar MCZ (from Defra, 2016)

The habitats the MCZ protects are important resources for marine animals, providing food, spawning areas and shelter. Burrowing anemones and brittlestars are found at the site as well as slender seapens that protrude from the surface of the mud (JNCC, 2018a). The JNCC's Advice on Operations within the Fulmar MCZ indicates that subtidal mud and subtidal sand habitats are both considered sensitive to abrasion and direct disturbance, changes to habitat structure due to the introduction of hard substrate, and increased levels of siltation which may arise during installation (JNCC, 2018a).

Community analysis of habitats within the Fulmar MCZ, identified the following biotopes within the overarching habitats subtidal sands and muds:

- A5.376: *Paramphinome jeffreysii*, *Thyasira spp.* and *Amphiura filiformis* in offshore circalittoral sandy mud;
- A5.354: *Virgularia mirabilis* and *Ophiura spp*. with *Pecten maximus* on circalittoral sandy or shelly mud; and
- A5.44x: Circalittoral mixed sediments, no matching biotope (Jones, Parry and Wright, 2016).

Of these, the proposed Affleck activities are likely to affect biotopes A5.376 and A5.354 due to the nature of the sediments observed in the area (Section 4.2.2), however the same infaunal community was largely recorded across the whole site (Jones, Parry and Wright, 2016).

Recovery times after physical disturbance have been found to vary for different sediment types; Dernie *et al.* (2003) found that muddy sand habitats had the longest recovery times, compared to mud and clean sand habitats. Population recovery rates will be species specific within these habitats (De-Bastos, 2016; Hill, Tyler-Walters and Garrard, 2016). Neither of the biotopes (A5.376 and A5.354) are likely to be affected by the Development activities are considered as having any resistance or long-term resilience to physical pressures, including abrasion and loss of habitat. While subtidal muds and subtidal sands themselves are such broad habitats, biotopes A5.376 and A5.354 are considered to be representative of these wider habitats by extension. Consequently, their lack of recoverability to disturbance can be applied to subtidal muds and subtidal sands. This would correspond to the JNCC's categorisation of the habitats as sensitive (JNCC, 2018c).

Ocean quahog are also considered to be sensitive to these impacts associated with the Development (JNCC, 2018c). The sensitivity of the species to disturbance, both direct and indirect, has been expanded upon in Sections **Error! Reference source not found.** to 7.3.3. This assessment remains equally applicable to ocean quahog within the Fulmar MCZ. While the majority of ocean quahog observations, as shown in Figure 7-1, are concentrated in the centre of the site and not close to the proposed Affleck activities, it is possible that they will be in the vicinity of the Development, though not in numbers constituting an aggregation.

The area of impact within the MCZ associated with the Development will be exclusively attributed to the installation of the pipeline and umbilical, and placement of rock protection associated with the trench transitions at Talbot. None of the crossings along the pipeline and umbilical are located within the MCZ. Overall, an anticipated 0.042 km^2 of the MCZ will be affected by the installation of the pipeline and umbilical directly through trenching and backfill.

Placement of rock will permanently affect an addition of up to 0.0009 km^2 from trench transitions and crossings and up to 0.0021 km^2 from UHB protection, resulting in a permanent area of impact of 0.003 km^2 within the MCZ. As the location and extent of rock placement required to address UHB is not yet known, an estimate has been based on the proportion of the Affleck production line within the MCZ. In total, 0.045 km^2 of the MCZ area will be affected by the Development, attributed to both temporary impacts and permanent impacts associated with rock placement.

The Fulmar MCZ covers an area of 2,437 km^2; within this context, the proposed direct impact of the Development (0.045 km^2) will affect 0.0018% of the site. Thus, a proportionately very small area of protected seabed habitat will be affected.

The NSTA produced a technical review of the placement of rock and other protective material associated with offshore oil and gas operations across the UKCS. Part of this review involved the quantification of rock placement within protected sites. In total, an estimated 17,228 m^2 (0.017 km^2) of seabed deposits have been installed within the Fulmar MCZ between 2011-2016, the vast majority of which is rock. This equates to 0.0007% of the site. More recently, additional rock may have been placed within the site associated with the decommissioning of the Fulmar and Auk pipelines and other facilities. The Fulmar and Auk decommissioning proposed a maximum worst-case rock installation of 0.231 km^2 within the MCZ. As described in Section 7.5, the Talbot development will also generate a seabed impact within the MCZ. Table 7-2 lists the area of rock within the Fulmar MCZ according to the NSTA (2021) review, in addition to the areas of rock which are proposed within the site as a result of the Development, the Talbot development, and the Fulmar and Auk decommissioning programme.

Table 7-2 Area of rock placement within the Fulmar MCZ

Source	Area of rock within MCZ (km^2)
Affleck	0.003
Rock within Fulmar MCZ (NSTA, 2021)	0.017
Talbot (Chrysaor, 2021)	0.004
Fulmar and Auk (Repsol Sinopec, 2021)	0.231
Total area of rock placement	**0.255**

The total combined area of rock within the site is 0.255 km^2 which equates to 0.01% of the Fulmar MCZ.

With respect to the Conservation Objectives of the site relating to subtidal sands, subtidal muds and ocean quahog (as outlined in Table 4-7), 'any temporary deterioration of habitat/reduction of numbers is to be disregarded if the habitat/population is sufficiently healthy/thriving and resilient to enable its recovery' (JNCC, 2018a). An area of 0.044 km^2 will be affected by disturbance from which the designated features of the site are likely to recover; the wider available supporting habitat and populations will enable population replenishment with time. A smaller area will be affected by the placement of hard substrate, some of which may remain *in situ* permanently (rock placement). With consideration of cumulative impacts within the MCZ, 0.01% of the site will experience a change to hard substrate. However, this area is small within the context of the whole site, affecting neither the overall structure and function of the designated habitat features, nor the quality and quantity of the ocean quahog communities within the site. Overall, the proposed Development activities are not likely to contravene the Conservation Objectives outlined for the Fulmar MCZ.

7.8 BLUE CARBON

Marine sediments, and particularly deep-sea sediments, are the primary store of biologically derived carbon (mostly inorganic carbon). Scotland's biogenic marine habitats are highly productive places, with a very high rate of assimilation of carbon into plant material (662 $gC/m^2/yr$), mostly in coastal areas. Yet their overall contribution to the carbon budget is relatively small compared to sediments (Burrows *et al*., 2014; 2017). Carbon stored in organisms can be broadly defined as either 'transient' stores, such as the carbon stored in seagrass beds, kelp and macroalgae; and 'long term' biological stores, such as biogenic structures (e.g., coral reefs, serpulid reefs, mussel beds).

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 was estimated as 18.1 Megatonnes of 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).

A review of sediment accumulation rates in northern waters showed that the burial rates for organic carbon are strongly dependent on sediment type. As described in Section 4.2.2, the seabed type within the Development area is primarily classified under the habitat complex 'deep circalittoral sand', EUNIS habitat code A5.27 (MD5: Offshore circalittoral sand), with a small area to the southwest of the pipeline classified as 'deep circalittoral coarse sediment', EUNIS habitat code A5.15 (MD3: Offshore circalittoral coarse sediment). However, surveys indicated medium to fine sand across the Development area. Burial rates for organic carbon into sand/mud sediments, such as those at Affleck, are moderate compared to other sediment types (50.6 gC/m^2/yr). However, the overall percentage carbonate in the top 10 cm of superficial sediments at the Development site, interpolated from BGS sediment records, is <10% (Burrows *et al*., 2014; NMPI, 2022).

Bivalves such as mussels are filter feeders that take particles from the water, ingest them and deposit them as faeces and pseudofaeces (non-food particles, such as grit) – both of which contain carbon. Where associated biogenic reefs occur, these particles and the associated carbon become trapped. Additionally, the 3D complex structure of the biogenic reef can also trap particles from the water column. Therefore, through this sediment accumulation, shellfish reefs may retain significant quantities of carbon (Norris *et al*., 2021). However, the act of respiration and the process of calcification during shell development actually make such reef habitats net CO_2 sources (Gregg *et al*., 2021; Norris *et al*., 2021). Studies of Scottish mussel beds suggested that mussels have low area-specific carbonate production rate which equates to a carbon sequestration capacity of approximately 40 gC/m^2/yr (Burrows *et al*., 2014).

During surveys of Talbot, potential Annex I *Modiolus* biogenic reef habitat was identified. However, the acoustic signature was not well defined, and the report concluded there was insufficient evidence for the positive identification of biogenic reef (Gardline, 2021b). As such, it is considered unlikely that biogenic reef would be significantly affected by the proposed Development.

Overall, the sediments in the Development area are considered to have a low carbonate value, and there is an absence of other habitats with blue carbon potential (e.g., kelp beds, seagrass beds) in the area, with the exception of potential biogenic reef which is unlikely to be present to a significant extent. Consequently, the Affleck area is not considered to represent an area of high blue carbon potential and so the activities associated with the development are unlikely to impact the carbon sequestration potential of the immediate seabed and associated habitats.

7.9 RESIDUAL IMPACTS

Receptor	Sensitivity	Vulnerability	Value	Magnitude
Seabed habitats	Low	Low	Low	Minor
Benthos	Low	Low	Low	Minor
Fulmar MCZ	Medium	Medium	High	Minor
Rationale				
The Development will directly affect 0.23 km^2 of seabed. The temporary indirect impact associated with sediment suspension generated by installation activities will affect twice the area: 0.46 km^2. Within the direct footprint of impact, 0.028 km^2 of habitat will be lost due to the placement of stabilisation materials, the majority of which will be rock placement (including contingency worst-case quantities). The seabed in the Development area is mainly muddy sand and sandy mud, which is consistent with a low energy environment. While this means that recovery of the seabed from physical disturbance, through trenching of the pipeline and umbilical and installation of infrastructure, the evidence of disturbance will eventually fade as the seabed recovers. Additionally, survey evidence determined that overall, there was an absence of sensitive				

habitats in the Development area due to the ‘rare’ presence of burrows and sponges. Therefore, the value of the seabed habitats in the area is considered low. As no sensitive habitats were observed in the area, the sensitivity is also considered low and, as seabed recovery is expected with time, vulnerability is also low. Owing to the highly localised impacts to the seabed and habitats, and the wider availability of sandy and muddy seabed in the CNS, the magnitude of impact has also been deemed minor.

Low numbers of ocean quahog were identified in the Affleck area, and areas of ‘medium confidence’ horse mussel beds, which constituted ‘likely’ Annex I biogenic reef were present. While both are intolerant of physical abrasion, they are relatively tolerant of increased sedimentation, although not smothering. The area of direct impact on the seabed associated with the Development will be very small in the context of more widely available habitat for ocean quahog, and the presence of horse mussel beds is not certain. As such, the magnitude of impact is considered minor. Owing to the uncertainty of the presence of these species, the value of benthos is considered low, as are sensitivity and vulnerability.

The Fulmar MCZ, as a designated site, is of inherently high value. As only short sections of pipeline and umbilical will be located within the site (4 km and 7 km respectively), and little rock placement is associated with the trench transitions within the MCZ, the magnitude of impact within the site is considered minor; 0.00179% of the site will be affected by the Development. Even in combination with the Talbot activities this footprint remains low. The MCZ is designated for the following: Subtidal mixed sediments; Subtidal mud; Subtidal sand; and ocean quahog. The seabed sediment features of the site are sensitive to physical disturbance and exhibit low recoverability, hence the sensitivity and vulnerability being considered medium.

Considering the above, in relation to the largely temporary small area of impact attributed to the Development and within the context of the wider CNS, the overall consequence of the proposed activities is considered low. The overall disturbance to the seabed caused by the Development is considered not significant.

Consequence	Impact Significance
Low	Not significance

8 UNDERWATER NOISE

8.1 INTRODUCTION

As noise is readily transmitted underwater, there is the potential for sound emissions from the proposed operations to affect marine mammals and fish which utilise sound in the marine environment for biological and behavioural functions. Hearing is the primary sense for cetaceans, particularly the odontocetes (i.e., toothed whales, dolphins, and porpoises), which use echolocation to build up an image of their environment and to detect prey and predators (Berta *et al*., 2005). Fish and sea turtles are also known to utilise sound to detect information from the marine environment, either through particle motion using sensory transmission via swim bladders or in-ear hair cells, or through pressure differences using sensory organs (i.e., lateral lines) (Popper *et al*., 2014).

In addition to responding to natural sounds, marine mammals may also respond to man-made noise which falls within their hearing range. Noise from anthropogenic sources may be intermittent, impulsive, continuous, high or low intensity, and in any given combination of these properties. Increased use of the marine environment for a range of activities (e.g., geophysical exploration for Oil & Gas, offshore renewable developments, military exercises, commercial shipping, etc.) has resulted in underwater noise levels that are estimated to be at least ten times higher today than they were a few decades ago (Todd, 2016).

Impacts from man-made noise can be temporary or chronic and impacts may range from individual to population-level effects (Graham *et al*., 2019; Gedamke *et al*., 2011). Sub-lethal impacts from noise encompass a whole host of behavioural responses, such as alterations to vocalisations, large or fine-scale changes in movements, changes in habitat usage or migration and communication masking, as well as auditory and non-auditory physiological impacts (Nowacek *et al*., 2007). Behavioural noise impacts are considered 'disturbance' if they halt an individual's normal (i.e., biological) activities, such as resting, socialising, nursing, or feeding, or if they cause undue stress which can leave an animal physiologically impaired (Erbe, 2012; Broucek, 2014). Marine mammals exposed to a sound source of great enough intensity may experience temporary or permanent alteration to their hearing ability, injury, or in extreme cases, mortality. All of these biological and behavioural responses to excessive noise exposure carry the potential to impact an individual's ability to survive and reproduce, which in turn can affect population stability.

The severity of the impacts resulting from anthropogenic noise, either behavioural or physiological, will depend on the nature of the sound (i.e., frequency, duration and source level), the surrounding environment and the auditory capabilities of the individual receiving the sound. Generally, however, if a sound is audible to an individual, the severity of the impact will increase with decreasing distance to the source and with an increasing duration of the sound (Erbe *et al*., 2012). That is, an individual closer to a noise source has a higher likelihood of suffering physical injury compared to an individual further away and this will be elevated the longer the exposure period lasts.

Noise sources that have been identified as likely to occur during the Development and which, depending on the specific nature of the sources, could cause injury or disturbance to marine mammals and fish, are limited to:

- Construction activities (pipeline installation, dredging and presence of Development vessels); and
- Short-term impulsive noise from piling of the new Affleck subsea tie-in structure.

However, of these activities, only installation of the subsea tie-in structure via piling is considered to have the potential to impact on the hearing of sensitive marine species because it forms the greatest noise source in both power (i.e., pressure levels) and in character (i.e., as an impulsive noise). For this reason, piling constitutes the worst-case activity and therefore forms the focus of this assessment.

8.2 REGULATORY CONTROLS

In addition to the EIA regulations detailed in Section 1.5, there are other requirements from UK and the EU legislation and international treaties and agreements which are relevant to the assessment of underwater noise impacts to marine species. The regulatory process requires operators to notify other interested parties including those whose activities might be affected by the piling operations (e.g., fisheries organisations), those who have an interest in the area (e.g., Ministry of Defence) and those who are responsible for conservation (e.g., JNCC). The regulatory controls which are relevant to underwater noise are discussed in the subsections below.

8.2.1 The EC Habitats Directive (92/43/EEC)

The key overarching legislation regarding the protection of marine mammals is the European Council (EC) Habitats Directive (92/43/EEC), transposed into law through the Conservation of Offshore Marine Habitats and Species Regulations 2017. This Directive lists all cetaceans in Annex IV (making them EPS) and lists harbour porpoise and bottlenose dolphins in Annex II (requiring that Special Areas of Conservation must be designated for these species). Annex IV requires regular assessments of conservation status of relevant species, covering abundance, distribution and the pressures and threats experienced. Cetaceans are given legal protection from (amongst other specifics) injury, killing or disturbance, viz. Article 12:

"Member States shall take the requisite measures to establish a system of strict protection for the animal species listed in Annex IV (a) in their natural range, prohibiting:

a) all forms of deliberate capture or killing of specimens of these species in the wild;

b) deliberate disturbance of these species, particularly during the period of breeding, rearing, hibernation, and migration; and

c) deterioration or destruction of breeding sites or resting places."

Under Article 6(3) of this directive, it states:

"*Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives. In the light of the conclusions of the assessment of the implications for the site and subject to the provisions of paragraph 4, the competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and, if appropriate, after having obtained the opinion of the general public*."

To determine whether an Appropriate Assessment (AA) is required, a Habitats Regulations Appraisal (HRA) must be undertaken to determine whether a Development could have any Likely Significant Effects (LSEs) on the qualifying interests of any offshore European site (formerly known as Natura sites in UK waters prior to EU Exit), as this will inform whether an AA is required. A HRA typically involves three stages. The first being an assessment of the ecological connectivity between a project and protected sites. This involves screening out sites where there is clearly no ecological connectivity with project activities. Those sites brought forward from the first phase progress to the second phase which involves assessing if an LSE to a European Site cannot be ruled out. If an LSE on a European site cannot be ruled out, the sites then progress to the third stage of HRA which involves the Competent Authority undertaking an AA, which constitutes a more detailed assessment of project impacts, to determine if adverse effects on European sites cannot be excluded. Only in exceptional circumstances, listed under Article 6(4) of this directive (e.g., a project of overriding public interest), will consent be granted to a plan or project which could potentially adversely affect a European site.

8.2.2 The Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 (as amended)

The Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 (as amended) implements, with respect to the UKCS offshore oil and gas activities only, the European directives for the protection of habitats and species, including the EC Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Flora and Fauna (the Habitats Directive).

The regulations within the Habitats Directive are transposed into law in UK offshore waters (beyond 12 NM from shore) through the Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 and makes it is an offence to "deliberately kill, capture or disturb any creature in the wild which is a member of any species listed in Annex IV(a) of the Habitats Directive", referred to as EPS.

The HRA process is transposed into offshore regulations under Provision 5 of the Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 (as amended). This is used to determine whether a plan or project could potentially adversely affect a European site through the HRA process described above.

8.3 ASSUMPTIONS AND DATA GAPS

In order to ensure that the underwater noise assessment reflects the realistic worst-case scenario, key assumptions have been made regarding the following:

- Piling of the subsea manifold forms the greatest noise source of the Development activities and thus represents the worst-case scenario for assessing underwater noise impacts; and
- The thresholds used to understand potential disturbance ranges are those at which the onset of possible disturbance could occur. Thresholds defined for disturbance are highly conservative and not species-specific. There will be variation, both within and between species, in terms of behavioural response to anthropogenic sound, and the relationship between disturbance and absolute noise exposure remains poorly characterised for marine species. Where environmental parameters are likely to be variable in time or space, the underwater noise modelling has utilised the worst-case scenario as inputs. For example, a sea state of zero has been assumed since it results in the greatest propagation of noise compared to other sea states. A conservative marine mammal swimming speed of 1.5 ms^{-1} has been selected to account for the potential that the marine mammal might not swim directly away from the source, could change direction, and/or does not maintain its average swim speed over a prolonged period.

It remains difficult to predict what impacts anthropogenic sound may have on marine life due to our limited understanding of the relationship between received sound and subsequent behavioural and biological response (Southall *et al*., 2007 & 2019). This seems particularly true for wild populations of marine mammals, for which there is limited available data on the effects of noise on underwater communication, foraging and predator detection and its impacts on individual fitness (Deecke et al., 2002; Erbe, 2012). Studies of marine mammal behavioural response to development activities to date have failed to decouple noise emissions from construction activities from the potentially confounding effects of vessel presence and engine noise (Erbe, 2012; Erbe *et al.,* 2019). Moreover, there is evidence that individual variation in behavioural response plays an important role in shaping the magnitude of noise related impacts (e.g., Gedamke *et al.,* 2011; Erbe, 2012; Gomez *et al.,* 2016; Southall *et al.,* 2019). As such, it is difficult to generalise a predicted response to an introduced sound across an entire population or species, but in the absence of in situ data, this is considered the best available means of assessing impacts to marine mammals.

8.4 UNDERWATER SOUND AND ASSESSMENT METRICS

Sound is transmitted through liquids as longitudinal waves, or compression waves. These are waves of alternating pressure deviations from the equilibrium pressure, causing local regions of compression and rarefaction. Sound pressure (p) is therefore the average variation in pressure caused by the sound. By convention, sound levels are expressed in decibels (dB) relative to a fixed reference pressure commonly

1 micropascal (µPa) for underwater measurements, as measurements typically cover a very wide range of pressure values.

8.4.1 Peak Sound Pressure Level (SPL)

The Peak Sound Pressure Level (SPL), or zero-to-peak (0-Peak) sound pressure, is the maximum sound pressure during a stated time interval. A peak sound pressure may arise from a positive or negative sound pressure, and the unit is the pascal (Pa). This quantity is typically useful as a metric for a pulsed waveform, though it may also be used to describe a periodic waveform.

8.4.2 Root Mean Square (RMS) Sound Pressure

The Root Mean Square (RMS) Sound Pressure Level (SPLrms) is the mean square pressure level measured over a given time interval. Therefore, it represents a measure of the average sound pressure level over the time. The RMS sound pressure is expressed in Pa.

When the SPLrms is used to quantify a transient sound source the time period over which the measurements are averaged must be given, as the SPLrms value will vary with the averaging time period.

8.4.3 Sound Exposure Level (SEL)

The Sound Exposure Level (SEL) is the time integral of the square pressure over a time window long enough to include the entire pressure pulse. The SEL is therefore the sum of the acoustic energy over a measurement period, and effectively takes account of both the level of sound, and the duration over which the sound is present in the environment.

8.5 MARINE MAMMAL IMPACT CRITERIA

The zone of hearing loss, discomfort, or injury: this is the area where the sound level is high enough to cause tissue damage to auditory or other systems. This can be classified as either a temporary threshold shift (TTS) or permanent threshold shift (PTS). At even closer ranges, and for very high intensity sound sources (e.g., underwater explosions), physical trauma or even death are possible.

For this assessment, the zones of injury in terms of PTS and disturbance (i.e., responsiveness) are of concern. To determine the potential spatial range of injury and disturbance, a review has been undertaken of available evidence, including international guidance and scientific literature. The following sections summarise the relevant thresholds for onset of effects and describe the evidence base used to derive them.

8.5.1 Injury (Physiological Damage)

The Joint Nature Conservation Committee (JNCC, 2010) recommends using the injury criteria proposed by Southall *et al.* (2007), which are based on a combination of linear (i.e., un-weighted) peak pressure levels and mammal hearing weighted (M-weighted) SEL.

In 2018 The National Marine Fisheries Service (NMFS,2018) published a revision to its technical guidance for assessing the effects of anthropogenic sound on marine mammal hearing. This document provides details of the acoustic thresholds at which individual marine mammals are predicted to experience changes in their hearing sensitivity for acute, incidental exposure to all underwater anthropogenic sound sources. These new thresholds reflected the new/updated scientific information and demonstrated differences between the marine mammal hearing groups first categorised in Southall *et.* al*.,* 2007.

The Southall *et al.* (2007) study was revaluated in light of these scientific advances and as a result revised sound exposure criterion to predict the onset of auditory effects in marine mammals was published (Southall *et al.,* 2019). The only significant difference between Southall *et al.* (2019) and

NMFS (2018) is the re-categorisation of mid-frequency and high frequency groups to High Frequency (HF) and Very High Frequency (VHF) respectively i.e., very high frequency for greater clarity. This report retains the categorisation used in NMFS guidance, namely, Mid-Frequency (MF) and HF.

The hearing weighting functions used in NMFS are designed to represent the bandwidths of each group within which acoustic exposures may have auditory effects. This study uses the NMFS (2018) hearing group frequency categories:

- Low-Frequency (LF) cetaceans — i.e., marine mammal species such as baleen whales with an estimated functional hearing range between 7 Hz and 35 kHz;
- Mid-Frequency (MF) cetaceans — i.e., marine mammal species such as dolphins, toothed whales, beaked whales and bottlenose whales with an estimated functional hearing range between 150 Hz and 160 kHz;
- High-Frequency (HF) cetaceans — i.e., marine mammal species such as true porpoises (including harbour porpoise), river dolphins and cephalorhynchus with an estimated functional hearing range between 275 Hz and 160 kHz; and
- Pinnipeds in Water (PW) — i.e., a suborder of carnivorous aquatic mammals that includes seals, walruses and other similar animals having finlike flippers with an estimated functional hearing range between 50 Hz and 86 kHz (for underwater).

These are presented graphically in Figure 8-1. Note this figure includes sirenians and otariid pinnipeds for completeness, but these taxa do not feature in the assessment.

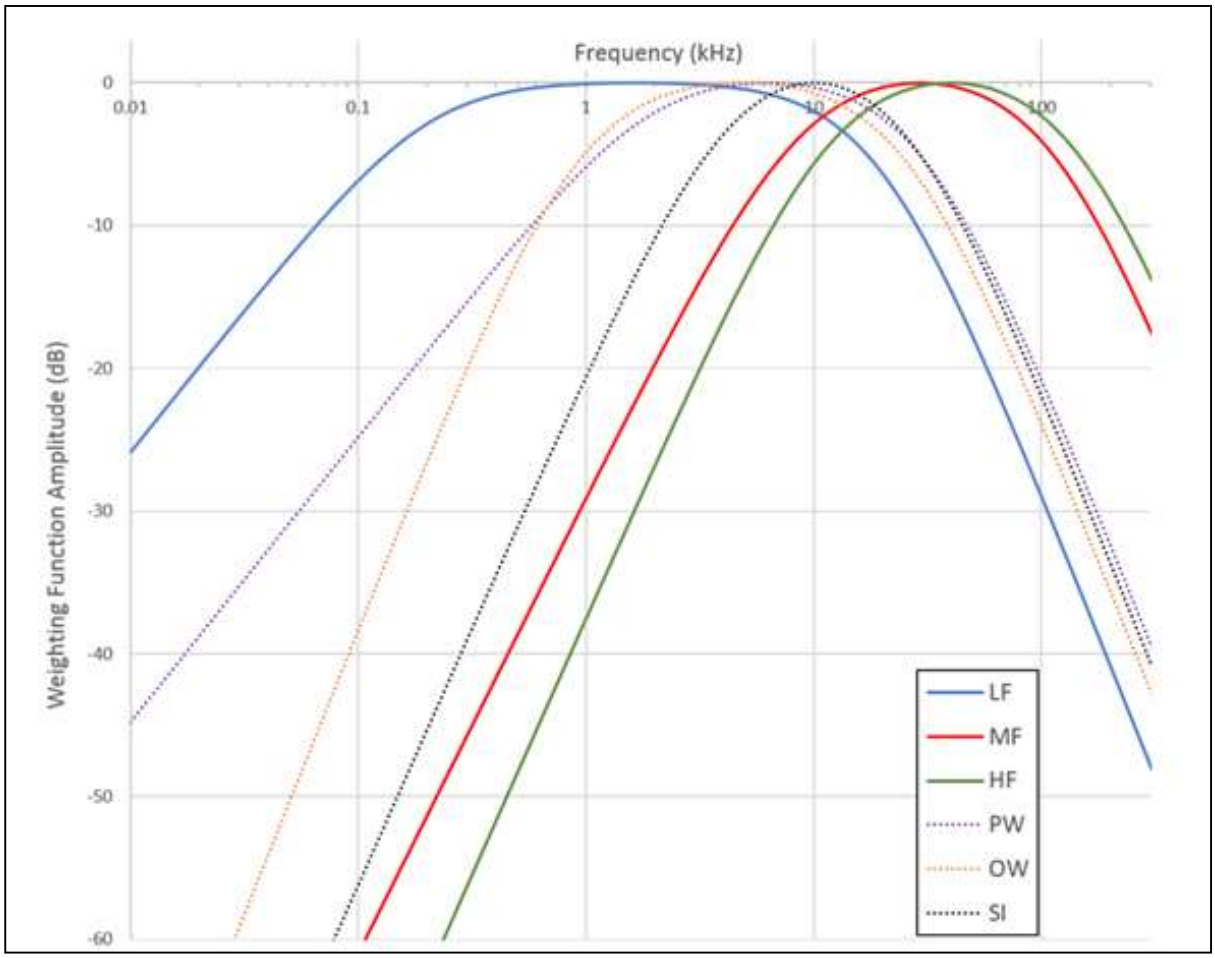

Figure 8-1 Auditory weighting functions for pinnipeds and cetaceans (NMFS, 2018)

8.5.2 Criteria Summary

A dual metric approach has been adopted to characterise the PTS for impulsive noise, including the peak SPL and the cumulative SEL. The PTS criteria adopted within this study were those presented in NMFS (2018) for impulsive sound which is characteristic of piling. These have been reproduced in Table 8-1.

Table 8-1 PTS onset thresholds for marine mammals exposed to impulsive noise (NMFS, 2018; Southall et al., 2019)

Marine mammal hearing group	Peak SPL (dB re 1 µPa)	Cumulate SEL (dB re 1 µPa^{2}s)
Low frequency cetaceans	179	119
Medium frequency cetaceans	178	198
High frequency cetaceans	153	173
Pinnipeds	181	201

8.6 NOISE PROPAGATION MODELLING RESULTS

Noise propagation modelling was used to characterise the potential impacts of piling on four different marine mammal hearing groups (LF, MF and HF cetaceans, and pinnipeds). This modelling enabled identification of the distances at which injurious peak SPLs and cumulative SELs and strong behavioural disturbance may be incurred from the proposed piling activities, based on the most current available noise impact criteria (NMFS, 2018). The resulting potential injury and disturbance ranges for the piling activity are provided in Table 8-2.

Table 8-2 Noise impact ranges associated with the piling operations

Situation	Radius of Potential PTS-Onset (m)			
	LF Cetaceans	MF Cetaceans	HF Cetaceans	Pinnipeds
Peak pressure (SPL) physiological damage	<1	< 1	8	<1
Peak pressure (SPL) physiological damage + soft start	< 1	< 1	3	< 1
SEL of static vessel and moving mammal	13	< 1	26	2
SEL of static vessel and moving mammal + Mitigation	2	< 1	4	< 1
Radius of potential disturbance (m)	176			

The unmitigated potential for injury from impulsive noise is limited to within 26 m of the piling location for the most sensitive group (HF cetaceans) and between < 1 m and 13 m for other groups. The HF cetaceans present in this Development area is comprised solely of harbour porpoise. Following implementations of mitigation measures, potential injury reduces to up to 4 m and less than 2 m for other groups. Injury is therefore extremely unlikely from the proposed piling operations.

8.6.1 Behavioural Change

Determining the proportion of marine mammals being disturbed is not straightforward, as it is not clear how individuals will respond on a localised scale, and what repercussions this may have for the wider populations or management units. For example, minke whales are likely to make use of the entire north-east Atlantic, so the population can be viewed as contiguous, whilst other species have a more localised approach to habitat use, such as coastal bottlenose dolphins, and are viewed as discrete populations (IAMMWG, 2021).

The radius of the zone for onset of behavioural change effects uses the United States (US) NMFS Level B harassment threshold of 160 dB re 1 µPa (rms) for impulsive sound (per the US Marine Mammal Protection Act 1972 (as amended)). Level B Harassment is defined as having the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioural patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering but which does not have the potential to injure a marine mammal or marine mammal stock in the wild. This is similar to the JNCC (2008) description of non-trivial disturbance and has therefore been adopted as an alternative value to the TTS criteria used above. The radius of the zone for onset of behavioural change effects, using a 160 dB re 1 µPa (rms) threshold criteria will be up to 176 m from the noise source, which is well within the 500 m exclusion zone, equates to an area of approximately 0.1 km^2.

Behavioural changes such as moving away from an area for short periods, reduced surfacing time, masking of communication signals or echolocation clicks, vocalisation changes and separation of mothers from offspring for short periods, do not necessarily imply that detrimental effects will result for the animals involved. It is therefore considered that the zone of behavioural change will not be a zone from which animals are necessarily excluded, but rather one in which normal behaviour might be affected across a range of potential responses, from a simple noticing of the sound, to a startle response and return to normal behaviour, through to exclusion from an area.

To determine the likelihood of impact in terms of actual number of animals, it is possible to calculate the number of animals likely to experience some sort of behavioural impact using local density and population estimates. Density estimates from the area covering the North Sea are not well understood for many cetacean species but estimates from SCANS-III (detailed in Hammond et al., 2017) provide regional density estimates for some of the species most regularly found in vicinity of the piling operations.

The Statutory Nature Conservation Bodies (SNCBs) (Hammond *et al.*, 2021; JNCC, 2010; JNCC, 2015) note that marine mammals of almost all species found in UK waters are part of larger biological populations whose range extends into the waters of other States and/or the High Seas. To obtain the best conservation outcomes for many species, it is necessary to consider the division of populations into smaller management units. This requires an understanding of the geographical range of populations and sub-populations, to provide advice on impacts at the most appropriate spatial scale. The output of the SNCB exercise investigating how marine mammal populations may act is the determination of Marine Mammal Management Units (MMMU) for species including harbour porpoise, bottlenose dolphin, white-beaked dolphin, Atlantic white-sided dolphin and minke whale. These MMMUs and associated population estimates can be interpreted in the context of the potential disturbance zones to consider the potential for a significant impact to occur.

Harbour porpoise, minke whale, Atlantic white-sided dolphin and white-beaked dolphin have been recorded within the development area (see Section 4.3.5.1). The number of individual cetaceans potentially affected by the proposed operations is detailed in Table 8-3.

The number of individual animals that are likely to exhibit some form of change in behaviour during the proposed piling operations is relatively small. Therefore, the proposed operations would be largely undetectable against natural variation and would have no significant effect at the population level.

The information provided in Table 8-3 indicates that there is a very low likelihood of injury or non-trivial disturbance as a result of the proposed piling.

Table 8-3 Estimated number of cetaceans experiencing behavioural changes based on piling operations for the Development Area (Hammond et al., 2021; IAMMWG, 2021)

Species	SCANS-III Density estimates[12] (individuals/km²)	Maximum number of animals within zone of behavioural change at any one time (density x area of behavioural change)	Relevant MMMU[13]	Percentage of MMMU potentially impacted behaviourally at any one time (%)
Harbour porpoise	0.333	0.0324	346,601	< 0.001%
Minke whale	0.007	0.0007	20,118	< 0.001%
Atlantic white-sided dolphin[12]	0.010	0.001	18,128	< 0.001%
White-beaked dolphin[12]	0.243	0.0236	43,951	< 0.001%

It should be noted that in England, Wales and Northern Ireland recent advice given for harbour porpoises (JNCC, 2020b) in which the Inter Agency Marine Mammal Working Group (IAMMWG) concluded that a habitat (area) based approach would be more appropriate than an approach based on numbers of porpoise disturbed. This approach was also considered to be simpler and would rely less on uncertain numbers within a site and would help level the playing field across various developments / activities

The number of seals expected to be encountered will vary depending on the piling location. According to the seal density maps provided in Figure 4-14, harbour and grey seal densities in the Development area are 0-5 individuals and 0 - 0.001% of the respective UK population per 25 km² (Russell *et al.,* 2017; Carter *et al.,* 2020).

Therefore, such impacts are considered negligible and would have no significant effects on local populations or the biological processes of any individuals. Due to their extremely low densities, further assessment of underwater noise impacts to seal populations (e.g., against contemporary population parameters supplied in the Special Committee on Seals, 2019) was not undertaken within the Development area. The information provided indicates that there is a negligible likelihood of injury or non-trivial disturbance as a result of the piling operations.

8.6.2 Fish

There are no available fish impact criteria based on piling. The most relevant criteria are considered to be those contained in the Sound Exposure Guidelines for Fishes and Sea Turtles (Popper *et al.*, 2014). The criteria for the different types of sources include a range of indices; SEL, rms and peak sound pressure levels. Where insufficient data exist to determine a quantitative guideline value, the risk is categorised in relative terms as “high”, “moderate” or “low” at three distances from the source: “near” (i.e., in the tens of metres), “intermediate” (i.e., in the hundreds of metres) or “far” (i.e., in the thousands of metres). It should be noted that these qualitative criteria cannot differentiate between exposures to different levels of sound and therefore all sources of sound, independent of source level, would theoretically elicit the same assessment result.

The Popper criteria presented for pile driving are reproduced in Table 8-4.

[12] *Density estimates from Hammond et al., (2021). Affleck Development area is located in SCANS-III Block Q. However due to the absence of data in Block Q for white-sided dolphin and white-beaked dolphin, data was taken from the adjacent Survey Block ‘R’*

[13] *This is the MMMU within which the Affleck Development area sits from IAMMWG (2021)*

Table 8-4 Threshold criteria for Potential Impacts to Fish due to Seismic Activities (Popper et al., 2014)

Type of Animal	Parameter	Mortality and Potential Mortal Injury	Impairment		Behavioural Response
			Recoverable Injury	TTS	
Fish: no swim bladder (particle motion detection)	Peak, dB re 1 µPa	>213	>213	-	(*Near*) High (*Intermediate*) Moderate (*Far*) Low
	SEL_{cum} dB re 1 $\mu Pa^2 \cdot s$.	>219	>216	>>186	
Fish: where swim bladder is not involved in hearing (particle motion detection)	Peak, dB re 1 µPa	>207	>207	-	(*Near*) High (*Intermediate*) Moderate (*Far*) Low
	SEL_{cum} dB re 1 $\mu Pa^2 \cdot s$.	>210	>203	>>186	
Fish: where swim bladder is involved in hearing (primarily pressure detection)	Peak, dB re 1 µPa	>207	>207	-	(*Near*) High (*Intermediate*) Moderate (*Far*) Low
	SEL_{cum} dB re 1 $\mu Pa^2 \cdot s$.	207	203	186	
Eggs and larvae	Peak, dB re 1 µPa	>207	(*Near*) Moderate	(*Near*) Moderate	(*Near*) Moderate
	SEL_{cum} dB re 1 $\mu Pa^2 \cdot s$.	>210	(*Intermediate*) Low (*Far*) Low	(*Intermediate*) Low (*Far*) Low	(*Intermediate*) Low (*Far*) Low

While detailed modelling of fish has not been carried out, the distances at which sound level decreases to below the various threshold values for the different types of fish due to the proposed piling operations are presented in Table 8-5. The assessment does not include the effect of soft start, partly due to the fact that eggs and larvae cannot move away from the source.

The distance at which the sound levels exceed the threshold values during the proposed piling operations using the Popper *et al.* (2014) criteria range up to 10 m for TTS depending on the type of hearing mechanism, and therefore sensitivity to sound, of the fish.

Adult fish not in the immediate vicinity of the sound generating activity are generally able to vacate the area and avoid the likelihood of physical injury. However, larvae are not highly mobile and are therefore more likely to incur injuries from the sound energy, including damage to their hearing, kidneys, hearts and swim bladders. Damage from shock to eggs and developing embryos consist of deformation and compression of the membrane, spiral curling of the embryo, displacement of the embryo, and disruption of the vitelline membrane. Although, such effects are unlikely to happen outside of the immediate vicinity

of the piling (> 10 m). Popper *et al*. (2014) recognises the need for more data to help determine the effects of anthropogenic sound on eggs and larvae.

In summary, using the approach adopted by Popper *et al.* (2014), the area of behavioural change will extend beyond 5 m from the source, but the risk of disturbance will be high and is unlikely to be significant beyond 10 m. Given the fact that the operations will be constantly moving and the relatively short period of activity no habituation to the sound is likely.

Table 8-5 Impact Assessment on Fish

Type of Animal	Parameter	Mortality and Potential Mortal Injury	Impairment		Behavioural Response
			Recoverable Injury	TTS	
Fish: no swim bladder (particle motion detection)	Peak, dB re 1 µPa SEL_{cum} dB re 1 µPa ^{2}·s.	3 m 1 m	3 m 1 m	- 10 m	(*Near*) High (*Intermediate*) Moderate (*Far*) Low
Fish: where swim bladder is not involved in hearing (particle motion detection)	Peak, dB re 1 µPa SEL_{cum} dB re 1 µPa ^{2}·s.	5 m 1 m	5 m 1 m	- 10 m	(*Near*) High (*Intermediate*) Moderate (*Far*) Low
Fish: where swim bladder is involved in hearing (primarily pressure detection)	Peak, dB re 1 µPa SEL_{cum} dB re 1 µPa ^{2}·s.	5 m 1 m	5 m 1 m	- 10 m	(*Near*) High (*Intermediate*) Moderate (*Far*) Low
Eggs and larvae	Peak, dB re 1 µPa SEL_{cum} dB re 1 µPa ^{2}·s.	5 m 1 m	(*Near*) Moderate (*Intermediate*) Low (*Far*) Low	(*Near*) Moderate (*Intermediate*) Low (*Far*) Low	(*Near*) Moderate (*Intermediate*) Low (*Far*) Low

8.6.3 Management and Mitigation

The primary measure of reducing potential impacts from continuous and impulsive noise sources will be to limit the duration of the noise emitting activities. For example, vessels will only be deployed where necessary and the number of acoustic beacons used for positioning will be limited as far as is practicable during installation activities.

NEO will additionally adhere to the JNCC guidelines for reducing the potential for injury and disturbance to marine mammals from piling (JNCC, 2010). The measures from the JNCC (2010) guidance are summarised below:

- A suitably trained marine mammal observer will conduct a pre-piling search over a 30-minute period prior to the commencement of piling. This will involve a visual assessment to determine if any marine mammals are within the 500 m mitigation zone (measured from the location of the piling). In addition, a Passive Acoustic Monitoring (PAM) system will be used concurrently with the marine mammal observer to monitor for submerged marine mammals within the mitigation zone;

- Should any marine mammals be detected within the 500 m mitigation zone during the pre-piling search, operations will be delayed until marine mammals have moved outside the 500 m mitigation zone. In this case, there will be a 20-minute delay from the time of the last marine mammal sighting to the commencement of activities;
- A soft start will be performed, whereby the total energy of the hammer used during piling will be ramped-up slowly over 20 minutes, in order to give marine mammals time to leave the area. Where possible, increase of power will occur in uniform stages to provide a constant ramp-up in power level. If a marine mammal enters the mitigation zone during the soft start, the energy of the hammer will not be increased further until the animal has left the mitigation zone;
- If piling is required to commence in sub-optimal conditions for visual monitoring (e.g., visibility of less than 1 km; sea state greater than Beaufort 3; and/or during hours of darkness), consideration will be given to using PAM instead of visual monitoring to conduct the pre-start search. Use of PAM allows the detection of vocalising marine mammals, thereby allowing pre-start searches to be implemented when visual observations are not possible; and
- Marine mammal observers will keep an open line of communication with the appropriate operations staff to ensure mitigation procedures are adhered to. Marine mammal observers will record all survey and sightings data on relevant forms for entry into the JNCC Noise Registry database.

8.6.4 Cumulative and Transboundary Impacts

When considering the localised, short-term nature of the activities in conjunction with the proposed mitigation measures, there are unlikely to be any significant cumulative effects in terms of other activities in the area.

Some animals may occur across the UK / Norwegian EEZ, such as free-ranging and highly mobile cetacean and pinniped species as it is 5 km from Affleck. However, due to the limited predicted zone for injury or behavioural change, the likelihood of the Affleck operations impacting upon cetacean or pinniped species in the wider area is low, and consequently the actual risk of affecting residual transboundary impacts is low.

Shipping activity in this area of the North Sea is estimated as very low and there are no other anthropogenic activities in close vicinity of the Affleck field, where installation of the subsea manifold, representing the greatest source of noise emissions from the Development, will take place (see Figure 4-22).

For these reasons, and in addition to the temporary nature of the piling activities that will take place during installation of the subsea manifold, cumulative and transboundary impacts due to underwater noise emissions from piling operations are considered negligible.

8.7 DECOMMISSIONING

The reverse installation of surface and subsea infrastructure which will characterise the decommissioning of the Development will not introduce important levels of sound. The majority of potential sound sources during decommissioning activities will be generated by the vessels, and the removal (e.g., cutting and excavation) of infrastructure.

Similarly, activities associated with infrastructure removals also represent low-amplitude continuous noise sources which are not easily discernible against background noise (Pangerc *et al*, 2016; Nedwell *et al.*, 2012). As such, potential decommissioning activities at Affleck are unlikely to produce underwater noise which could injure or cause significant disturbance to marine mammals or fish occurring across the development area.

8.8 PROTECTED SITES

There are no protected sites with marine mammal qualifying features which may be potentially impacted by the Development activities. Affleck is located at a distance of 130 km from the nearest marine

mammal protected site, the Southern North Sea SAC, which is SSW of the Development area, (see Figure 4-15). Not only does the distance from the protected sites limit the potential for important interactions with marine mammals affiliated with those sites, but the total area over which impacts may occur is not considered large enough to encompass animals with likely connectivity to those sites.

8.9 RESIDUAL IMPACTS

The information below presents the anticipated residual impacts as a result of the physical presence of the Development, following the implementation of mitigation measures outlined in Section 8.6.3.

Receptor	Sensitivity	Vulnerability	Value	Magnitude
Marine Mammals	Low	Negligible	High	Minor
Fish	Low	Negligible	Negligible	Minor

Rationale

All receptor groups have some tolerance to accommodate the limited change that piling activity could give rise to (i.e., no injury but some minor disturbance). There is expected to be no change at the population level for any receptor group when an area of 0.1 km^2 from piling activities is considered as a worst-case scenario. Receptor sensitivity is therefore ranked as **low** for all receptors.

As there is expected to be no change at the population level for all receptor groups, the impact is not likely to affect long term function or status of any population. Further this, given the minimal, heterogeneous and widespread habitat use of marine mammals across the area, coupled with the limited area of impact, the proposed downhole piling activities are not expected to generate any perceptible changes to baseline conditions and, as such, receptor vulnerability is considered **negligible**.

In terms of receptor value, cetaceans and pinnipeds found within the Development area are considered for protection under the Habitats Directive (Annex II and IV) which originates from Europe. In this regard, the cetaceans within the area are likely to comprise harbour porpoise, minke whale, white beaked dolphin, and white-sided dolphin, all of which retain **high** receptor value because those species do not need to be affiliated with a European protected site to retain protections under the EU Habitats Directive. There are unlikely to be any fish species within the area which are considered for protection.

Several mitigation measures have been suggested to minimise the impacts of underwater noise emissions associated with Development activities. These include the employment of an MMO and/or the use of PAM, a 500 m marine mammal mitigation zone and a soft-start regime. Once these mitigation measures have been implemented, any possible impact on marine mammals is expected to be limited to **minor** disturbance to cetaceans and **negligible** disturbance to pinnipeds. On this basis, the impact magnitude gradings reflect these values.

In light of the low levels of predicted impact from the piling, and the management and control measures that will be in place, NEO considers that the piling activity will not have any significant adverse impacts on the environment.

Consequence	Impact Significance
Low consequence	Not significant

9 PHYSICAL PRESENCE

9.1 INTRODUCTION

This chapter addresses relevant impacts to the other sea users in the vicinity of the Development as result of the additional development above existing activity. The activities associated with the Development, including use of vessels, have the potential to interfere with the activities of other marine users, including:

- Commercial fisheries;
- Oil and gas activities;
- Telecommunications cables;
- Commercial shipping; and
- Archaeological sites.

According to the latest fisheries statistics and data, the fishing activity in ICES rectangles 41F2 and 42F2 primarily targets demersal fish. Shellfish are also targeted to a lesser extent and landings values and weights for pelagic fish is generally low. According to VMS data from 2016 - 2019 for UK vessels over 15 m in length, the Development area sustains moderate levels of effort and value for vessels operating demersal trawls.

There are several oil and gas assets that could be affected by the Development, including 14 surface installations within 40 km of the Development, the nearest of which is the Judy platform, approximately 15.2 km north-west of the pipeline and immediately adjacent to the umbilical, which ties into Judy. There are also a number of pipelines and other subsurface infrastructure within the vicinity of the Development, including existing pipelines associated with nearby fields, including Orion, Clyde, Janice, Auk, Auk North, Fulmar, Flyndyre, Cawdor, Judy and Joanne. The Affleck pipeline crosses the Flyndyre-Cawdor EHC umbilical and pipeline (PLU3190 and PL3189) and Clyde to Valhall telecommunications cable operated by Tampnet. The Affleck umbilical crosses the Stella oil export pipeline (PL4028), the Judy 24-inch oil export pipeline (PL0998), the 16-inch Gannet-A to Fulmar-A oil pipeline (PL763), and the inactive Janice FPU to Judy Platform 12-inch gas export pipeline (PL1632).

Shipping activity within the vicinity of the Development is considered to be at very low or low intensities. Cargo vessels are the most dominant vessel type in the Development area.

Aquaculture in the CNS/NNS is largely constrained to coastal locations, and the closest aquaculture site is located >200 km from the Development area. There are no military practice areas or known activities within UKCS Blocks 30/7, 30/12, 30/13, 30/14 and 30/19. Therefore, these marine users are considered to be beyond a distance at which an interaction with the Development activities is likely. There are no offshore wind farms in the vicinity of the Development, the closest being located > 200 km from the Development (Berwick Bank Option Agreement Area (OAA)), offshore from the Firth of Forth. No interactions with these or any other renewable energy developments are anticipated from the Development. There are several unidentified wreck locations recorded as being present within the vicinity of the Affleck pipeline and umbilical, the closest of which is 1.7 km south-west from the umbilical. The closest identified wreck to the Affleck pipeline and umbilical is Devotion, located 18 km north-east of the Affleck pipeline and 11.8 km northeast of the Affleck umbilical. No wrecks or wreck debris were identified during the geophysical surveys in the vicinity of the Affleck pipeline or Talbot pipeline. Therefore, no loss of marine archaeological remains is expected to result from the Development.

Activities at the Development area have the potential of impacting upon these marine users through their exclusion from areas where structures are laid / fixed on the seabed, including the new pipeline, umbilical, tie-in structure(s) at Talbot DC1 manifold and the potential umbilical tie-in at the Judy platform.

Any obstruction and/or exclusion impacts associated with any existing safety zones around the existing Affleck wells will not be considered.

9.2 REGULATORY CONTROLS

The regulatory framework which guides the management of impacts to other sea users from the proposed Development consists of the following legislation:

- Marine and Coastal Access Act 2009; and
- Energy Act 2008.

The Marine and Coastal Access Act 2009 replaced the Coast Protection Act 1949 and provides for navigational safety and risk management in UK waters. The Marine and Coastal Access Act 2009 also covers all activities associated with oil and gas exploration or production/ storage activities which require licences. The provisions for "consent to locate" (Section 34 of The Coast Protection Act 1949) have since been transferred to the Energy Act 2008 Part 4A to cover exempted exploration or production/storage activities; these provisions came into force in April 2011.

9.3 ASSUMPTIONS AND DATA GAPS

To ensure that the assessment of physical presence reflects the worst-case scenario, a number of assumptions are made regarding Development activities. Primarily, these relate to vessel use:

- There will not be an increase in vessel activity as a result of increased production due to the existing Affleck wells coming back online;
- The Affleck umbilical and pipeline will be installed in separate trenches;
- Up to 60,750 Te of rock, 212 concrete mattresses (total of 141 with a contingency for 50%) and 50 x 1 Te grout bags (1 m^2 per bag) for external protection at the trench transitions at either end of the route, at crossing points with existing pipelines and telecommunication cables, at the tie-in spools and for upheaval mitigation (based on as-built trenching and out of straightness survey results and analysis);
- A 500 m safety zone around the Talbot DC1 subsea infrastructure will be in place for installation and operations, within which the Affleck pipeline tie-in structure will be located;
- No moored or anchored vessels will be used;
- The 500 m safety zone around the Judy platform will remain in place for installation and operations; and
- The 500 m safety zone around the existing Affleck wells at the Affleck manifold will remain for installation and operations.

It is considered that the information available to inform this assessment has been sufficient to undertake a thorough and accurate assessment of the potential impacts as a result of the physical presence of the Development. Therefore, there are no data gaps identified.

9.4 DESCRIPTION OF POTENTIAL IMPACTS

9.4.1 Increased Vessel Traffic and Collision Risk

The temporary physical presence of Development vessels has the potential to interfere with other sea users (in particular fishing and shipping) that may be present in the area and may increase the risk of vessel collision.

The Development is in the open sea (approximately 263 km from the east coast of Scotland and England) and the installation campaign is a temporary, short-term activity, and thus, vessel use will be minimal (Table 3-8).

Seven vessel types will be physically present within the Development area, with duration ranging from 10 to 229 days. The Development is expected to be constructed over a nine-month period, during which these vessels will be present, but it is unlikely that all vessels will be on site at the same time. No

anchored or moored vessels are anticipated to be used. Nevertheless, the presence of the increased vessel traffic result in an increased collision risk for third-party vessels.

9.4.2 Temporary and Permanent Exclusion

No additional safety zones are planned for the Affleck Development, beyond those that are already in place at Affleck and Judy and is proposed to be in place at Talbot DC1 for the Talbot development. However, it is acknowledged that the installation works, including the presence of installation vessels, which may be restricted in their manoeuvrability, may temporarily obstruct access for other sea users and require vessels to use route diversions. The installation phase is expected to occur over five months. Additionally, there may be a delay between the pipeline and umbilical lay and subsequent trenching / backfill activities, during which access by other sea users may also be restricted. Long term exclusion will not occur as there will be no permanent exclusion zone applied around the trench, except in the areas that overlap with the 500 m safety zones associated with the Affleck, Talbot DC1 and Judy infrastructure. As such, for the majority of the pipeline and umbilical trenches, there will be no statutory restrictions on fishing or other activities.

It is expected that the pipeline and umbilical will be buried for the majority of the routes, with a target depth of cover of >0.6m. External protection, including concrete mattresses and rock placement will be required at the following locations:

- Trench transitions;
- At three crossing points along the pipeline and potentially seven crossing points along the umbilical (outwith the 500 m safety zone around Judy); and
- Spot locations for upheaval buckling mitigation, identified during post-installation surveys.

Concrete mattresses and rock placement will also be required at the tie-in spools which connect up the production line to the Affleck and Talbot DC1 manifold and for the umbilical approach around Talbot.

In areas where external protection is used, the pipeline and/or umbilical will be above the seabed, and therefore, may present a risk to vessels engaging in fishing activity in contact with the seabed (e.g., demersal trawls). Demersal trawling is expected to occur in the vicinity of the Development; however, the protection will be designed to be overtrawlable, and therefore, no permanent exclusion is expected to occur. It is also expected that the external protection at the tie-in spools will be within the 500 m safety zone at the Affleck manifold and the Affleck tie-in structure will be within the 500 m safety zone of the Talbot DC1 subsea infrastructure.

9.4.3 Snagging Risk and Dropped Objects

Fishing activity in ICES Rectangles 41F2 and 42F2 is predominantly demersal. Demersal fishing gear involves towing nets along the seabed and this type of fishing may penetrate the seabed and pose a risk to subsea infrastructure, and in extreme cases, a potential risk to life, if snagging occurs.

In the installation phase, during the delay between the pipelay and umbilical lay and subsequent trenching, these assets will be unburied and may present a potential snagging risk. It is expected that the pipeline and umbilical will first be laid by a reel-lay vessel and that trenching and backfill will then be performed by a dedicated trenching support vessel using a MPP and BFP.

Trenching berms may form following pipeline and umbilical trenching and backfill. However, cohesive clay sediment is likely to generate more resistance to gear than the sediments observed in the Development area which are sand and non-cohesive muddy sand. Berms formed in clay sediments are likely to persist for longer, while features formed in sand are likely to be re-worked by the currents fairly rapidly. Geophysical and geotechnical survey data also indicated that underlying sediments underneath Holocene sands are dense to very dense fine shelly silty sand. The sandy sediment observed in the Development area is expected to provide a little resistance to demersal towed gear and therefore, the gear is likely to be able to pull through the sediment and wash out.

With regards to snagging risks during operation, it is expected that the pipeline and umbilical will be trenched and buried for the majority of the routes, with a target depth of cover of >0.6 m. External protection, including rock placement and concrete mattresses will be required in some areas which may present a potential snagging risk to demersal towed gears. External protection will be designed to be overtrawlable to reduce the potential snagging risk. In addition, regular inspection surveys will be undertaken to assess pipeline conditions, including free spans, which will subsequently be rectified.

The Affleck tie-in structure will be located within the permanent 500 m safety zone at the Talbot DC1 manifold, within which fishing activity is prohibited. The tie-in spools will be located within the existing 500 m safety zones around the Affleck manifold. Therefore, these structures will not present a snagging risk as fishing will already be prohibited from this area.

9.5 ASSESSMENT OF IMPACTS TO OTHER SEA USERS

9.5.1 Increased Vessel Traffic and Collision Risk

Although there will be a minor increase in vessel traffic during the Development installation activities, it will be a temporary change in vessel presence in a region with moderate vessel traffic. The Development is in the open and the construction period is a temporary, short-term activity, and thus, vessel use will be minimal.

Management and mitigation measures have been outlined in Section 9.6 to reduce the risk of collision, including communication and notification procedures to ensure that all vessels operating in the area are aware of drilling activities and Development-associated vessels. This, in combination with the limited vessel requirement during development, and the deployment of proposed mitigation measures, there is little potential for an increase in vessel collision risk from Development activities.

9.5.2 Temporary and Permanent Obstruction and/or Exclusion

There will be no temporary or permanent exclusion zone implemented specifically for the Development, meaning there will be no statutory restrictions on vessel or fishing activity beyond that which is implemented through the safety zones at Affleck, Talbot DC1 and Judy. Although during installation, activities by other sea users may be obstructed and require vessels to use route diversions, this will be for a duration of approximately 9 months only. As the installation vessels will be moving along the pipeline / umbilical routes, this obstruction of access will be on a rolling basis, meaning any impacts will be temporary and transient. Guard vessels will be on-site to communicate the Development activities with third-party vessels, ensuring other users are aware of the works.

As described in Section 4.4.1, the area is of moderate importance to the fishing industry, including for demersal trawls. Any exclusion during construction is expected to be temporary and short-term. In addition, permanent exclusion is expected to be limited to the permanent safety zones at either trench end for the pipeline and umbilical (which do not form part of the Development) and any external protection will be spatially limited and designed to be overtrawlable. Given the limited spatial and temporal extent of any obstructed access to fishing grounds, and the limited spatial extent of any external protection, no significant impacts to other sea users are anticipated from either temporary or permanent exclusion.

9.5.3 Snagging Risk and Dropped Objects

As described in Section 9.4.3 the main sources of snagging from the Development during the installation phase include any unburied sections of pipeline or umbilical awaiting burial and potential trenching berms. The snagging risk associated with unburied sections of the pipeline will be minimised by the presence of guard vessels that will reduce any potential interactions between fishing vessels and unprotected assets. Furthermore, the non-cohesive nature of the sediment in the Development area also limits any potential snagging in relation to trenching berms. Where other potential snag risks are identified during the installation phase, they will be remediated as appropriate.

The snagging risks during operation relate to the presence of the infrastructure on the seabed, including any external protection, as well as potential free spans that may form over time. The tie-in points at the Affleck manifold and Talbot DC1 manifold are not expected to present a snagging risk as these will be located within existing permanent 500 m safety zones. The pipelines are expected to be trenched and buried along the majority of the route except at crossings, at trench transitions, and in spot locations for upheaval mitigation. Where the pipelines are trenched and buried to a depth of >0.6 m, the snagging risk will be low, as this depth is expected to be beyond the penetration depth of most fishing gears. Any external protection will be designed to be overtrawlable to reduce the potential for snagging. The footprint of external protection will also remain very limited, thus reducing the snagging risk.

With regards to dropped objects, the mitigation measures outlined below will ensure the potential for such occurrences will be minimised and dealt with appropriately.

Considering the above, and the implementation of the management and mitigation measures listed in Section 9.6.3, it is considered that the snagging risk will be minimal.

9.6 MANAGEMENT AND MITIGATION

9.6.1 Increased Vessel Traffic and Collision Risk

A number of mitigation measures will be employed to reduce the impact of increased vessel traffic and collision risk on other sea users:

- Information on the location of subsea infrastructure, safety zones and vessel operations will be communicated to other sea users (via the United Kingdom Hydrographic Office) through the standard communication channels including Kingfisher, Notice to Mariners and Radio Navigation Warnings;
- Infrastructure and safety zones will be marked as hazards on admiralty charts and entered into the FishSafe system so that it may be avoided by fishing vessels;
- During installation, the number of vessels and length of time they are required on site will be reduced as far as practicable through careful planning of the installation activities;
- A guard vessel will be present on site in the interim period between the laying of the pipeline and umbilical and arrival of the trenching support vessel to ensure that other sea users are aware of the surface laid pipeline and umbilical;
- Consultation will be undertaken with relevant authorities and organisations;
- Environmental awareness training will be given to all relevant crew members to reduce the risk of collisions between vessels and animals; and
- Development and implementation of a fisheries liaison strategy.

9.6.2 Temporary and Permanent Obstruction and/or Exclusion

With regard to temporary exclusion during installation, NEO has reduced vessel numbers and vessels days as far as practicable whilst adhering to safety and emergency response requirements.

9.6.3 Snagging Risk

A number of mitigation measures will be employed to reduce the impact of snagging on other sea users:

- The location of subsea infrastructure will be communicated to other sea users through standard communication channels, including Notices to Mariners and Kingfisher bulletins;
- Should it be required, the spread of contingency rock will be minimised through the use of a fall pipe vessel; and
- A post-installation survey will be performed once activities are completed to identify any hazards to fishing and shipping and navigation; and

- Regular maintenance inspection surveys will be undertaken throughout the Development's lifetime to ensure structures remain in a favourable condition.

9.6.4 Dropped Objects

The potential for dropped objects will be minimised during installation, and operation through the following measures:

- Personnel will be suitably trained as to minimise the potential for dropped objects:
  - Lift planning will be undertaken to manage risk during lifting activities, and all lifting equipment will be tested and certified;
  - All deck items will be securely stowed;
  - All equipment and material on installation vessels will be adequately stowed or seafastened;
  - Transfers of objects will use specialist equipment and consider environmental conditions; and
  - Procedures will be put in place to ensure that the location of any lost material is recorded and that significant objects are recovered where practicable.
- The contractor will have a dropped objects procedure which will be used for the proposed installation operations to minimise any issues with dropped objects;
- Compliance to Lifting Operations and Lifting Equipment Regulations (LOLER) including inspection/testing; and
- A post-installation survey will be performed once activities are completed to identify any significant dropped objects and seabed anomalies.

9.7 CUMULATIVE AND TRANSBOUNDARY IMPACTS

The CNS is well-developed in terms of the oil and gas industry and the Development Area is within an area extensively used for oil development (DECC, 2016). The offshore oil and gas industry is the main activity taking place in the CNS region. There are six platforms within 25 km of the pipeline and umbilical, including Judy (15.2 km northwest of the pipeline and <0.01 km southwest of the umbilical), Judy JRP (14.5 km northwest of the pipeline and 0.16 km northwest of the umbilical), Clyde (18.3 km southwest of the pipeline and 18.6 km northwest of the umbilical), Fulmar A and Fulmar AD (22 km west of the pipeline and umbilical) and Jasmine wellhead (22.7 km west of the pipeline and 8.6 km north west of the umbilical) and Jackdaw (proposed) (35.8 km from the pipeline and 22.8 km from the umbilical) as shown in Figure 4-22. The new Talbot subsea infrastructure is also expected to be constructed before the Development. This could lead to fishing vessels in the region being impacted from two nearby areas either simultaneously or sequentially. However, given the short-term duration of the Development installation activities, any cumulative impact arising from construction is expected to be low. Furthermore, in the future, decommissioning of nearby installations could generate increased vessel presence. Nevertheless, with regards to immediate activities, which are temporally limited, there are not likely to be significant cumulative impacts associated with the Development. Given the small potential for snagging risks to arise and dropped objects to occur, it is considered that the chance for cumulative impact relating to these hazards is negligible.

Other developments will utilise vessels which have the potential to act cumulatively in increasing vessel collision risk. As mentioned in Section 4.4.7, shipping and general vessel traffic is considered low in the area. As the Development is located within the open sea (approximately 263 km from the east coast of Scotland and England), and increased vessel traffic will be temporary, limited to installation, maintenance and decommissioning activities, it should not act in combination with any other existing projects to increase collision risk.

The Affleck pipeline and umbilical are located 5 km from the UK-Norway boundary line. As such this area is expected to experience above average levels of fishing by foreign vessels compared to other

regions of the UKCS (Marine Scotland, 2012). The Development area, within which fishing activity and vessel traffic may be temporarily obstructed, represents a small fraction of the total sea available for both fisheries and shipping. On this basis it is considered that the potential for transboundary impacts related to exclusion of other sea users is negligible.

9.8 DECOMMISSIONING

It is anticipated that the decommissioning activities associated with the Development will in the main be a reversal of the installation activities. The majority of the potential impacts and the suggested mitigation and management relating to physical presence of the Development will be the same as has been described for installation. Any potential impacts that decommissioning operations may have on other sea users will occur in an area that experienced an impact during the installation operations. The current philosophy is full removal of infrastructure and considerations for its potential removal at end of field life is being taken into account during design. Removal of all non-buried infrastructure would reduce any risks to other sea users to a negligible level and negate any requirement for long-term inspection and monitoring. However, if not all of the Development infrastructure is removed at decommissioning, then there are likely to be fewer activities/vessels present to cause physical presence impacts compared to the drilling and installation phases of the Development. The majority of potential impacts will be of a similar or lesser magnitude than the impacts already described above.

Any infrastructure left *in situ* or rock placement made, will be surveyed for potential snagging risks and mitigated accordingly. Prior to the end of field life, there may be changes to the statutory decommissioning requirements as well as advances in technology and knowledge. NEO will aim to utilise recognised industry standard environmental practice during all decommissioning operations in line with the legislation and guidance in place at the time of decommissioning.

9.9 RESIDUAL IMPACTS

Receptor	Sensitivity	Vulnerability	Value	Magnitude
Oil and Gas activities	Medium	Low	Low	Minor
Shipping	Medium	Low	Negligible	Minor
Fisheries	Low	Low	Medium	Minor
Telecommunication cables	Low	Low	Medium	Minor

Rationale

Oil and Gas activities

Although the Development will be located within relatively close proximity to a number of oil and gas developments, these should be able to tolerate any impacts associated with small area occupied by the reel lay vessel and increased vessel activity. However, the nature of oil and gas developments is considered relatively sensitive, and thus, the overall sensitivity is considered **medium**. There are not thought to be any prolonged impacts on oil and gas developments in the area, beyond the 500 m safety zone around the existing subsea infrastructure at Affleck and Talbot and Judy, which are not considered as part of this Development. Therefore, the vulnerability is considered **low**. The value of the receptor is considered **low** given the distance between the existing oil and gas activities and the Development will not impact the operational functionality of the industry. The magnitude of the impact to oil and gas developments from the Development is **minor** given the temporary and short-term nature of the disruption. Consequence is therefore **low**.

Shipping

The area experiences low vessel traffic so the risk of collision due to Development vessel presence is minimal. Shipping is also capable of accommodating short-term interference therefore sensitivity is **low**. Vulnerability is also considered **low** as even though behaviour may have to change short-term, it is considered the Development will not cause any prolonged changes to shipping within the area. The value of shipping is considered **low** given the level of activity in the area. The magnitude is also considered to be **minor** as the Development activities are temporary in duration and so limited in extent. The operational phase of the Development will be much less likely to impact shipping in the region. Consequence is therefore **low**.

Fisheries

Fishing effort within the Development area is moderate with the majority of vessels targeting demersal species and to a lesser extent shellfish. However, the sensitivity of fisheries to potential impacts as a result of the physical presence of the Development is considered to be **low** as the fishing industry has the ability to tolerate the impact and is also capable of adapting to exclusion. In addition, the obstruction to fishing during pipeline and umbilical installation activities will be temporary. Furthermore, ICES Rectangle 41F2 and 42F2 is not considered to be as productive in terms of landings by weight and catch value as the surrounding region. Therefore, the vulnerability is considered to be **low** as the area of obstruction is small in the context of available fishing area. The value of the receptor is considered to be **medium** as the effort in the area is considered to be moderate, however the installation forms a small part of a much larger area available for fishers i.e. there is flexibility to utilise other areas. The magnitude of the impact is considered to be **minor** as any impact will be localised and largely of a short-term nature. Consequence is therefore **low.**

Telecommunication cables

The pipeline route crosses the Tampnet telecommunications cable. However, telecommunications cables are considered to be highly tolerant of a small area of temporary interference associated with the installation works and increased vessel activity, as typically, only infrequent access to these assets are required. Therefore, sensitivity is considered to be **low**. There are not thought to be any prolonged impacts on telecommunications cables in the area, beyond the 500 m safety zone around the existing subsea infrastructure at Affleck and Talbot and Judy, which are not considered as part of this Development. Any crossings with the Tampnet telecommunications cable will also be in agreement with the asset operator. Therefore, vulnerability is **low.** Given the proximity of the Tampnet telecommunications cable and the Development, the value is considered to be **medium**. The magnitude of the impact from the Development is **minor** given the temporary and short-term nature of the disruption. Consequence is therefore **low.**

Consequence	Impact Significance
Low consequence	Not significant

10 ATMOSPHERIC EMISSIONS

10.1 INTRODUCTION

On a global scale, concern regarding atmospheric emission of GHGs (including water vapour, CO_2, CH_4, nitrous oxides (N_2O), ozone (O_3) and chlorofluorocarbons) is focused on the impact they have on global climate change. The Intergovernmental Panel on Climate Change (IPCC) in its sixth assessment report (AR6) states that it is unequivocal that the increase of CO_2, CH_4 and N_2O in the atmosphere over the industrial era is the result of human activities. Human influence is the principal driver of many changes observed across the atmosphere, ocean, cryosphere and biosphere. (IPCC, 2021). Climate change estimates in the AR6 report state that each of the last four decades have been successively warmer than any decade that preceded it since 1850. IPCC (2021) reports a 47% increase in CO_2 concentrations since 1750, which far exceeds the natural multi-millennial changes between glacial and interglacial periods over at least the past 800,000 years, and states that fossil fuel combustion is the primary contributor to the observed climate change.

Greenhouse gas emissions from the Development selected option[14] will arise during all phases of the lifecycle, from fabrication (of the new infrastructure to be installed), installation and commissioning, operation (power generation, flaring, venting and potentially fugitives) and decommissioning. All emissions will contribute to impacts at a local, regional, national, transboundary and global scale. It is important to quantify and assess the impact of all emissions planned to be released from the development of the Affleck field. The quantification will facilitate the assessment of the environmental impact of activities. The information on the quantification and impact assessment of the emissions is presented in this chapter of the ES for the:

- Atmospheric emissions associated with the fabrication, installation, commissioning, operation and decommissioning of the Development; and
- The operational emissions associated with the processing of the Affleck production at the Judy facility where they will be released.

On a local-scale, project emissions such as nitrogen and sulphur oxides (NO_x and SO_x) and carbon monoxide (CO) may affect air quality. These emissions may be assessed against onshore local air quality guidelines to understand the potential magnitude of impact on human health and the environment. These guidelines are intended to mitigate the regional, national, and transboundary issues caused by these pollutants such as acid rain and eutrophication.

10.2 REGULATORY CONTROLS

In the UK, there are several atmospheric regulatory controls which apply to offshore developments and require the provision of atmospheric emissions inventories and management. Following the UK's departure from the EU, the atmospherics legislation that is derived from EU regulations was transcribed into UK law.

Relevant legislation for offshore combustion equipment includes:

- Climate Change Act 2008 (as amended);
- The National Emission Ceilings Regulations 2002;
- The Greenhouse Gas Emissions Trading Scheme Order 2020;
- Directive 96/61 on Integrated Pollution Prevention and Control;
- Pollution Prevention and Control Act 1999;

[14] *The GHG emissions assessment of options is presented in the comparison of alternatives (Section 2).*

- The Offshore Combustion Installations (Pollution Prevention and Control) Regulations 2013 as amended by The Offshore Combustion Installations (Pollution Prevention and Control) (Amendment) Regulations 2018;
- The Pollution Prevention and Control (Designation of Medium Combustion Plant Directive) (Scotland) Order 2017;
- The Pollution Prevention and Control (Scotland) Amendment Regulations 2017; and
- The Pollution Prevention and Control (Designation of the Medium Combustion Plant Directive) (Offshore) Order 2018.

10.2.1 Guidance

The NSTA, (formerly the Oil and Gas Authority), issued (June 2021) consolidated and updated guidance on flaring and venting, which sets out their approach to driving reductions in the emissions, through clear principles, using the NSTA consenting regime and stewardship activity. The consent requirements to conduct flaring and venting are set out in the Energy Act 1976, as well as the applicable offshore production licence (granted under the Petroleum Act (1998)).

In March 2021, the NSTA issued Net Zero Stewardship Expectation 11, (NSTA 2021). The Stewardship Expectations are designed to give operators and licensees clarity on expected behaviours and good practices. Expectation 11 focuses on the following areas:

- Creating a culture of GHG emissions reduction within the United Kingdom Continental Shelf (UKCS);
- Ensuring that GHG emissions reduction is considered throughout the entire oil and gas lifecycle; and
- Collaboration between all relevant parties to support and progress potential energy integration developments (such as electrification).

The North Sea Transition Deal (2021) requires the sector to follow Stewardship Expectation 11, encouraging emissions reductions from both existing and new developments.

This Chapter quantifies the emissions anticipated as a result the Development across the entire oil and gas lifecycle and assesses the potential impacts of CO_2e and climate change, (as well as other atmospheric pollutants). Collaborative efforts towards electrification are also discussed. Any significant environmental risks and impacts are managed in line with regulatory requirements and the NEO Low Carbon Plan (NEO Energy, 2021).

10.2.2 F-gasses

- Regulation (EC) No. 517/2014 of the European Parliament and of the Council on fluorinated greenhouse gases;
- The Fluorinated Greenhouse Gases Regulations 2015; and
- Fluorinated Greenhouse Gases (Amendment) Regulations 2018.

10.2.3 Vessels

The Merchant Shipping (Prevention of Air Pollution from Ships) Regulations 2008 implement MARPOL Annex VI in the UK and establish controls on marine engines and marine fuel in order to limit emissions, in particular NOx and SOx. All vessels used during the proposed Development will have the appropriate UK Air Pollution Prevention Certificate (UKAPP) or International Air Pollution Prevention Certificate (IAPP) in place, as required.

- Regulation 14 designated the North Sea for the purposes of SOx and particulate matter control Sulphur Oxides Emission Control (SECA);

- Regulation 13 requires Nitrogen Oxides emissions (NECA) to be included within Emission Control Areas (ECA) as evidenced by the issue of Engine International Air Pollution Prevention Certifications (EIAPP);
- Directive 2005/33/EC amending Directive 1999/32/EC as regards the sulphur content of marine fuels
    - The Sulphur Content of Liquid Fuels (England and Wales) Regulations 2000; and
    - The Sulphur Content of Liquid Fuels (Scotland) Regulations 2014.

10.3 ASSUMPTIONS

The concept select assessment identified tie-back to Judy via Talbot as the best economically and technically feasible option for the Development, Section 2.

The following assumptions have been made when calculating and presenting the atmospheric emissions for the Development:

- All vessels required for the Development will use low sulphur diesel (<0.1% sulphur content);
- The maximum expected life of field is from 2024 to 2037 (based on 'high case profiles' – see Section 3.3.2).
- In terms of gas compression systems, the addition of Affleck processing may cause an increase in fuel gas demand (up to a 3% increase from pre-Affleck levels) and the associated emission from combusting Affleck gas;
- In terms of power generation, Affleck production is not predicted to significantly alter the associated emissions from combusting gas, as the flow will increase energy efficiency of the existing plant.
- All calculations of emissions have been based on the "High case" for Affleck Production since it would represent the worst case in terms of emissions.
- Affleck production is not predicted to affect topside process depressurisation, with limited changes to the associated topside inventory, and therefore increased flare loading is expected to be minimal
- Since Affleck is a subsea development, tied back to Judy with minimal new connections on Judy, it is predicted that there will be no increase in emissions of methane or nmVOC as a result of the Development. No additional venting is anticipated. Therefore, methane and nmVOC emissions have not been included in any calculation in this chapter.
- The Judy base case assumes no electrification in this assessment. However, electrification is an ongoing project being assessed as part of emissions management on Judy, (see Section 5.5.1).
- Decommissioning is assumed to be of the same order of magnitude as vessel emissions for the installation. This assumes no de-carbonisation of the decommissioning fleet by 2037.
- When Judy is mentioned in this chapter, it is referring to Judy base case, i.e., Judy alone, unless specified otherwise.

10.4 POTENTIAL EMISSIONS INVENTORY AND ASSESSMENT

The following atmospheric emissions are expected as a result of the Development and are assessed in this chapter:

- New subsea infrastructure materials and fabrication;
- Vessel fuel combustion during the installation phase;
- Judy facility operational emissions:
    - Judy emissions due to the processing of Affleck production; and
    - fuel combustion during the maintenance of the Affleck infrastructure and production.
- Decommissioning of Affleck infrastructure.

There are no anticipated changes to topside inventory that would drive a change to fugitive emissions.

There will be a limited increase in helicopter flights and supply vessel transits to Judy as a result of Affleck, although space may be taken up on these trips by staff and equipment for Affleck specific work scopes. Additionally, Affleck specific work scopes during operations are predicted to occur periodically and therefore, it is considered that operational increases in vessel emissions will be negligible when compared to the existing emissions inventory in the region.

In alignment with the NSTA Net Zero Stewardship Expectation 11, (NSTA 2021), a complete forecast of the field's energy consumption and GHG emissions is presented below, considering all applicable lifecycle phases. As per Expectation 11, the assessment includes evaluation of GHG emissions impacts on selected host infrastructure.

10.4.1 Embodied carbon in new infrastructure, materials and fabrication

In alignment with the NSTA Net Zero Stewardship Expectation 11, (NSTA 2021), the Development will take advantage of existing infrastructure and facilities to the extent possible, (Judy will be the host installation). This is significant because the production of materials, (mining raw materials, refining, forming, transportation, etc.) results in the emission of CO_2e, termed embodied carbon. The embodied carbon[15] in the context of the Development is in relation to the new infrastructure, i.e., the tie-in structure, PiP flowline, umbilical, spools, concrete mattresses, and rock protection. All details of the construction basis for these are listed in Section 3.2. The existing infrastructure is not considered as no new emissions will be required to produce materials or for fabrication, and no new equipment is planned to be installed on Judy discrete to Affleck requirements.

The material quantities in each item of Affleck infrastructure were calculated based on the available data with expert engineering knowledge. Carbon conversion factors (ICE, 2022) were applied to obtain the values for the embodied carbon in the materials.

The total embodied carbon for the Development (flowline tied back to Talbot) was determined to be 44,303 tCO_2e (Table 10-1). The total embodied carbon for Affleck tied back directly to Judy was similar determined to be 55,360 tCO_2e. The difference is mainly due to the longer PiP flowline that would be required to make up the distance from Talbot to Judy. For Affleck (tie-back to Talbot), the main contribution to embodied carbon is from the electro-hydraulic control umbilical at 65.8%, followed by the pipe-in-pipe at 33.2%, with the remaining infrastructure representing just 1%, (see Figure 10-1).

The embodied carbon makes the largest carbon contribution to the carbon inventory for the Development, with the Affleck via Talbot development option containing the lowest embodied carbon of the two options being taken forward for consideration. This is due to the reduced length of the PiP flowline in the Affleck via Talbot development option. Other than this difference in materials, the two options are equivalent in design and therefore the difference in carbon between them is relatively small. As Affleck is a small subsea development tie-back, the embodied carbon in the design is relatively low and many of the elements included could be decommissioned and recycled at the end of field-life. In addition, steel line pipe, (the main constituent of much of the subsea infrastructure), contains a varying proportion of recycled steel and is rarely made from virgin steel alone. As such, the embodied carbon in the design represents a minimal carbon impact if all recycling options are realized at decommissioning.

[15] *The carbon calculations have been carried out in accordance with the international standards PAS 2050:2011 Specification for the assessment of life cycle greenhouse gas emissions of goods and services, and ISO 14064: 2018 Greenhouse gases - Parts 1 to 3.*

Table 10-1 Embodied carbon associated with the new infrastructure for the Development

Infrastructure	Affleck via Talbot CO_2e (Te)
Pipe-in-pipe	14,651
Electro-hydraulic control umbilical	29,066
Tie-in structure	288
Rigid tie-in spools	37
Concrete mattresses for pipeline protection	128
Rock placement	171
Total	44,303

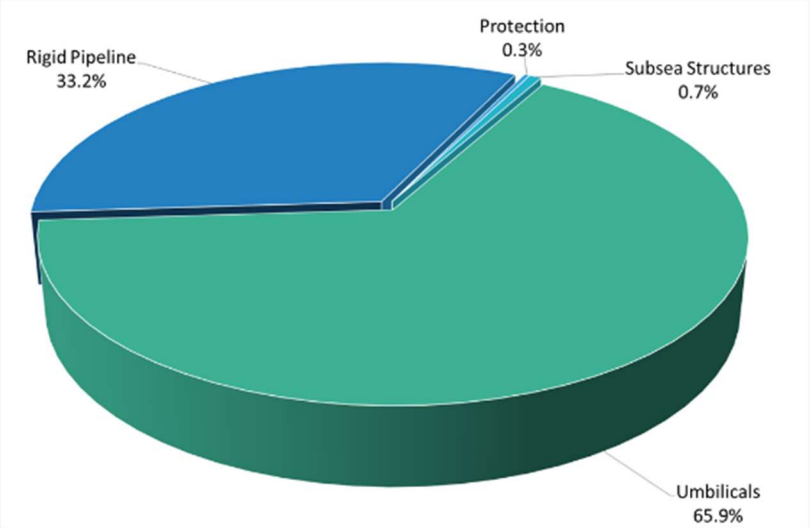

Figure 10-1 Proportion of Embodied Carbon in the Subsea Infrastructure for Affleck (tie-back via Talbot)

10.4.2 Vessel and Helicopter fuel combustion

There will be limited increases in helicopter flights or supply vessel transits to Judy as a result of Affleck, although space may be taken up on these trips by staff and equipment for Affleck specific work scopes. The emissions of relevant GHGs have been calculated from the estimated total amount of fuel that will be required by vessels working during the Development life of field. Vessel emissions for combustion gases other than CO_2 were converted into an overall carbon dioxide equivalent (CO_2e)[16] using their global warming potential (GWP) as defined by the Intergovernmental Panel for Climate Change (IPCC), (see Table 10-2). The conversion factors used to estimate of the equivalent CO_2 from fuel use are presented in Table 10-2 (Institute of Petroleum (IP) (2000), EEMS, Atmospheric Emissions Calculations (OGUK, 2008) and IPCC (2014)). The emissions of individual GHGs were then summed to a single value of CO_2e, in order to describe different GHGs in a common unit. CO_2e was then used to compare the emissions from the Development with total UKCS emissions and the UK carbon budget.

[16] *Carbon dioxide equivalent (CO2e) is a term for describing different greenhouse gases in a common unit. For any quantity and type of greenhouse gas, CO2e signifies the amount of CO2, which would have the equivalent global warming impact.*

Table 10-2 Global warming potential (100-year horizon (AR5 / AR6)) of relevant GHGs - CO_2 equivalent (te)

CO_2	CH_4	N_2O	CO	NMVOC
1	29.8	273	1.6	5.6

Table 10-3 below shows the expected duration of vessel and helicopter activity (in days) per phase of the Development, as described in Section 3.2.11, Project Description. On that basis, atmospheric emissions (in Te) from vessels during the Development have been calculated and presented in

Table 10-4. As illustrated in Figure 10-2, vessel emissions associated with subsea installation represent the highest percentage of overall Development vessel CO_2e emissions at 92.5%, (assuming a life of field from 2024 to 2037), with operations phase emissions representing only 7.5%.

Table 10-3 Vessel Activity during Survey, Installation and Operation of Affleck

Activity	Source	Details	Duration (days)[17]
Survey	Seabed preparation and crossing preparation	Support operation vessel (SUV)	46
Subsea Installation[18]	Pipelay	Pipelay vessel	25
	Umbilical lay	Construction Support Vessel (CSV)	24
	Trenching	Trenching Support Vessel (TSV)	19
	Tie-in of spools	Diving Support Vessel (DSV)	25
	Rock Placement	Rock Placement Vessel	1 trip[19]
	Guard Vessel	Guard Vessel	229
	Helicopter		2 x helicopters per week (3 hr round trip)
Operation	Annual Inspection and maintenance[20] of subsea structures for LoF	SUV	1 (for manifolds) 2 (for pipeline and umbilical)

[17] *Estimated other than the October 2021 survey.*
[18] *Decommissioning is assumed to be of the same order of magnitude as vessel emissions for the installation excluding the survey vessel. This assumes no de-carbonization of the decommissioning fleet by 2035.*
[19] *Assume to be 10 days*
[20] *Remedial operations including scopes such as rock dump for free spans etc.*

Table 10-4 Atmospheric emissions (Te) from vessels during the Development

Activity	CO_2	CO	NOx	N_2O	SOx	CH_4	VOC	CO_2e
Subsea Installation	23,644	116	419	1.11	0.15	0.37	17.18	24,240
Operation per year	173	0.85	3.07	0.01	0.00	0.00	0.13	177
Total assuming a life of field from 2024 to 2037	25,548	125	453	1.20	0.16	0.40	18.57	26,192

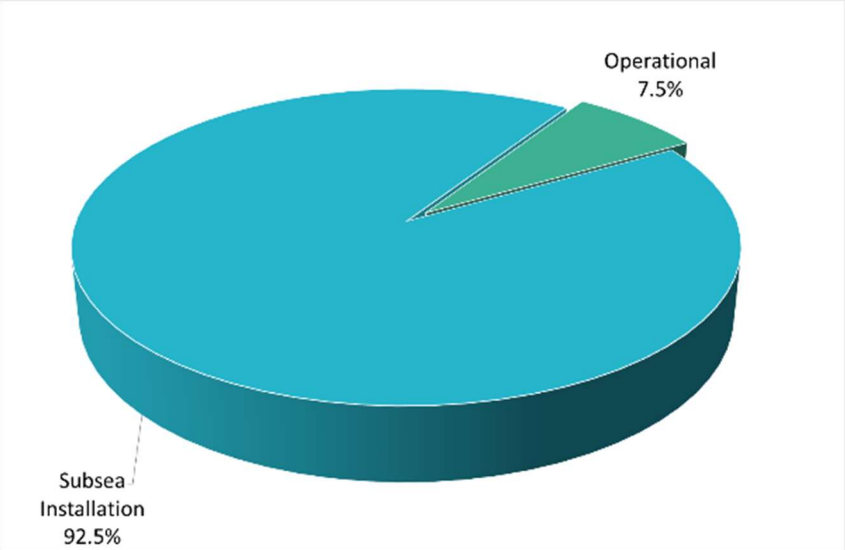

Figure 10-2 Percentage of CO_2e emitted by vessel activities for Affleck (assuming a life of field from 2024 to 2037)

In 2019[21], commercial fishing in UK waters emitted 782 kt CO_2e, coastal shipping[22] 4,521 kt CO_2e, and leisure craft 186 kt CO_2e. The maximum annual emissions from Affleck would occur during the subsea installation phase at about 24 kt CO_2e. These installation emissions would represent about 0.44% of the sum of the emissions from the sources described above for shipping in 2019. During operations, Affleck related vessel emissions would be around 0.19 kt CO_2e per annum, which represents 0.04% of the 2019 shipping emissions described above.

Impacts on local air quality and global warming due to vessel use in the Development are not expected to be detectable above current background levels due to the limited number of vessels and time spent of Affleck related activities.

Decommissioning is expected to result in a similar scale of boat activity to the installation of Affleck, and therefore will cause a similar level of effect on local air quality and global warming as that activity emitting approximately 24 kt CO_2e. As with all other sectors of UK industry, shipping is identifying

[21] NAEI dataset. These figures are from the NAEI dataset and do not include international shipping passing through UK waters
[22] Includes local project traffic movements near to the Affleck field in 2019. This demonstrates that the cumulative impact from other projects near Affleck would be negligible.

opportunities to decarbonize and therefore the atmospheric emissions from the decommissioning vessels may be less than those predicted for installation and commissioning.

10.4.3 Judy Operational Emissions

CO_2 emissions, which constitute 90% of Judy´s emissions, are regulated by the UK Emissions Trading Scheme (UKETS) and are measured and quantified as per regulations. The forecast emissions profile for Judy is based on sanctioned plans for well production and shutdowns through to the year 2037.

The impacts of Affleck on the Judy facility emissions are summarised as follows:

- Affleck affects Judy emissions from additional gas compression power demand only;
- Liquid export power demand (i.e., electrical demand) is not affected, as pump duty is not expected to increase from minimum turndown;
- No additional venting or diesel emissions are expected as shutdown requirements are not altered; and
- Flaring is expected to increase slightly in 2024 compared to the baseline, and then decrease through 2025 to 2027. Due to production profiles from the wells a slight increase is seen from 2022 to 2028.
- Flaring is also anticipated to increase when Affleck is restarted following shutdown to depressurise the pipeline.

10.4.4 Flaring

The NSTA's offshore flaring and venting regime aims at eliminating unnecessary or wasteful flaring and venting of gas. The Energy White Paper (2020) commits the UK to the World Bank's 'Zero Routine Flaring by 2030' initiative, with the aim of eliminating this practice as soon as possible. This echoed by the North Sea Transition Deal (2021), which seeks to accelerate compliance with the World Bank 'Zero Routine Flaring' Initiative ahead of 2030. Furthermore, NSTA Net Zero Stewardship Expectation 11, (NSTA 2021) identifies the expectation of zero routine non-safety related flaring/venting, and the utilization of gas recovery systems.

In alignment with the above, Judy does not undertake routine venting activities. Venting is limited to unlit flare events or purging for equipment isolations. As there is a gas export route from Judy there is no routine flaring to allow production, with flaring only used in non-routine situations, e.g., for safety. Judy also has a flash gas compressor, which gives noticeable reduction in flaring emissions. HE is exploring potential of full flare gas recovery, i.e., N_2 purged flare and flare on demand.

The introduction of Affleck fluids will require limited routine flaring on Judy. Only a marginal increase in emissions (<7,000t CO_2e over the life of field) from flaring is expected with the addition of Affleck (and the proposed Talbot project) fluids. Affleck (plus Talbot) is expected to result in a maximum increase of 7,000 tCO_2e in 2024. There is an increase versus the baseline due to changes in non-routine start-up and shut-down requirements associated with the addition of Affleck. Additional flaring during start-up has been conservatively estimated at 5,900m^3 of gas as the Affleck pipeline is depressurised.

The estimated emissions for flaring at Judy for the life of the Affleck field are shown in Table 10-5.The addition of Affleck, or Affleck and Talbot, production at the Judy installation, will result in a minimal additional to the total CO_2e emissions from the platform. Affleck alone would result in a 2.86% increase, while Talbot alone would result in a 2.92% increase. However, the emissions from Judy when both Affleck and Talbot are tied-back result in an increase 3.20%. This increase is less than the sum of the two individual increases due to efficiencies in processing the large quantities of combined Affleck and Talbot fluids, as discussed in Section 3.3.

As explained in Section **Error! Reference source not found.**, additional flaring is also anticipated when Affleck is restarted following shutdown, and this is estimated at five flaring events each year, one estimated at 102 Te of gas (510 Te per year) to depressurise the pipeline.

Table 10-5 KiloTe of CO_2e released from flaring from Judy alone and with the addition of Affleck and Talbot production, assuming a life of field from 2024 to 2037 ($ktCO_2e$ rounded to 1 decimal place)

Year	Judy alone (Base case)	Judy with Talbot	Judy with Affleck	Judy with Talbot and Affleck
	$ktCO_2e$			
2024	18	25	25	25
2025	18	18	18	18
2026	19	19	19	19
2027	18	18	18	18
2028	24	24	24	24
2029	26	26	26	26
2030	25	25	25	25
2031	24	24	24	24
2032	25	25	25	25
2033	25	25	25	25
2034	25	25	25	25
2035	25	25	25	25
2036	25	25	25	25
2037	25	25	25	25
Total	322	329	329	330
Delta to Judy (base case) (Te)	**N/A**	**8**	**8**	**9**
Delta % of Judy base case	**N/A**	**2.92%**	**2.86%**	**3.2%**

10.4.5 Power generation fuel gas demand

The estimated emissions at Judy for the life of the Affleck field are shown in Table 10-6. This includes the gas and diesel use. The addition of Affleck, or Affleck and Talbot, production at the Judy installation, will result in additional power generation demand, which will increase total CO_2e emissions from the platform. The distribution is the same as the flaring described above. Affleck only a 2.86% increase and Talbot only a 2.92% increase. However, the emissions from Judy when both Affleck and Talbot are tied-back result in an increase 3.20%. This increase is less than the sum of the two individual increases due to efficiencies in processing the large quantities of combined Affleck and Talbot fluids, as discussed in Section 3.3.

Table 10-6 KiloTe of CO_2e released from power generation from Judy alone, and with the addition of Affleck and Talbot production, assuming a life of field from 2024 to 2037 ($ktCO_2e$ rounded to 1 decimal place)

Year	Judy alone (Base case)	Judy with Talbot	Judy with Affleck	Judy with Talbot and Affleck
	$ktCO_2e$			
2024	162	229	229	227
2025	167	164	163	166
2026	164	172	172	174
2027	167	167	167	167
2028	224	218	218	219
2029	228	234	234	235
2030	229	230	230	230
2031	221	216	216	217
2032	222	228	228	228
2033	224	224	224	224
2034	231	231	231	231
2035	228	228	228	228
2036	228	228	228	228
2037	228	228	228	228
Total	2,923	2,997	2,996	3,002
Delta to Judy (base case) (Te)	**N/A**	**74**	**73**	**79**
Delta % of Judy base case	**N/A**	**2.92**	**2.86**	**3.20**

Diesel consumption is not considered to change significantly as a result of the Development as it is only required in abnormal operations, e.g., a process outage or a shutdown.

10.4.6 Carbon intensity

The historical average carbon intensity[23] of large (> 10,000 Te weight) platforms in the Central North Sea is presented in Figure 10-3. In 2020, the carbon intensity of this group of installations was 58.9 kg CO2e/boe[24] for platforms older than 25 years and 14.9 kg CO2e/boe for platforms between 11 and 25 years old. Production from Judy commenced in 1997 making it 25-years old in 2022. Judy's carbon intensity in 2021 was 13.45 kg CO2e/boe, which is below the regional 2020 average for similar platforms in the CNS. The carbon intensity for Judy in 2021 was among the 10% lowest values for CNS platforms when compared to the 2020 platform specific carbon intensity data published by the NSTA (see Figure 10-3). On an all platform UKCS basis, this equates to the 17th percentile lowest carbon intensity.

The carbon intensity for Judy (base case) and Judy + Affleck forecasts that there will be an initial 17% decrease in the Judy carbon intensity from 15.2 ktCO2e/mmboe to 12.6 ktCO2e/mmboe due to the Affleck production. In the later life of the asset the carbon intensity increases to >50 ktCO2e/mmboe inline with the similar assets in the CNS. However, due to the inclusion of Affleck production the carbon

[23] *Data from the OGA (now NSTA) website*
[24] *kg CO2e/boe is equivalent to kt CO2e/mmboe*

intensity is predicted to be around 40.3 ktCO2e/mmboe compared to 55.3 ktCO2e/mmboe without the Affleck production.

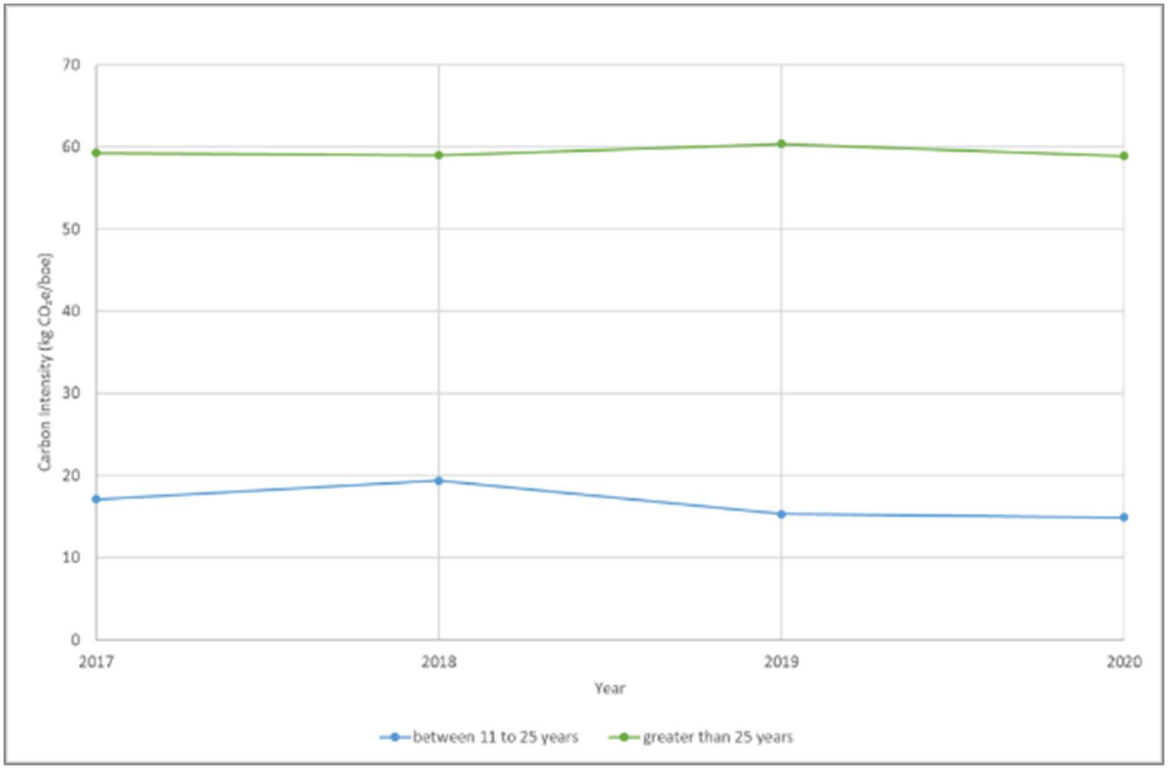

Figure 10-3 Historical Carbon Intensity of Large CNS Fixed Platforms

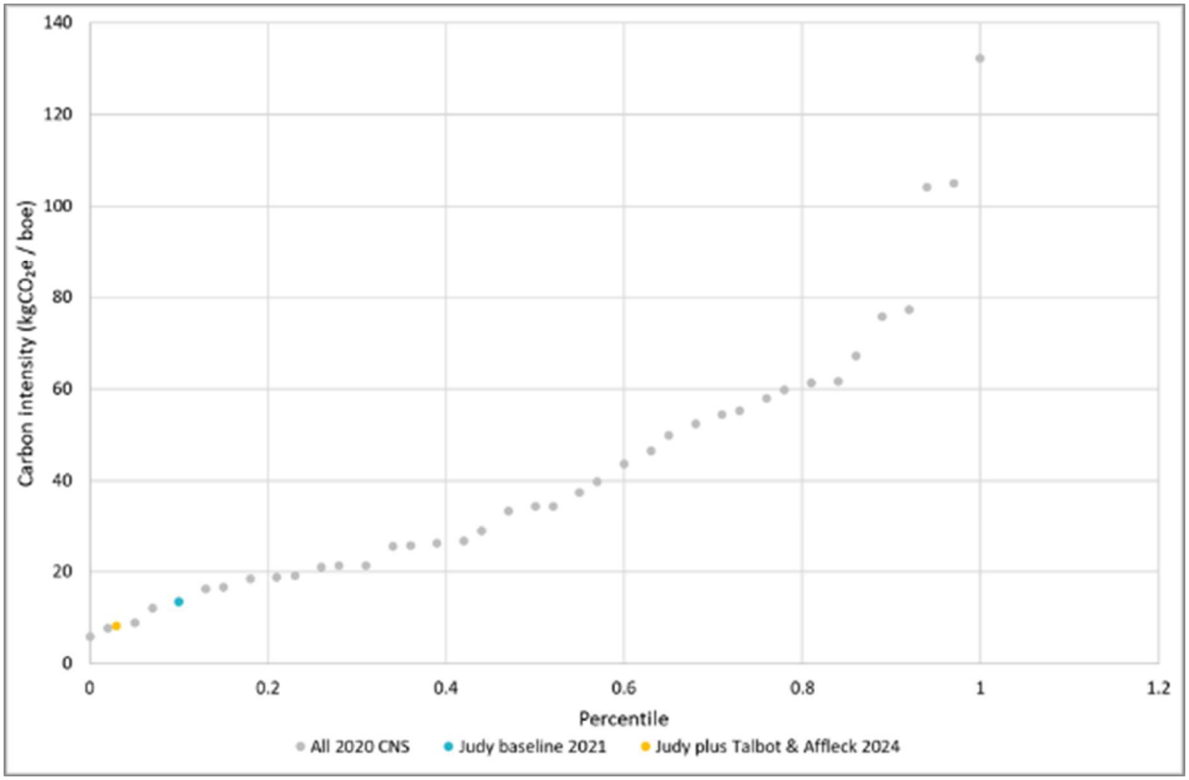

Figure 10-4 2020 Annual carbon intensity (kgCO2e/boe) for all CNS platforms with initial year forecast values for Judy and Judy with Talbot and Affleck

10.4.7 Summary of the atmospheric GHG inventory

Total Development emissions are presented in Figure 10-5 and Table 10-7. The embodied carbon in the subsea infrastructure, presented in year 2024, makes the largest contribution to Development emissions, with operations and maintenance emissions from vessels and additional emissions at Judy contributing no more than 59 kt CO_2e in any year. The assessment of impacts of GHG are presented in Section 10.6.2 (Global Climate Change). The operation considered is the impact Affleck will have when tied back to Talbot.

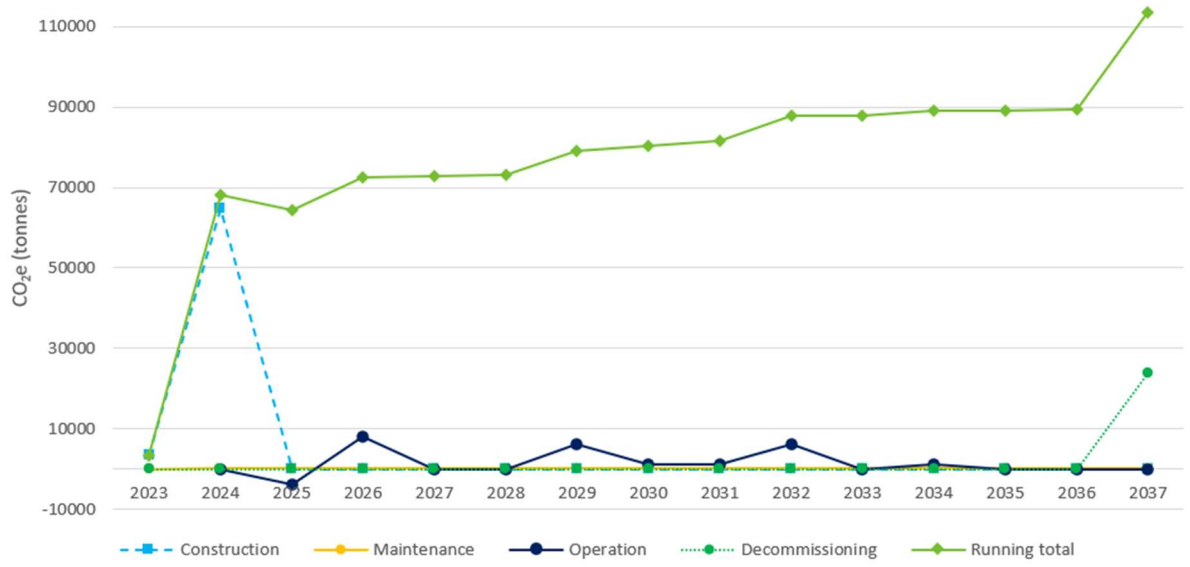

Figure 10-5 Affleck related CO_2e emissions (assuming a life of field from 2024 to 2037)

Table 10-7 Total Affleck CO_2e Emissions (kiloTe), (assuming a life of field from 2024 to 2037)

Year	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
Construction (embodied carbon and installation vessel emissions)	3.5	65	0	0	0	0	0	0	0	0	0	0	0	0	0
Maintenance	0	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
Operation[25]	0	18	23	23	21	22	22	21	23	21	21	21	21	21	21
Decommissioning	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24

10.5 MANAGEMENT AND MITIGATION

In alignment with the NSTA Net Zero Stewardship Expectation 11, (NSTA 2021), NEO incorporates consideration and quantification of the societal costs of GHG emissions into company decision making,

[25] *Based on Judy emissions associated with Affleck via Talbot*

as described in NEO´s "Roadmap to a low carbon future"[26], and its Low Carbon Transition Plan to Reduce Emissions[27].NEO has assessed the impact of the Development on climate and the UK Net Zero targets, and has embedded the identification, assessment, and minimisation of GHG emissions as part of the Development.

The NSTA Net Zero Stewardship Expectation 11, (NSTA 2021) places an expectation on NEO to ensure that GHG emissions reduction is considered throughout lifecycle of the Development. The processes for identification, assessment and delivery of the opportunities are embedded within the Plan stage of the NEO management system and is not limited to the preparation of the regulatory EIA submission. The identification of emissions reduction opportunities has been carried out at the current stage of the design process and as the Development progresses, opportunities will be sought to minimize emissions. NEO will minimise Development emissions by carrying out emissions reduction reviews as part of further detailed design, installation processes, and through operations and maintenance with HE on the Judy installation. These reduction reviews will include third party contractors, where appropriate.

Key areas where emission reduction opportunities have been identified during the concept select stage include:

- The simplification of project complexity by selection of a subsea tie-back; and
- Combination of the Affleck subsea installation with the HE Talbot project scope.

10.5.1 Operational GHG Emissions

In alignment with the NSTA Net Zero Stewardship Expectation 11, (NSTA 2021), NEO will seek to deliver continuous improvement across all areas of GHG emissions reduction during the operations phase. Since the GHG strategy for the Judy facility is within the control of the Harbour J-Area GHG Emissions Reduction Action Plan (Harbour Energy, 2022), NEO will influence and support HE activities during operations, maintenance and decommissioning, to influence delivery of the plan. This collaboration will extend to other J-Area partners, with both operated and non-operated portfolios, in alignment with wider UKCS strategy.

HE has applied a robust and systematic approach to the identification and assessment of GHG emission reduction opportunities covering energy generation, energy demand intensity, and flaring. Projects range in scale from easily applied short-term opportunities to large-scale decarbonisation of fuel gas and electrification from shore, (see below). At the time of writing, HE is conducting a comprehensive energy audit programme for Judy. Opportunities have been identified and now require scoping/study/quantification before they can be determined in the context of the asset GHG reduction plan and prioritized as appropriate.

As part of the emissions reduction opportunities, HE is seeking to minimize the methane fugitive emissions through innovation and adoption of best practice. HE is also part of the North Sea methane monitoring group tackling the challenge of methane emissions from North Sea assets by increasing the accuracy of emissions estimates via monitoring of emissions using drones and sensors.

In alignment with the NSTA Net Zero Stewardship Expectation 11, (NSTA 2021), the NSTA energy integration strategy (Oil and Gas Authority, 2020a) and the North Sea Transition Deal (2021), HE is actively engaged in both their own stand-alone assessment of the potential for full/partial electrification of J-Block, as well as part of a cross-industry workgroup of Central North Sea Electrification (CNSE) partners seeking electrification solutions. HE aims to establish an Energy Transition forum (Harbour Energy, 2020) with non-operated partners, and NEO will engage with this forum to support the initiatives in line with the NEO Low Carbon Plan (NEO Energy, 2021).

[26] https://wp-neweuropeanoffshore-2020.s3.eu-west-2.amazonaws.com/media/2021/05/04172416/NEO-Energy_Low-Carbon-Transition-Plan_Final_May-2021.pdf
[27] https://www.neweuropeanoffshore.com/low-carbon-transition-plan-to-reduce-emissions/

Key industry members, including HE, are collaborating in a multi hub CNS Electrification project which aims to significantly reduce production emissions from key CNS infrastructure through electrification, and if executed would make a material contribution to the NSTA target of reducing production emissions by 50% by 2030. The participation of multiple hubs with sufficient remaining operating lifetimes, is considered to be critical to the economics of electrification. It provides critical mass of electrical demand and spreads the cost of greenfield (electricity) infrastructure across a larger customer base over a sufficient period of time. The Development ties in to the longevity of the Judy platform, and as such supports the CNS.

Other potential emissions reduction projects that are being evaluated by HE for Judy, in collaboration with NEO, are listed Table 10-8. The only interdependency is between the filter upgrade projects and reducing the spinning reserve from going to 2oo4 generation since this would result in fewer power generation gas turbines being online and therefore fewer emissions. To date there have been two filter upgrades (500 tCO_2 each) and Main Oil Line (MOL) pumps are now in 1oo2 operation (1,000 tCO_2).

Table 10-8 Estimated CO2 reduction impact[28]

Project description	Estimated CO_2 reduction impact (Te per year)
Judy power generator filter upgrades	1,500 (500 for each of the three AGTs)
Moving to 2oo4 AGTS instead of 3oo4 (power gen.)	9,000
Run on 1oo2 Judy MOL pumps rather than 2oo2	1,000
Destage Judy MOL pump	1,800
Cooling medium pump & Sea Water lift pump optimisation	1,000
TOTAL	**14,400**

10.5.1.1 Flare management

Flare minimisation and recommencement of installation production is a key driver, behind safe operations, for any and all asset trips. Monitoring of flare combustion efficiency is an area of focus for HE who are screening the market for suitable technologies and services that would provide flare combustion efficiency. The tracking of flare unlit periods is now a regulatory requirement under the NSTA flare and vent guidance, and so is tracked as part of HE compliance.

10.5.2 Installation, Commissioning, Maintenance and Decommissioning

As in the emissions inventory section above, most emissions in these phases, excluding the embodied carbon, will be the result of combustion of hydrocarbons for power generation related to vessel activities. Vessels will be owned by a third party and the activities are therefore subject to supply chain processes of contract selection and management. In alignment with the NSTA Net Zero Stewardship Expectation 11, (NSTA 2021), minimisation of emissions from vessels will form part of the selection criteria for the installation vessels through the tendering and selection process.

- Each vessel will have a Shipboard Energy Efficiency Management Plan (SEEMP) which contains information of minimising fuel consumptions e.g., economical speeds when operationally appropriate;
- Green DP or economical speeds when operationally appropriate;

[28] *Note no new measurement instrumentation will be required on Judy as the exiting equipment meets the requirements for UK ETS and regulator reporting therefore this has not been identified as an opportunity for improvement for estimations of emissions.*

- Developing the subsea installation to minimise the number of mobilisations or demobilisations;
- Opportunity to carry out installation, commissioning, maintenance, and decommissioning of the Affleck and Talbot projects together to reduced emissions, (as well as collaboration with other operators and sectors); and
- Streamlining of activities through planning to reduce the time required for vessels and helicopters will be required for these activities and will support the drive to reduce emissions.

During operation and maintenance of the Affleck field, HE will be responsible for logistics, including vessel selection and management. In alignment with NSTA Net Zero Stewardship Expectation 11, (NSTA 2021), HE´s logistics operations strategy seeks to minimise GHG emissions through collaboration with other operators, and thus, to the extent practicable, HE shares Judy supply vessel operations with wider J-area operations.

10.6 CUMULATIVE AND TRANSBOUNDARY IMPACTS

10.6.1 Local air quality

Throughout the installation, commissioning and operation of the Development, atmospheric emissions will be released, which have the potential to have local or regional (including transboundary) effects. Any releases from installation and commissioning vessels will be transitory, whilst emissions from operational activities will be relatively constant throughout the life of the field.

As noted in Section 4.4.3, the closest active oil and gas activities to Affleck are the Judy platform (approximately 15 km from Affleck) and the Clyde platform (approximately 18 km). There are no offshore windfarms in the vicinity. There is unlikely to be any cumulative effects in terms of local air quality with the addition of Affleck emissions in the area. The proposed activities and associated emissions arising from the Development will be approximately 287 km east coast of the UK and approximately 5 km from the UK/Norway transboundary line.

In the absence of any other available data for comparison that can be geographically located at the Development, data on fishing activity has been used as a proxy for baseline air emissions in the area. As described in Section 4.4.1, the ICES rectangles where the Development is located represent <0.01% of the landed value and landed weight of fish when compared to the UKCS totals. Fishing effort for the Development area is considered low to moderate. Section 4.4.7 also states that the Development area experiences very low shipping intensity. Given the distance from these receptors, and the temporary nature and small scale of the emissions, there is no expected impact on air quality in the coastal area or beyond UK waters.

The cumulative local air quality impact at Judy resulting from existing fields and the addition of Talbot and Affleck are expected to be negligible, as power generation and compression facilities are expected to run more efficiently with the addition of Talbot and Affleck than they currently do under the Judy base case. No new combustion equipment is being added as a consequence of the addition of the new fields, and the new fluids are within the design capacity of the Judy platform (i.e., not above those anticipated for the original design). The ongoing CO_2 reduction work scopes will also improve energy efficiency and therefore reduce emissions due to fuel combustion.

10.6.2 Global Climate Change

The potential impact of GHG emissions from developments on global climate change is not geographically constrained. This means all developments with GHG emissions have the potential to result in a cumulative effect on the global climate.

The sensitivity of the climate to GHG emissions is considered to be ‘high’ as:

- Any additional GHG impacts could affect the UK’s ability to limit its GHG emissions and achieve its future carbon budgets, (as per the Climate Change Act 2008, which commits the UK to reducing GHG emissions by at least 100% of 1990 levels by 2050); and

- The importance of meeting the Paris Agreement goal and of limiting global warming below 1.5°C (IPCC, 2021).

The current assessment is aligned with Institute of Environmental Management and Assessment (2022) which states that:

"The crux of significance is not whether a project emits GHG emissions, nor even the magnitude of GHG emissions alone, but whether it contributes to reducing GHG emissions relative to a comparable baseline consistent with a trajectory towards net zero by 2050."

Where no sector-based or local emissions budgets exist, comparison can be made with the UK Carbon Budgets. In this assessment, NSTA sector-based area emission values are available and are therefore used as a proxy for the impact of the Development on the global climate. On this basis, where GHG emissions from a development would be greater than 30%, the magnitude of the emissions would be considered large.

Table 10-9 NSTA UKCS offshore CO_2 emissions and estimated impact of Affleck (NSTA, 2020).

Period	CO2 (Mt)
2017	12.6
2018	12.7
2019	13.1
2020	11.9
Average	12.6
Approximate Annual Operational Emissions due to the Judy with Affleck	0.006
Estimate of the % change in annual emissions for the offshore oil and gas sector that could result from Judy with Affleck	0.05%
Approximate Annual Operational Emissions due to the Judy with Talbot and Affleck	0.007
Estimate of the % change in annual emissions for the offshore oil and gas sector that could result from Judy with Talbot and Affleck	0.05%

Table 10-10 Magnitude criteria used for impact assessment

Magnitude	Magnitude criteria description
Beneficial change	> 3 % decrease in the most recent 4-year average of the offshore oil and gas sector emission value
Negligible change	+/- 3 % change to the most recent 4-year average of the offshore oil and gas sector emission value
Small increase	Between 3 and 30% increase in the most recent 4-year average of the offshore oil and gas sector emission value
Large increase	Greater than 30% increase in the most recent 4-year average of the offshore oil and gas sector emission value

The average offshore CO_2e emissions from the offshore oil and gas sector from the last 4 years of data is 12.6 Mt CO_2 (Table 10-9). The annual operational emissions of Affleck alone are expected be in the order of 0.006 Mt CO_2e per year over the life of field, (excluding possible scenario of future electrification). This equates to 0.052% of the annual sector emissions which (Table 10-9), and the percentage is the same when Talbot is included. The magnitude of the Development emissions is therefore considered to have a negligible cumulative impact on global climate change.

Given the high sensitivity of the receptor and the minor magnitude of the impact the overall significance is assessed to be minor and not significant (Table 10-14). The Development is therefore likely to have a limited cumulative effect in the context of the release of GHGs into the environment i.e., they will have negligible cumulative or transboundary impact.

Table 10-11 Significance of effects matrix for GHG emissions impact assessment

Magnitude of GHG emissions	Sensitivity of Receptor – High
Beneficial change	Beneficial
Negligible change	Minor – Not Significant
Small increase	Moderate - Significant
Large increase	Major - Significant

10.7 DECOMMISSIONING

At the end of field life, the Development will be decommissioned. The decommissioning process will generate atmospheric emissions both directly from late-life management of the asset, cessation of operation activities and associated vessel traffic, and indirectly through the reuse and recycling of materials (e.g., steel).

Management of the emissions in the late-life, cessation of production of the Judy asset will be in line with HE's decommissioning plans. In alignment with the NSTA Net Zero Stewardship Expectation 11, (NSTA 2021), the decommissioning plan will seek to minimise GHG emissions by assessing the latest technology at the time. As with all other sectors of UK industry, shipping is identifying opportunities to decarbonize and therefore the atmospheric emissions from the decommissioning vessels may be less than those predicted for installation and commissioning. NEO´s procurement process will ensure GHG emissions reduction is part of the selection criteria to deliver the decommissioning plan when developed.

10.8 PROTECTED SITES

The Scottish Marine Plan and the English North East Marine Plan seek to ensure that oil and gas developments consider key environmental risks including the impacts of releases to atmosphere. Atmospheric emissions associated with the Development will not occur within any SAC, SPA, MCZ or NCMPA.

The closest protected site to the Development is the Fulmar MCZ, which is approximately 11km west of the Development. As discussed in Section 4.3.7, the Fulmar MCZ is designated for benthic habitat features and ocean quahogs. As the qualifying features of Fulmar MCZ are situated at depth on the seabed and given that atmospheric emissions are expected to represent at most a negligible increase in the baseline for the area, there are no significant effects expected within the MCZ, and no expected risk to its conservation objectives or integrity.

The next closest protected site is approximately 60 km north west from the Development. Any elevated concentrations offshore due to the Development will be short-lived and hardly detectable beyond a short distance from their source, (due to the dispersive nature of the offshore environment). Since atmospheric emissions are localised and transitory, the Development does not present a risk to the conservation objectives or integrity of any other protected sites.

10.9 RESIDUAL IMPACTS

With respect to air quality, the atmospheric emissions from the Development will mostly be temporary and limited in nature during the installation and decommissioning phase. It is not anticipated that there will be any changes to significant changes to flaring, fuel gas demand or combustion. Taking into account the distance from any potentially sensitive receptors, it is not expected that atmospheric emissions will negatively impact local air quality or result in significant local cumulative impacts.

In terms of global climate change (i.e., cumulative and transboundary impacts), the Development will add a relatively small increment to the overall offshore emissions of the UK. Its contribution to global

warming will be negligible in relation to those from the wider offshore industry and outputs at a national or international level.

Table 10-12 Local air quality residual impact

Receptor	Sensitivity	Vulnerability	Value	Magnitude
Local Air Quality	Low	Low	Low	Minor
Rationale				
Information regarding emissions has been used to assign the sensitivity, vulnerability and value of the receptor as follows. On the basis that the majority of activity will only occur in the highly dispersive marine environment, the receptor sensitivity and vulnerability is ranked as **low**. A ranking of **low** has been assigned to the vulnerability of the receptor as there are no air quality issues identified in the vicinity and any impact will occur in the immediate vicinity of the Development. Magnitude is ranked as **minor** as the emissions are short term in duration, intermittent and distributed and therefore unlikely to be discernible or measurable. On this basis, the consequence is **negligible** and the impact **not significant**.				

Consequence	Impact Significance
Negligible	Not significant

Table 10-13 Contribution to Global Climate change residual impact

Receptor	Sensitivity	Vulnerability	Value	Magnitude
Contribution to Global Climate change	High	High	High	Negligible
Rationale				
Information regarding CO_2e emissions has been used to assign the sensitivity, vulnerability and value of the receptor as follows: On a global scale, the IPCC in its sixth assessment report (AR6) states that it is unequivocal that the increase of CO_2, CH_4 and N_2O in the atmosphere over the industrial era is the result of human activities and that human influence is the principal driver of many changes observed across the atmosphere, ocean, cryosphere and biosphere, (IPCC, 2021). Climate change estimates in the AR6 report that each of the last four decades have been successively warmer than any decade that preceded it since 1850. IPCC (2021) reports a 47% increase in CO_2 concentrations since 1750, which far exceeds the natural multi-millennial changes between glacial and interglacial periods over at least the past 800,000 years, and states that fossil fuel combustion is the primary contributor to the observed climate change. On this basis, the receptor sensitivity, vulnerability and value are all ranked as **high**. The magnitude of the impact is ranked as **negligible** due to the low level of additional emissions of CO_2e resulting from the Development relative to the UK carbon budget. On this basis, the consequence is **negligible** and the impact **not significant**.				

Consequence	Impact Significance
Negligible	Not significant

10.10 CLIMATE CHANGE ASSESSMENT

10.10.1 Introduction

This section summarises the climate change impact assessment for the Development. This section differs from other impacts assessed within this ES, as it does not consider the potential impact of the Development on specific receptors, but instead the impact of the climate (i.e., an external factor) on the Development itself and the in-combination impacts of the Development and climate change (In-Combination Climate Impact, ICCI).

As the construction phase is much shorter than the operational phase and will be undertaken in 2023, future climate change for the construction phase is less relevant and not considered further. Detailed information on the decommissioning of the Development infrastructure is also limited at this time, and therefore, a meaningful assessment of the Development and climate change during the decommissioning phase is not possible. For these reasons, this section focusses on the potential impacts posed by climate change on the Development during the seven-year operational phase, including operations and maintenance as well as the infrastructure itself.

10.10.2 Data Gaps and Uncertainties

The key uncertainties / difficulties associated with predicting the impact on the Development and the impacts assessed within this ES include:

- Uncertainty in the modelled predictions – based on the uncertainty around the future emissions scenario as well as an uncertainty in other model inputs (e.g., current conditions, parameters etc.);
- Uncertainty around the response of the physical, biological and socio-economic environment to changes in climate variables; and
- Difficulties in attributing changes in the physical, biological and socio-economic environment to climate change.

The climate change resilience review and the ICCI assessment are also limited by the data availability at the time of the assessment.

10.10.3 Climate Change Resilience

This section looks at the ability of the Development to withstand, respond to and recover from the projected changes in climate, as they are described in Section 4.5.

Climate change resilience is defined as the indication of a project's ability to withstand, respond to, and recover rapidly from disruptions caused by changing climate variables (IEMA, 2020). The projected change in climate variables were considered and assessed for potential impact on the Development infrastructure, facilities or activities. The potential impacts on the Development associated with projected changes in climate variables are listed in Table 10-14 below.

Table 10-14 Potential impact of changing climate variables on the Development (during the operations and maintenance phase)

Climate Variable		Potential Impact on Project Design	Significance on Project Design
Extreme weather events	Increased frequency of high wind events	Disruption or increased safety risk to operation and maintenance procedures or equipment / vessels as a result of high wind events.	Not significant
	Increased mean maximum wave heights	Disruption or increased safety risk to operation and maintenance procedures or equipment / vessels as a result of high waves.	Not significant

Climate Variable		Potential Impact on Project Design	Significance on Project Design
Changing sea conditions	Increased sea temperature	Potential damage, loss or reduced structural integrity of the Development's infrastructure (e.g., thermal expansion).	Not significant
	Increased near-bed temperature	Potential damage, loss or reduced structural integrity of the Development's infrastructure (e.g., thermal expansion).	Not significant
	Reduced mean wave height.	None identified / within current conditions.	Not significant
Sea level rise	Sea level rise	Potential damage, loss or reduced structural integrity of Development infrastructure (e.g., impact on FPSO).	Not significant

It has been determined that, based on the table above and the Development planned, no significant impact is expected from climate change on the Development.

10.10.4 In Combination Climate Impact Assessment

An ICCI is defined as an interaction between a) a projected future climate change, and b) an effect identified as a result of the Development, which exacerbates the scale of the impact (IEMA, 2020). This section considers how the impacts assessed within this ES could be exacerbated or reduced by any predicted future changes in the physical environment.

Following review of the relevant potential impacts assessed within this ES, as outlined in Chapter 5 to Chapter 11, is has been concluded that the consequences of any potential ICCI would be negligible and would not change the potential significance assessed through this ES.

11 ACCIDENTAL EVENTS

11.1 INTRODUCTION

All marine activities carry with them some risk of accidents. Accidents caused by human error, equipment failure or by extreme natural conditions may result in environmental impacts. The risk of accidental hydrocarbon or chemical releases is inherent in all offshore oil and gas activities, and an area of public concern as whilst they are low probability events, have potential to cause significant impacts on water quality, flora, fauna, and other users of the sea.

The potential sources of large oil releases from the Development include well blowouts and pipeline releases.

The potential impact of any accidental hydrocarbon or chemical release will be determined by the location of the release, environmental profile of the released material, and a pathway (via the sea surface, water column or atmosphere) to sensitive environmental receptors (environmental sensitivities). These environmental sensitivities have spatial and temporal variations. Therefore, the risk of any accidental release having a potential impact on the environment must consider both the likelihood of occurrence and the probability of that release reaching the environmental sensitivities present. It should be noted that chemical releases will not be considered further in this chapter as there is no scope for a significant chemical release as a result of the Development.

In light of major accidental events in recent years, this chapter incorporates relevant information in assessing and mitigating the impacts of potential accidental events resulting from the proposed operations.

11.2 REGULATORY CONTROLS

The key regulatory drivers associated with the prevention and response to spill risks are summarized as follows:

- The International Convention on Oil Pollution, Preparedness, Response and Cooperation (OPRC), which has been ratified by the UK, requires the UK Government to ensure that operators have a formally approved Oil Pollution Emergency Plan (OPEP) in place for each offshore operation or agreed grouping of facilities. This is enacted through The Merchant Shipping (Oil Pollution Preparedness, Response Co-operation Convention) Regulations 1998;
- The Offshore Installations (Emergency Pollution Control) Regulations 2002 give the Government power to intervene in the event of an incident involving an offshore installation where there is, or may be, a risk of significant pollution, or where an operator has failed to implement proper control and preventative measures. These regulations apply to accidental hydrocarbon releases;
- The Offshore Petroleum Licensing (Offshore Safety Directive) Regulations 2015 implement Directive 2013/30/EU. The objectives of the Directive are to reduce as far as possible the occurrence of major accidents relating to offshore oil and gas operations and limit their consequences., thus increasing the protection of the marine environment and coastal economies against pollution. The Directive aims to achieve this objective by establishing minimum conditions for safe hydrocarbon exploration and exploitation offshore as well as improving the response mechanisms in case of an accident; thereby limiting possible disruptions to the EU's indigenous energy production;
- Assessment may also be required to determine if there could be any LSE from spill risk on any SACs or SPAs designated under the European Directives listed below, which are transcribed into UK legislation by the Conservation Regulations 1994 (as amended) (inshore out to 12 NM) and the Offshore Marine Conservation Regulations 2007 (as amended) (beyond 12 NM). These regulations require the project developer to provide the information required by the competent authority (BEIS) to undertake such an assessment; and
- The Offshore Installations (Offshore Safety Directive) (Safety Case) Regulations 2015, to understand how a major accident (MA) may impact the environment and to identify safety and

environmental critical elements (SECEs) in the design and operation of an offshore installation. As part of that commitment, operators are now required to identify in their safety cases where any major accident hazards (MAHs) have the potential to cause a major environmental incident (MEI) and where applicable, ensure there are robust safeguards in place to prevent MEIs from occurring.

11.3 DESCRIPTION AND QUANTIFICATION OF POTENTIAL IMPACTS

11.3.1 Sources and Likelihood of Occurrence

Major loss of containment events at offshore facilities are typically low frequency, high consequence scenarios. These differ from minor leaks which are more common, but with lesser consequences. As such, the relative number of such large-scale events reported in any historical dataset for a given location, such as the UKCS, is very low.

The source of UKCS oil release data from offshore installations is the Petroleum Operations Notices 1 (PON1) database (BEIS, 2019). PON1 data is collated by OPRED. Under the OPPC Regulations, the offshore environmental regulator requires operators to submit details of all non-permitted chemical and oil releases to sea as a PON1 report, regardless of quantity released. Additionally permitted discharges which do not meet the permit limit (e.g., oil-in-water) are also submitted as a non-compliance of the OPPC regulations in the PON1 system.

Figure 11-1 and Table 11-1 presents a summary of the accidental oil releases reported to OPRED per year from 2008 to 2018 and total quantities of oil released (in Te) for each year. Overall, the number of reported releases increased considerably over the years since 1975, potentially associated with improvements in reporting behaviours, although a decrease between 1990 and 1995 was observed. The total quantities of oil released had a significant spike between 1985 and 1990, with an overall average decrease afterward (despite a spike in 1997, with over 800 Te of oil being released in that year[29] (UKOOA, 2006)). Since 2002 the average number of reported oil releases remained approximately constant (fluctuating between 250 – 375 releases per year) (UKOOA, 2006). The peaks in released amounts observed between 2010 - 2012 are a consequence of the three largest releases in the reported period - one release of 131 Te in 2010, one release of 218 Te in 2011, and one release of 405 Te in 2012. In the 11-year period between 2008-2018 approximately 1,246 Te of oil were released, while in the preceding 11-years (1997-2007) this amount was approximately 1,700 Te.

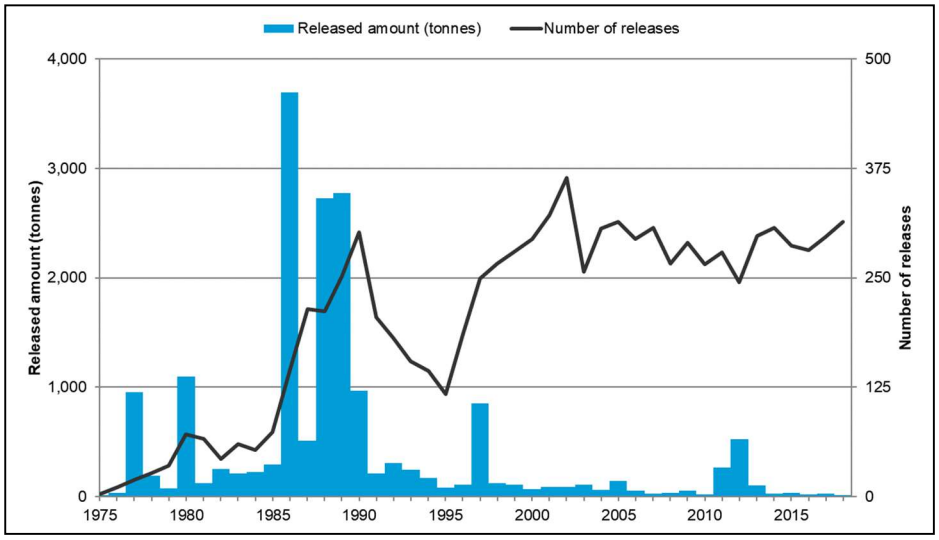

Figure 11-1 Time series of the number of accidental oil releases and the associated released amount from 1975 to 2018

[29] 1,800 tonnes of crude oil was spilled, with the source reported as being related to flaring of recovered oil arising from planned de-oiling operation in August 1997.

Table 11-1 Summary of reported accidental oil releases and spilled amounts, 2008-2018

Year	Number of accidental oil releases	Quantity released (Te)
2008	266	31.5
2009	290	52.2
2010	265	19.2
2011	280	265.4
2012	246	521.9
2013	298	102.5
2014	307	30.4
2015	287	34.9
2016	282	20.6
2017	297	26.8
2018	314	13.0
Total in period	**3034**	**1246**

Out of the 3,034 oil releases reported in the 11-years between 2008-2018, 1146 releases (~38%) were of less than 1 kg, and 2959 (~97%) were releases of less than a single tonne. Only two events were of a magnitude greater than 100 Te and no event exceeded 1,000 Te.

The Development major accident scenarios with the potential to result in losses of containment leading to large oil releases are:

- Blowouts and well releases; and
- Pipeline releases.

The construction and commissioning phases of this development require a number of vessel activities. Inherent with this increase in vessels is the increased risk of a collision puncturing a vessel fuel tank and loss of fuel inventory. Vessel management and designs (multiple hulls, separate tanks) ensure that the risk of collision is minimized significantly, reducing both the probability of a collision occurring and limiting the amount of fuel released in the event of tank rupture. Marine fuels are refined hydrocarbons and their persistence in the environment is very short. A typical diesel spill dissipating from the sea surface within a few hours to a day. Spills from vessels are therefore not considered in further detail in this impact assessment.

11.3.2 Blowout and Well Releases

A surface blowout is defined as an uncontrolled flow of formation hydrocarbons from the reservoir to the sea surface. A blowout occurs due to the loss of the primary and secondary well controls, i.e., allowing oil to flow freely from a well and reservoir. The drilling phase of a project carries the highest potential risk for a well blowout to occur. As the Affleck wells are already drilled and suspended there is no risk of a blowout during drilling. There is a residual risk of a well control incident (blowout) occurring during production or well intervention activities, but this risk is extremely remote.

Primary well control is the process which maintains the hydrostatic pressure in the wellbore greater than the pressure of hydrocarbons in the formation, but less than the formation fracture pressure. If hydrostatic pressure is less than reservoir pressure, reservoir fluid may enter the wellbore. The principle of maintaining primary well control is to maintain hydrostatic pressure that is high enough to overcome formation pressure but not to fracture formations.

Secondary well control is the role of the Blow Out Preventer (BOP), which is used when primary well control is lost. The BOP is used to prevent fluid escaping from a wellbore. If the primary and secondary well controls fail, then a blowout may occur.

Based on International Association of Oil and Gas Producers analysis (IOGP, 2010), the likelihood of a blowout is remote. Nevertheless, as the consequence of a hydrocarbon release of any nature is potentially significant, NEO will implement rigorous measures to reduce the potential for a failure of well control and ensure effective response should an incident occur.

The estimated frequency of releases larger than 10-Te were calculated based on an 11-year (2008 – 2018) UKCS oil spill profile (Table 11-2).

Table 11-2 Estimated frequencies of large releases

	10 ≤ Q < 100 Te	Q ≥ 100 Te	Unknown
Number of Releases	7	3	5
F (year^{-1})	0.6	0.3	0.5

In the period between 2000 - 2015 there were 22 well control incidents in the UK (ExproSoft, 2017). The Elgin incident in 2012 was the only well control related incident resulting in significant loss of oil to the sea in the history of UKCS offshore activity.

Eight of the 22 incidents were related to completion and workover activities, 4 to wireline, 3 to production wells, 1 to an abandoned well, 1 unknown, with the remaining 5 related to exploration and development drilling (Table 11-3). These figures result in approximately 1.4 well control incidents per year on average. Based on this analysis and on the probability definitions in Section 11.6.3 the likelihood of a blowout or well release during production or well intervention is considered extremely remote. Nevertheless, as the consequence of a hydrocarbon release of any nature is potentially significant, NEO will implement rigorous measures to reduce the potential for a failure of well control and will respond should an incident occur (these are detailed in Section 11.7).

Table 11-3 Overview of the number of loss of well control events that occurred during different operational phases 2000 - 2015 (ExproSoft, 2017)

Descriptor	Drilling		Completion	Workover	Production causes		Wireline	Abandoned well	Unknown	Total
	Development drilling	Exploration			External*	Internal				
Number of well blowouts	4	3	5	5	-	3	4	1	1	26
Percentage (%)	15.4	11.5	19.2	19.2	-	11.5	15.4	3.8	3.8	

*External causes include storm, military, and ship collision

11.3.3 Pipeline Releases

From analysis of the PON1 dataset, releases from risers and pipelines were one of the main contributors to oil releases. The worst pipeline release within the dataset was the 2011 incident at the Gannet pipeline, in which 218 Te of released oil were reported. More recently, a release of about 500 barrels (~70 Te) occurred in February 2022 from a pipeline between the Conwy and Douglas platforms in the Irish Sea, a recent pipeline tie-in similar to the Development. The importance of ensuring a robust

pipeline design and extensive management controls (see Section 11.7) to effectively manage corrosion and minimize free spans is key to mitigating pipeline integrity issues.

The quantities released from a pipeline failure scenario can vary significantly, and these will depend on many factors:

- Pipeline diameter;
- Topography of the pipeline;
- Pipeline pressurization;
- Hole size for the leak;
- Flow rates;
- Oil type and specific gravity.

A severe release from a pipeline could result in released quantities in excess of 1,000 Te. The potential release in a worst-case pipeline release could exceed 100,000 Te, although a release of such magnitude would likely result from severe failures on large pipelines, such as the Norpipe pipeline which connects Ekofisk to the UK coast. The pipeline at the Development is an in-field production pipeline and will contain a much smaller volume (approximately 4,000 Te maximum) at any given time compared to a larger trunkline which would hold tens of thousands of cubic metres. After identification of a pipeline leak by reduction in receiving pressure or oil on the sea surface, the pipeline will be isolated from the wells (via the well controls on the Christmas tree). The release of oil from the isolated pipeline will only continue until the internal pressure reduces and it is hydrostatically locked. The quantities of oil released also depend on the way the pipeline is laid on the seabed and seabed topography. A full-bore rupture may therefore only allow a portion of the pipeline volume to be released.

A pipeline release of the magnitude of the full Affleck in-field pipeline inventory (approximately 4,000 Te) is a low likelihood scenario due to the controls in place for the prevention of occurrence and the limitation of the escalation. Consideration of the UKCS history where no event of this scale has occurred. According to EnvAid (2018), prior to 2008 there were two significant releases from pipelines in the UK:

- A release of just under 1,000 Te of crude oil from the rupture of the Thistle-Dunlin pipeline in April 1980; and
- A release of 3,000 Te of crude oil from Occidental's Claymore Pipeline in November 1986.

11.4 BEHAVIOUR OF HYDROCARBONS AT SEA

The potential environmental impact of an accidental hydrocarbon release depends on a wide variety of factors, which include:

- Released volume;
- Type of hydrocarbon released;
- Direction of travel of hydrocarbons;
- Weathering properties of the hydrocarbon;
- Any environmental receptors present in the path of the slick (these may change with time); and
- Sensitivity of the environmental receptors to hydrocarbons.

The Oil Spill Contingency and Response (OSCAR) model has been developed by Sintef to model the fate of accidentally release hydrocarbons at sea. To understand the specific behaviour of releases from the Development, oil release modelling was conducted in accordance with BEIS guidance (BEIS, 2021b) using this model. The two worst-case scenarios modelled were a well-blowout and an instantaneous loss of crude from the mid-point of the infield pipeline. The highly conservative model assumes that a low probability event has occurred and that no action has been taken to respond to the

released oil. to mitigate the released hydrocarbons. The accidental release scenarios for the Development are detailed in Table 11-4.

Hydrocarbons undergo physicochemical changes when they are released into the marine environment, which will change the composition, behaviour and toxicity characteristics of the oil. These changes are dependent upon a number of factors including the type and volume of hydrocarbons released, and the prevailing weather and sea conditions. In the case of the Development, the expected hydrocarbons will be of the International Tankers Owners Pollution Federation (ITOPF) oil group 2. The oils in this group tend to have moderate properties such as specific gravity (~0.84 for Affleck crude) and pour point (~6°C), which indicate the oil will be a liquid upon release and will float to the sea surface. Weathering processes will then determine the fate of the oil. In the case of a moderate oil such as the Affleck crude, the more volatile components will evaporate to the atmosphere and the remaining oil would likely undergo a series of physio-chemical processes including biodegradation from microbial activity, dispersion from wave action sedimentation and emulsification. Group 2 oils tend to undergo rapid initial dissipation from the sea surface in a few hours to days.

Table 11-4 Summary of accidental release scenarios modelled for the Development

Scenario number	Scenario description	Hydrocarbon type	Release volume (m^3)	Modelled depth of release	Model type
1	Instantaneous loss of crude from the mid-point of the infield pipeline	Affleck crude	4,270	Seabed	Stochastic
2	Well blowout at Affleck using the highest unconstrained well flowrate for 90 days (time taken to drill a relief well)	Affleck crude	225,682	Seabed	Stochastic

11.4.1 Scenario 1: Instantaneous Loss of Crude from the Mid-point of the Infield Pipeline

The probability plots for surface oiling are displayed in Figure 11-2. Modelling indicated that oil is predicted to cross the Norwegian, Danish, German and Dutch median lines in all seasons; the worst-case probability of contamination and arrival times for these crossings are listed below:

- Norway – maximum probability of 85.5% in summer and a minimum arrival time of 1 hour in both winter and autumn;
- Demark - maximum probability of 17.3% in autumn and a minimum arrival time of 19 hours in both winter and autumn;
- Germany – maximum probability of 39.1% in spring and a minimum arrival time of 2 days 6 hours in winter; and
- Netherlands - maximum probability of 29.1 % in spring and a minimum arrival time of 2 days 18 hours in winter.

In addition, beaching was predicted to occur on the east coast of the UK from the Highlands to north-east England and on European coastlines including Norway, Denmark and Germany. The worst-case probability of contamination and arrival times for the beached oil at different locations is as follows:

- UK – the region with the worst-case oiling is Aberdeenshire / Aberdeen City with a maximum probability of 5.5% and a minimum arrival time of 7 days 5 hours in spring. However, beaching is also predicted at Dundee City (minimum arrival time of 15 days 1 hour), Scottish Borders (minimum arrival time of 13 days 22 hours), East Lothian (minimum arrival time of 26 days 18 hours), Fife (minimum arrival time of 16 days 17 hours), Angus (minimum arrival time of 16 days 9 hours), Highland (minimum arrival time of 19 days 14 hours), Moray (minimum arrival time of 23 days 7 hours) and Northumberland (minimum arrival time of 13 days 22 hours). However, the maximum probability of beaching at any of these locations is only 1.8%.
- Norway – maximum probability of 23.6% and a minimum arrival time of 8 days 4 hours in autumn;

- Demark - maximum probability of 57.3% in summer and a minimum arrival time of 9 days 3 hours in winter; and
- Germany – maximum probability of 2.7% and a minimum arrival time of 15 days 12 hours in winter.

The maximum mass of beached oil in any single run was predicted to be 35 Te in autumn (or 108 Te of beached emulsion), which would be distributed across the North Sea coast and therefore represents a very small quantity. There are no UK protected sites that are predicted to receive beached oil as a result of the release.

Figure 11-2 Scenario 1 – Probability of surface contamination for an instantaneous loss of pipeline crude inventory (above 0.3 µm) above 10%

11.4.2 Scenario 2: Well Blowout at Affleck for 90 days (Time Taken to Drill a Relief Well)

The probability plots for surface oiling due to a worst-case well blowout are displayed in Figure 11-3. Modelling indicated that oil is predicted to cross the Norwegian, Danish, Swedish, German, and Dutch median lines in all seasons; the worst-case probability of contamination and arrival times for these crossings are listed below:

- Norway – maximum probability of 100% and a minimum arrival time of 3 hours in all seasons;
- Demark - maximum probability of 100% in all seasons and a minimum arrival time of 21 hours in winter;
- Sweden - maximum probability of 100% in summer and a minimum arrival time of 9 days in winter;
- Germany – maximum probability of 100% in all seasons and a minimum arrival time of 42 hours in winter; and
- Netherlands - maximum probability of 100% in all seasons and a minimum arrival time of 2 days in all seasons.

In addition, beaching was predicted to occur on the east coast of the UK from Shetland to East of England and on European coastlines including Norway, Denmark, and Germany. The worst-case probability of contamination and arrival times for the beached oil at different locations is as follows:

- UK – the region with the worst-case probability of oiling is north-east England with a maximum probability of 30% and a minimum arrival time of 13 days in winter. However, beaching is also predicted at Shetland (minimum arrival time of 12 days), Grampian (minimum arrival time of 13 days), Tayside and Fife (minimum arrival time of 17 days), Orkney, Highlands, Lothian and Borders, Yorkshire and the Humber, East Midlands, and East of England (minimum arrival time for (all with minimum arrival times of > 20 days). However, the maximum probability of beaching at any in these regions has a maximum value of 20%.
- Norway – maximum probability of 100% in summer and a minimum arrival time of 5 days in winter;
- Demark - maximum probability of 100% in summer and a minimum arrival time of 7 days in winter;
- Sweden - maximum probability of 100% in summer and a minimum arrival time of 14 days in winter
- Germany – maximum probability of 30% in winter and a minimum arrival time of 15 days in spring; and
- Netherlands – maximum probability of 10% in winter and a minimum arrival time of >20 days in all seasons.

The maximum volume of beached oil in any single run was predicted to be 4,031 m^3 in autumn, which would be distributed across a wide area of North Sea coast but likely particularly on the Norwegian and Danish coasts given the prevailing current direction, as illustrated in Figure 11-3.

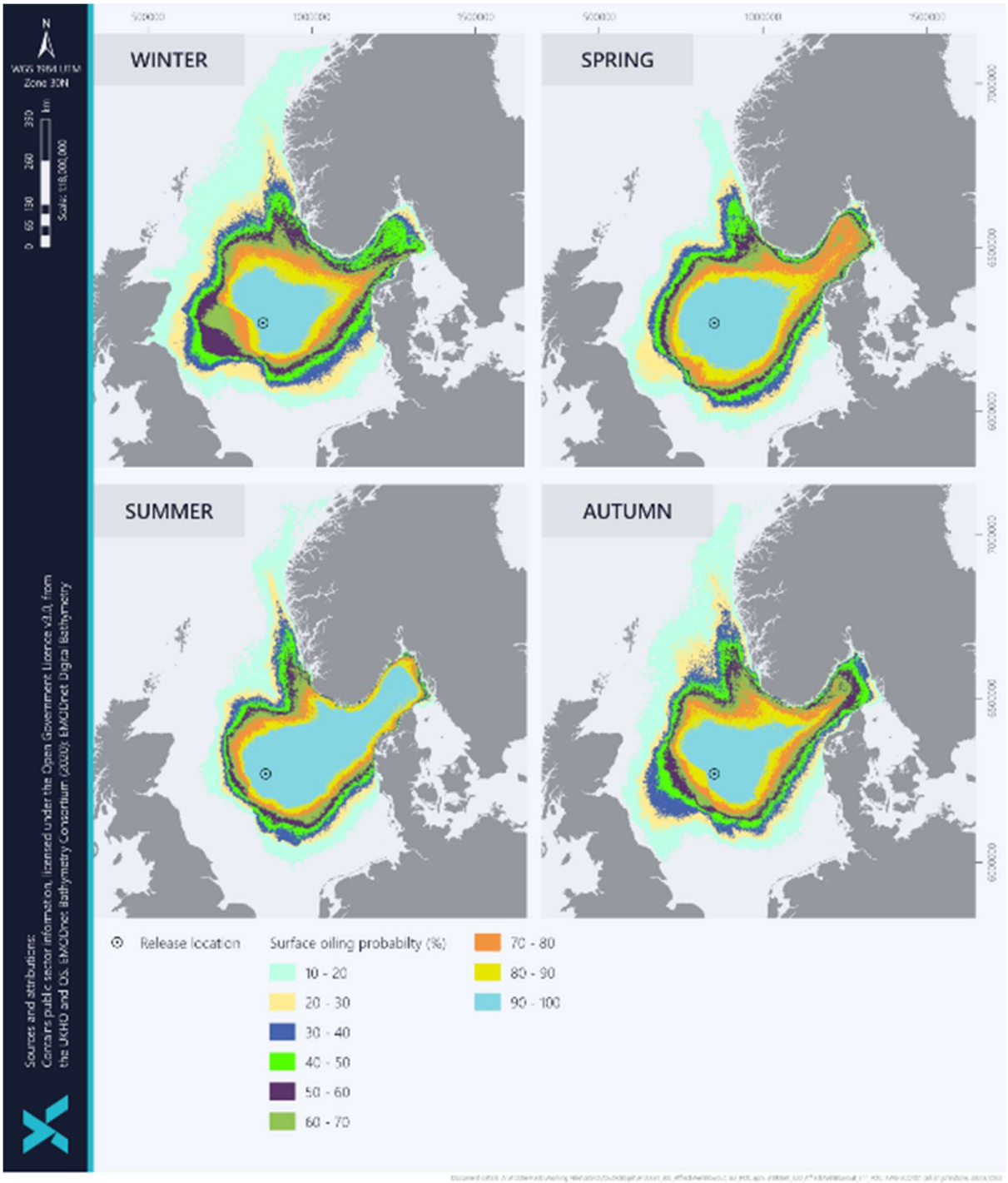

Figure 11-3 Scenario 2 – Probability of surface contamination for a well blowout (above 0.3 µm) above 10%[30]

[30] *Petrofac Affleck and Flyndre Fields OPEP (Petrofac, 2020)*

11.5 POTENTIAL RECEPTORS

Vulnerability of the environment is a function of the exposure routes of the environment to a stressor and has both a temporal and spatial variability. The severity or consequence of a hydrocarbon release is a function of the vulnerability of the receptor and the exposure of the receptors to the hydrocarbon and this is in turn dependent on the quantity and duration of the hydrocarbons release (its source term) and its physical properties which determine its behaviour (persistence and distribution) in the environment. Risk is the product of the probability of exposure to a hazard and consequence of that hazard on a particular receptor. Uncertainty in the environmental risk is difficult to quantify and accounted for by assuming worst-case outcomes to assess high consequence low probability events. The following assessment therefore considers a low probability unmitigated blowout event, for which worst-case source control predictions are used to determine the duration of the release and a stand-off approach is adopted with respect to the released hydrocarbons i.e., no response or clean-up activities are considered to mitigate the released hydrocarbons. This is therefore the largest theoretical release that could occur from the Affleck wells.

11.5.1 Coastal Environments

The likelihood of a hydrocarbon release reaching the coastal environment is a function of the likelihood of a hydrocarbon release occurring and the probability of the released hydrocarbons beaching. The level of impact on the shoreline is related to the volume of hydrocarbon beaching, the composition of the beached hydrocarbons, and the type of beach.

Coastal environmental sensitivities to oil include nearshore breeding seabird populations, shore birds, over wintering diver and duck species, marine mammals, aquaculture operations and sub-littoral and coastal habitats many of which are designated as SACs and SPAs.

Intertidal areas of the coast show varying degrees of sensitivity to oil; this variability is a function of both actual effects on specific organisms and the physical fate of the released substances within the habitat concerned. For example, high energy rock, boulder or cliff coastlines tend to have lower sensitivity to hydrocarbon pollution because oil is rapidly broken up and dispersed by wave action, whilst beached oil remains on the surface of rocks and is exposed to weathering. In contrast, sheltered, low energy shorelines tend to have moderate to high sensitivity because oil is not broken up by wave action and it can be mixed into the sediment, shingle or cobbles where it is not exposed to weathering and therefore persists for longer.

11.5.2 Protected Sites

Sea surface and shoreline probability of contamination data exported from the stochastic oil spill modelling (see Section 11.4) were examined to identify protected sites which are at risk of hydrocarbon contamination and require further assessment. For the purposes of this assessment, it was concluded a protected site required further assessment if the probability of shoreline contamination within the site was equal to or above 40% in any of the release scenarios.

The qualifying features in most coastal sites identified as having the potential to be impacted as a result of oiling are estuaries, mud and sandflats and dune features, although dunes are unlikely to be oiled. These habitats are also more likely to be negatively affected by hydrocarbon contamination than sea cliff habitats.

As the blowout represents the worst-case scenario, the potential of contamination at protected sites was assessed for this scenario only. The protected sites included in the assessment were SACs (including cSACs), SPAs (including pSPAs) and MCZs (including pMCZs). There are five sites with the potential to be impacted by a 40% probability of surface oiling (Figure 11-3). These are presented in Table 11-5. The impact of contamination on the designation features are discussed in Sections 11.5.3 - 11.5.6.

Table 11-5 Protected sites potentially impacted as a result of hydrocarbon contamination from a well blowout at Affleck (>40% probability of surface contamination) (JNCC, 2020c)

Site	Primary designation features
Braemar Pockmarks SAC (Offshore) Maximum probability of surface oiling (%): 41.6	Annex I Habitats that are primary reason for selection: ▪ Submarine structures made by leaking gases
Dogger Bank SAC (Offshore) Probability of surface oiling (%): 100	Annex I Habitats that are primary reason for selection: ▪ Sandbanks which are slightly covered by sea water all the time
East of Gannet and Montrose Fields NCMPA Probability of surface oiling (%): 100	Protected habitats: ▪ Offshore deep sea muds Protected species: ▪ Ocean quahogs aggregations
Farnes East MCZ (Offshore) Probability of surface oiling (%): 41.6	Protected habitats: ▪ Moderate energy circalittoral rock ▪ Subtidal coarse sediment / sand / mud / mixed sediments ▪ Sea-pen and burrowing megafauna communities Protected species: ▪ Ocean quahogs aggregations
Fulmar MCZ (Offshore) Probability of surface oiling (%): 100	Protected habitats: ▪ Subtidal sand / mud / mixed sediments Protected species: ▪ Ocean quahogs aggregations
North East of Farnes Deep MCZ Probability of surface oiling (%): 44	Protected habitats: ▪ Subtidal coarse sediment / sand / mud / mixed sediments Protected species: ▪ Ocean quahogs aggregations
Norwegian Boundary Sediment Plain NCMPA Probability of surface oiling (%): 91.2	Protected species: ▪ Ocean quahog aggregations
Scanner Pockmarks SAC (Offshore) Probability of surface oiling (%): 61.6	Annex I habitats that are primary reason for selection: ▪ Submarine structures made by leaking gases
Southern North Sea MCZ Probability of surface oiling (%): 84	Annex II Species that are primary reason for selection: ▪ Harbour porpoise *Phocoena phocoena*
Swallow Sand MCZ (Offshore) Probability of surface oiling (%): 92.8	Protected habitats: ▪ Subtidal coarse sediment / sand ▪ North Sea glacial tunnel valley (Swallow Hole)

11.5.3 Plankton and Fish

There can be impacts on plankton in the immediate area of the release for the duration of the release due to the dissolution of aromatic fractions into the water column. Such effects will be greater during a period of plankton bloom and during fish spawning periods as these life stages are more sensitive to these dissolved contaminants. Contamination of marine prey including plankton and small fish species may then lead to aromatic hydrocarbons accumulating in the food chain. These could have long-term chronic effects such as reduced fecundity and breeding failure in fish, bird, and cetacean populations.

This may affect fish stocks of commercially fished species. A major release could also have a localised effect on the fishing industry, should certain areas be temporarily closed to fishing. Juvenile fish and eggs are potentially the most sensitive life-stage to hydrocarbon discharges. As outlined in Section 4.3.3, a number of commercially important pelagic and demersal fish species are found in the vicinity of the Development. However, it is expected that it is unlikely to cause an adverse significant impact due to the short-life expectancy of the plankton and the small proportion of the North Sea population likely to be affected.

11.5.4 Marine Mammals

Marine mammals such as cetaceans and seals are potentially vulnerable to oil on the sea surface and shorelines. These species are highly mobile and are present in temporally and spatially varying densities in the North Sea. As a result, the impact of released oil on these species will depend on the encounter rate of each species with the oil and as such includes a behavioural component (e.g., there is some evidence of some marine mammal species actively avoiding oil on the sea surface).

Cetaceans are present in the vicinity of the Development area (see Section 4.3.5). In the event of a release, the potential impact will depend on the encounter rate of the species with the oil and their feeding habits; the overall health of individuals before exposure; and the characteristics of the hydrocarbons. Cetaceans are pelagic (move freely in the water column) and migrate. Their strong attraction to specific areas for breeding or feeding may override any tendency cetaceans have to avoid hydrocarbon contaminated areas. It is thought unlikely that a population of cetaceans in the open sea would be affected by a spill in the long-term (Aubin, 1990). In contrast to seabirds, there is relatively little evidence of direct mortality associated with oil spills (Geraci & St. Aubin, 1990; Hammond *et al*. 2002), although the aggregated distribution of some species (especially dolphins) may expose large numbers of individuals to localised oiling.

Whilst it is possible that some marine mammals could come into contact with surface accumulations of oil and would be susceptible through inhalation or skin absorption, their ability for avoidance would reduce the potential for impact and it is considered to be unlikely that any marine mammal listed under the Habitats Directive would be impacted on a population level. As such, no significant impact is expected on marine mammals at sea.

Seals are widespread in the North Sea and come ashore to breed and pup (see Section 4.3.5.2). There are a number of seal haul-out sites along the east coast of the UK. The animals most at risk from oil coming ashore on seal haul-out sites and breeding colonies are neonatal pups. These animals are born without any blubber and rely on their prenatal fur and metabolic activity for thermal balance. They are therefore more susceptible than adults to external oil contamination (Ekker *et al*., 1992). The pups remain on the breeding colonies until they are weaned and unlike adults or juveniles, would be unable to leave the contaminated areas. Any oil which comes ashore will therefore increase the exposure of oil to the seals at these sites. The pups remain on the breeding colonies until they are weened and are particularly susceptible to oil. Therefore, the population could be significantly impacted for at least one breeding season.

11.5.5 Benthic Environments

Although there are a number of sites with the potential to be impacted by surface oiling (Section 11.5.2), it is very unlikely that the hydrocarbons would be mixed with the water column in sufficient quantities or and depth to interact with the protected seabed features. As such, no significant impact is expected on the benthic environment.

11.5.6 Birds

Impacts of sea surface oiling on seabirds is one of the greatest environmental risks posed by accidental hydrocarbon release events. This is primarily due to the high affinity of oil for seabird plumage. Once oil becomes incorporated into the feathers, there is a very high chance of death due to loss of body heat, starvation, drowning or oil ingestion from preening activity. Plumage is essential to flight,

waterproofing and heat insulation and even small effects on any of these functions can result in mortality.

Some groups of seabirds are more vulnerable than others due to their particular behaviours. Guillemots, which spend much of their time on the sea surface and typically dive to avoid danger, are particularly sensitive to oil slicks. Common guillemot are particularly vulnerable in the post-breeding period because the male parents accompany their flightless young in swimming offshore from the breeding colonies. This generally occurs in late spring and early summer. Gannets are also sensitive due to their diving behaviour which causes them to repeatedly pass through any sea surface hydrocarbon layer.

Species that nest on cliffs and cliff tops are unlikely to have their nesting sites directly adversely affected by an accidental hydrocarbon release, although following the Sea Empress incident gannets were observed collecting contaminated nesting material (Santillo *et al*., 1998).

Sheltered habitats that encourage wading or resting on calm water may suffer significant losses of birds in the event of sea surface oiling due to the greater likelihood that large accumulations of birds will be exposed. Following the Sivand spill in the Humber Estuary, the Royal Society for the Protection of Birds (RSPB) reported 160 dead oiled birds were found and estimated that 4,000 birds may have been oiled in total (NOAA, 1992). It is likely that the vast majority of oiled birds would have died due to hypothermia and toxicity; it is common that only a small proportion of bird carcasses are recovered following hydrocarbon release mortality events.

Sensitivity of particular species also varies in line with the total biogeographical population, which influences the potential for population recovery following an incident.

The JNCC has stated in a memorandum to the UK Parliament that the greatest risks to nature conservation from oil on the offshore sea surface is to seabirds (JNCC, 2011). The seasonal vulnerability of seabirds to surface pollutants is identified using SOSI, derived from JNCC block-specific data; In the immediate vicinity of the Development, seabird sensitivity to oil releases range from low to high (see Section 4.3.4 for further detail). The magnitude of any impact will depend on the number of birds present, the percentage of the population present, their vulnerability to released hydrocarbons and their recovery rates from oil pollution. The physical impact of a release is one of plumage damage leading to loss of insulation and waterproofing.

Seabirds that rest and breed within SPA boundaries commonly feed in waters outside the site boundary, meaning that hydrocarbon releases may impact protected site features without actually entering the site. As discussed below, the impacts of sea surface oiling on seabirds is one of the greatest environmental risks posed by accidental hydrocarbon release events and there is a potential for a well blowout to result in significant adverse effects on bird species.

Potential recovery rates may range from 1 to 10 or more years depending on the species affected and the extent of population loss. Recovery rates depend on numerous factors including:

- The percentage of the breeding population killed (and therefore numbers remaining);
- Number of juveniles lost (affecting recruitment rates in following years);
- Size of the existing pre-breeding pool and rates of recruitment into the colonies;
- Rates of reproduction of individual species;
- Long-term loss of feeding grounds and prey species; and
- Sub-lethal effects which may affect reproductive success.

11.6 MAJOR POLLUTION INCIDENT RELEASE ASSESSMENT

11.6.1 Summary

Under the Offshore Safety Directive (2013/30/EC) and the implementing UK regulations, the Offshore Installations (Offshore Safety Directive) (Safety Case) Regulations 2015 (OSCR), operators are required to identify in their well notifications where any MAHs associated with the operations has the potential to cause a MEI. The Development does not have a safety case associated with it as it is a subsea tie-back and therefore an MEI will not be caused by an MAH. However, in line with the EIA regulations, an assessment of the worst-case accidental event is required and will therefore be considered to determine if it has the potential to cause a major pollution incident.

The worst-case accidental event associated with the Development has been determined as a well blowout. The season in this scenario which resulted in the largest volume of onshore oil was investigated further using deterministic modelling to determine the potential for a major pollution incident to occur. Specifically, the potential for a blowout to cause significant adverse change to a protected species or habitat as defined by Annex I of the Birds Directive or Annex I, Annex II and Annex IV of the Habitats Directive was identified and assessed. It should be noted that, although such an incident may have the potential to cause significant impacts, this is under the assumption that it is a worst-case blowout where no response measures have taken place. Therefore, this is very conservative in its assumptions. Furthermore, the deterministic model which represents the worst-case oiling onshore for the Development predominantly impacts the Norwegian and Danish coasts and does not represent the worst case UKCS oiling. As such, this chapter also uses an interpretation of the stochastic modelling to determine the potential impacts for the UKCS and ensure a robust assessment methodology.

The provision for assessing a major pollution incident will also apply to transitional and coastal waters covered by the Water Framework Directive (WFD) (Directive 2000/60/EC). The guidance states that a major accident relating to offshore oil activities are extremely unlikely to result in significant adverse changes to the water quality status (BEIS, 2017). However, designated shellfish waters should be discussed in detail as Member States are required to ensure implementation of the WFD. Degradation in water quality could impact the shellfish leading to unsafe products for human consumption and the temporary closure of the area to commercial production.

11.6.2 Release Behaviour

The mass balance of oil over the duration of the release is presented in Figure 11-4. The deterministic model indicated that the majority of the released oil evaporated (36.14%) by the end of the model (day 100), with approximately 32.15% was predicted to be deposited in the seabed sediment. Biodegraded oil accounted for approximately 21.64%, with approximately 7.85% remaining within the water column. Approximately 1% and 1.21% accounted for oil present on the sea surface and becoming beached onshore, respectively. The remaining 0.01% left the gridded area during the model run, however this is considered to be a negligible quantity.

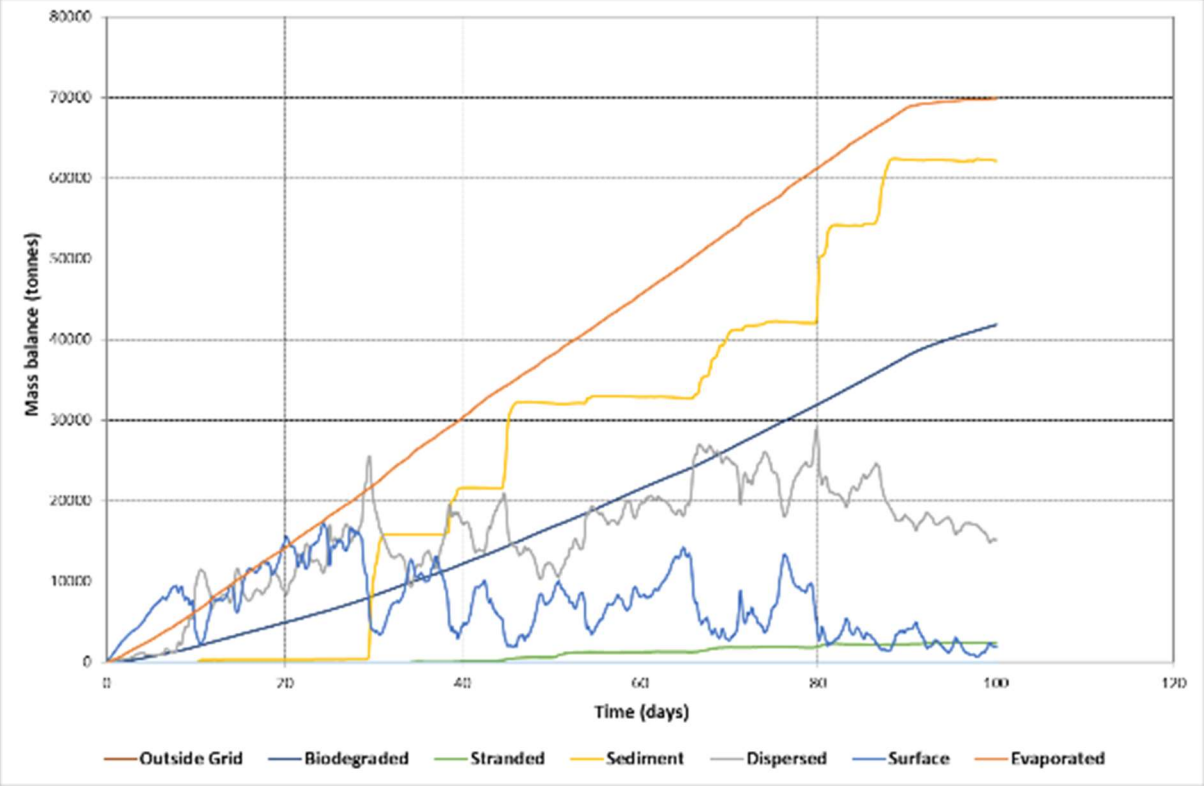

Figure 11-4 Mass balance of oil from Affleck blow out deterministic scenario

Table 11-6 Mass balance of oil from Affleck blow out deterministic scenario after 100 days

Fate	Mass (Te)	Percentage (%)
Surface	1,943	1.00
Evaporated	69,900	36.14
Water Column	15,180	7.85
Sediments	62,190	32.15
Beached onshore	2,344	1.21
Biodegraded	41,860	21.64
Outside Gridded Area	12	0.01

11.6.3 Assessment Methodology

Environmental vulnerability to oil spills is both a function of the magnitude of the event and the sensitivity of environmental receptors to such events. There is no standard or widely recognised method of determining the environmental impact associated with crude oil spills, therefore the approach undertaken was based on the “Impact Scales and Gradation of Oil Spill Ecological Hazards and Consequences in the Marine Environments” classification guide described by Patin (2004), and provides assessment criteria which is in line with the Offshore Safety Directive [Article 2(37)], as detailed in Table 11-7 to Table 11-10.

The major pollution incident spill assessment considered the potential impacts to UK protected sites (specifically SACs, SPAs and NCMPAs) and species (specifically those listed under Annex I of the Birds Directive Annex II and IV of the Habitats Directive) in terms of surface oiling, shoreline oiling and oil in sediments (Sections 11.6.4 to 11.6.7).

Although separate to an MEI, this assessment utilizes the MEI guidance (BEIS, 2017) which states that impacts on plankton and pelagic species are unlikely to be significant as any hydrocarbons entering the water column will be rapidly and widely dispersed. It should also be noted that the only protected fish species found within the North Sea is the sturgeon *Acipenser sturio* however their sightings are uncommon. Therefore, oil within the water column offshore is only considered in terms of potential effects on shellfish waters (Section 11.6.7).

Table 11-7 Consequence assessment – spatial scale (Area)

Spatial scale	Area under impact
Point	Less than 100 m^2
Local	Range from 100 m^2 to 1 km^2
Confined	Range from 1 km^2 to 100 km^2
Sub-regional	More than 100 km^2
Regional	Spread over shelf area

Table 11-8 Consequence assessment – temporal scale

Temporal scale	Longevity
Short term	Several minutes to several days
Temporary	Several days to one season
Long-term	One season to one year
Chronic	More than one year

Table 11-9 Consequence assessment – reversibility of changes

Reversibility of changes	Longevity of disturbance
Reversible (acute stress)	Acute disturbances in the state of environment and stresses in biota that can be eliminated either naturally or artificially within a short time span (several days to one season)
Slightly reversible	Disturbances in the state of environment and stresses in biota that can be eliminated either naturally or artificially within a relatively short time span (one season to three years)
Irreversible (chronic stress)	Prolonged disturbances in the state of environment and stresses in biota that exist longer than three years

Table 11-10 Consequence assessment – general assessment

General assessment	Disruption
Insignificant	Minimal changes that are either absent or not discernible.
Slight	Slight disturbances to the environment and short-term stresses in biota are discernible (below minimum reaction threshold 0.1% of natural population reaction).
Moderate	Moderate disturbances to the environment and stresses in biota are observed (changes up to 1% of natural population reaction are feasible).
Severe	Severe disturbances to the environment and stresses in biota are observed (up to 10% of natural population).
Catastrophic	Catastrophic disturbances to the environment and stresses in biota are observed (up to 50% of natural population). Changes are irreversible and stable structural and functional degradation of a system is evident.

11.6.4 Oil on the Sea Surface

Birds on the sea surface are sensitive to oiling which damages their feathers and thus causes death via waterlogging and hyperthermia. Canadian research (O'Hara and Morandin, 2010) has identified that sheens as thin as 0.1 µm can have a negative impact on feather structure. At certain times of the year there is potential for high densities of birds to be on the sea surface in the vicinity of Affleck and to encounter the resulting surface slick.

The worst-case deterministic modelling predicts that, over the period of the blowout scenario, much of the sea surface throughout the CNS will experience surface oil above the threshold determined for seabird species (Figure 11-5). However, most of the oiling will travel east away from the UKCS. There are no UK SPAs designated or proposed under the Birds Directive which are predicted to be contaminated by any surface oiling. As a negative impact on any protected bird species is not predicted, this aspect of the release behaviour does not constitute a major pollution incident to protected birds.

The worst-case deterministic model shows surface oiling is predicted at four UK protected sites including Fulmar MCZ, Dogger Bank SAC, East of Gannet and Montrose Fields MPA and Norwegian Boundary Sediment Plain MPA, with concentrations greater than the 0.1 µm threshold. However, as shown by the stochastic modelling in Section 11.4.2, there is also potential for the oil to drift westwards towards the UKCS, therefore there are likely to be more protected sites that could experience oil at the surface, although it is highly unlikely that they would all be impacted in one model run. Despite this, UKCS protected sites in the CNS are almost all designated for benthic features such as ocean quahogs or subtidal muds, and as such there is not expected to be any adverse impact on the qualifying features of these protected sites from surface oiling.

Marine mammals also have potential to encounter the surface sheen, although no specific threshold for impact has been determined. A number of marine mammals listed as European Protected Species have been sighted within the vicinity of Affleck, however the number of sightings was low. Therefore, it is reasonable to conclude that given the limited extent of the area with the highest surface oiling levels, and the temporary nature of the event, the surface oil will not present a significant adverse impact to dolphins or whales migrating through the area.

Due to the location of Affleck, significant surface oil is not predicted to arrive at the UK coast where marine mammals, e.g., harbour seal, are common in spatially varying densities. As a result, the occurrence of a major pollution incident to a marine mammal protected species is not expected. As mentioned, no other protected species or habitats are expected to be adversely impacted as a result of the surface sheen and therefore an assessment using Patin (2004) methodology was not completed.

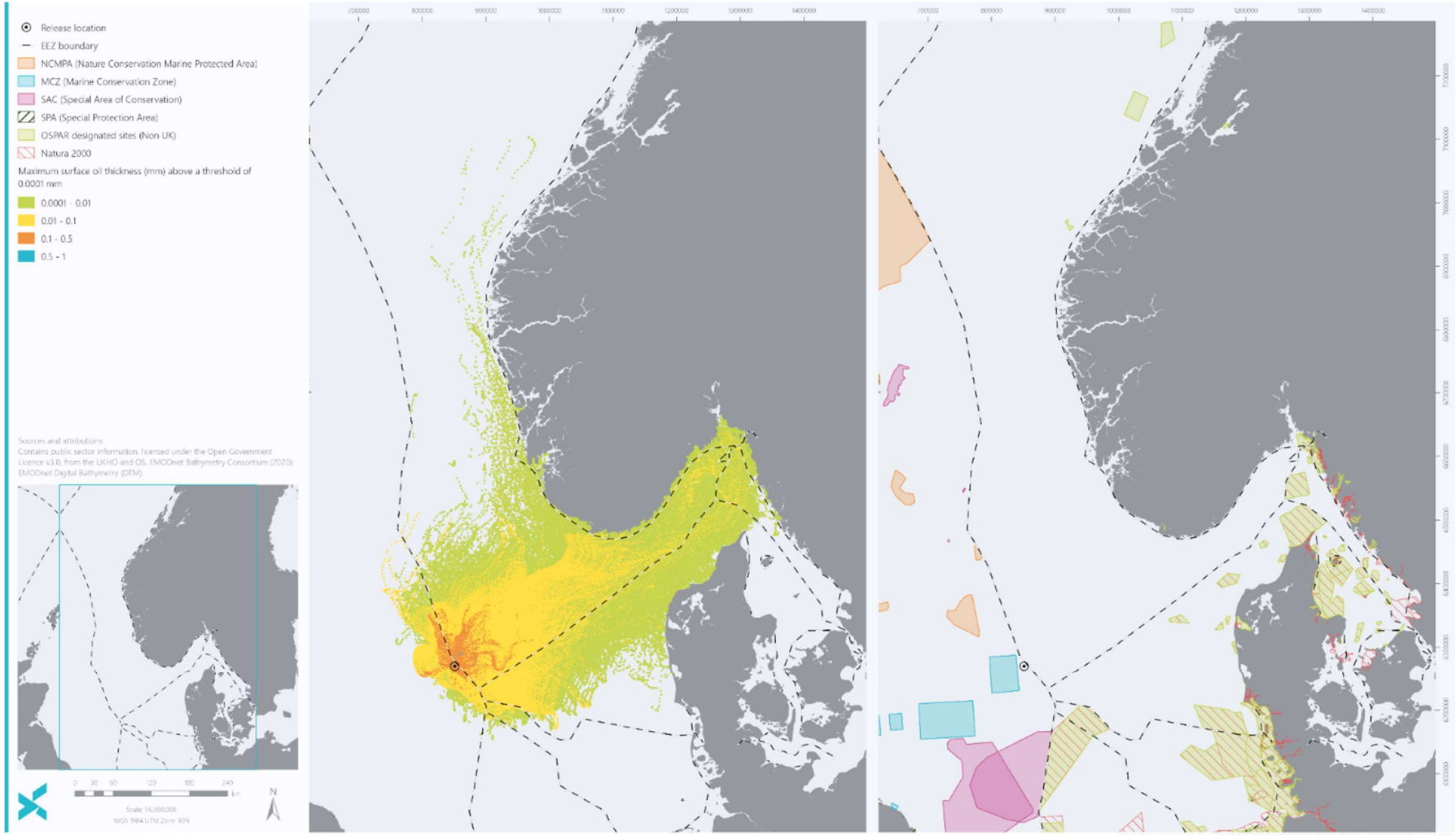

Figure 11-5 Deterministic modelling: Maximum oil on the sea surface

11.6.5 Shoreline Oil

ITOPF have produced a Technical Information Paper providing guidance on how to estimate the stranded oil volume (ITOPF, 2011). Using this guidance, it was estimated that a light oiling of Affleck Crude would equate to a volume of 0.1 l/m^2 (0.0843 kg/m^2), while moderate oiling equates to volumes between 0.1 l/m^2 (0.0843 kg/m^2) and 1 l/m^2 (0.843 kg/m^2), and heavy oiling equates to volumes greater than 1 l/m^2 (>0.843 kg/m^2).

Based on the worst-case deterministic oil release scenario, shoreline oiling is not predicted at any UK sites (Figure 11-6). However, this particular simulation considers the worst-case across the entire North Sea, not specifically the UKCS. By studying the stochastic simulations for the well blowout, it can be interpreted that there is the potential for oiling on the UK shoreline in a worst-case event, specifically in the winter and spring seasons. The oiling could potentially beach from as far south as the north-east of England and could stretch up the coast to the north-east tip of Aberdeenshire, There are a number of sensitive habitats in these regions, such as the Farne Islands (protected within the Berwickshire and North Northumberland Coast SAC) and the Buchan Ness to Collieston Coast SPA which serves as a breeding ground for a number of protected bird species. Therefore, based upon the stochastic modelling it is considered that there is potential for a major pollution incident on the UKCS shoreline.

Following screening using the Patin (2004) assessment tables revealed the spatial scale was “regional”, the temporal scale “temporary”, the reversibility of changes was “reversible” and the general assessment “severe ”, as per Table 11-7 to Table 11-10. Although is unlikely that any protected species would suffer any impact due to the low probability of a release and the likelihood of the currents taking the oil away from the UKCS, there is the potential for the occurrence of a major pollution incident due to shoreline oiling nevertheless.

When considering oil on the shoreline, it should be considered that much of the east coast of the UK is predominantly rocky shoreline and numerous observations in different parts of the world indicate that oil persistence, and consequently its adverse impact, sharply decrease from sheltered gravel and pebble shorelines to open rocky shores (Patin 2004). In addition, a rocky nature of the coastline is likely to mean that most of the birds would be roosting and nesting above the narrow zone where potential oil may reach the shoreline.

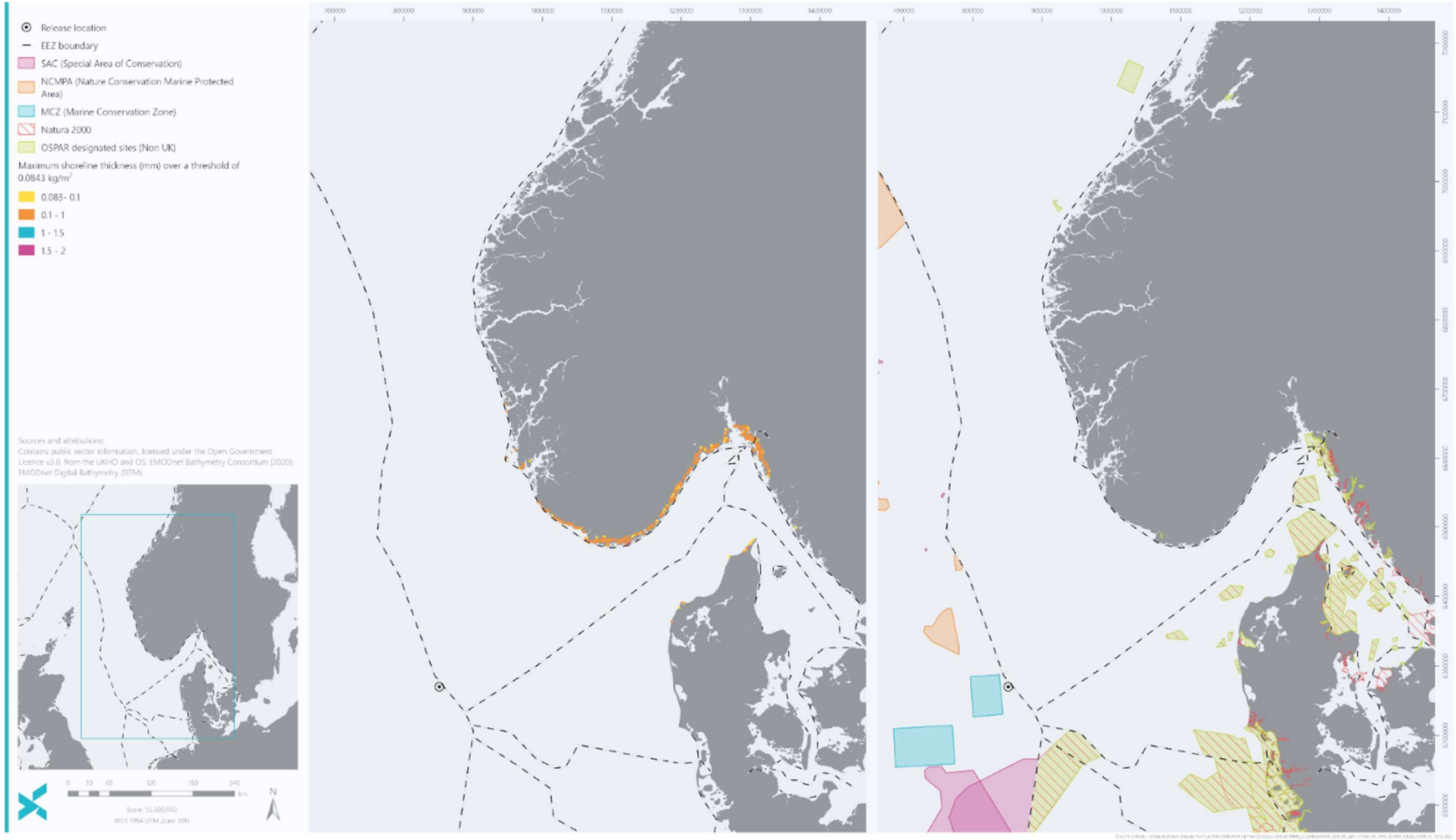

Figure 11-6 Deterministic modelling: Maximum oil on the shoreline

11.6.6 Oil in Sediment

There are currently no published North Sea thresholds for oil in sediment; however, the Fisheries Research Services (now Marine Scotland) have carried out temporal studies into the levels of hydrocarbons in the sediments from the East Shetland Basin and the Fladden grounds (Marine Scotland, 2008). These studies determined that a hydrocarbon sediment concentration of 50 µg/g is common in North Sea sediments and levels higher than this appear to return to background levels over time. In terms of mass 50 µg/g equates to 6.88 g/m^2 (assuming a sediment bulk density of 2.75 kg/m^2).

Although the deterministic model predicted sediment contamination to occur over a wide area of the seabed, there are no UKCS sites predicted to have oil in sediment above this threshold. Oil in sediment (≤ 4 g/m^2) was only predicted at 4 UK protected sites (Figure 11-7). In addition, only a very small proportion of the seabed is expected to receive oil above this threshold so it is highly unlikely that the worst-case deterministic model for the UKCS would result in any protected sites above this threshold also. Therefore, in consideration of the potential impacts, oil in sediment is not considered to cause a measurable significant adverse change to a protected species or habitat as defined by Annex I of the Birds Directive or Annex I, II and IV of the Habitats Directive in accordance with the Offshore Safety Directive and so the potential for a major pollution incident to occur via oil in sediment is unlikely.

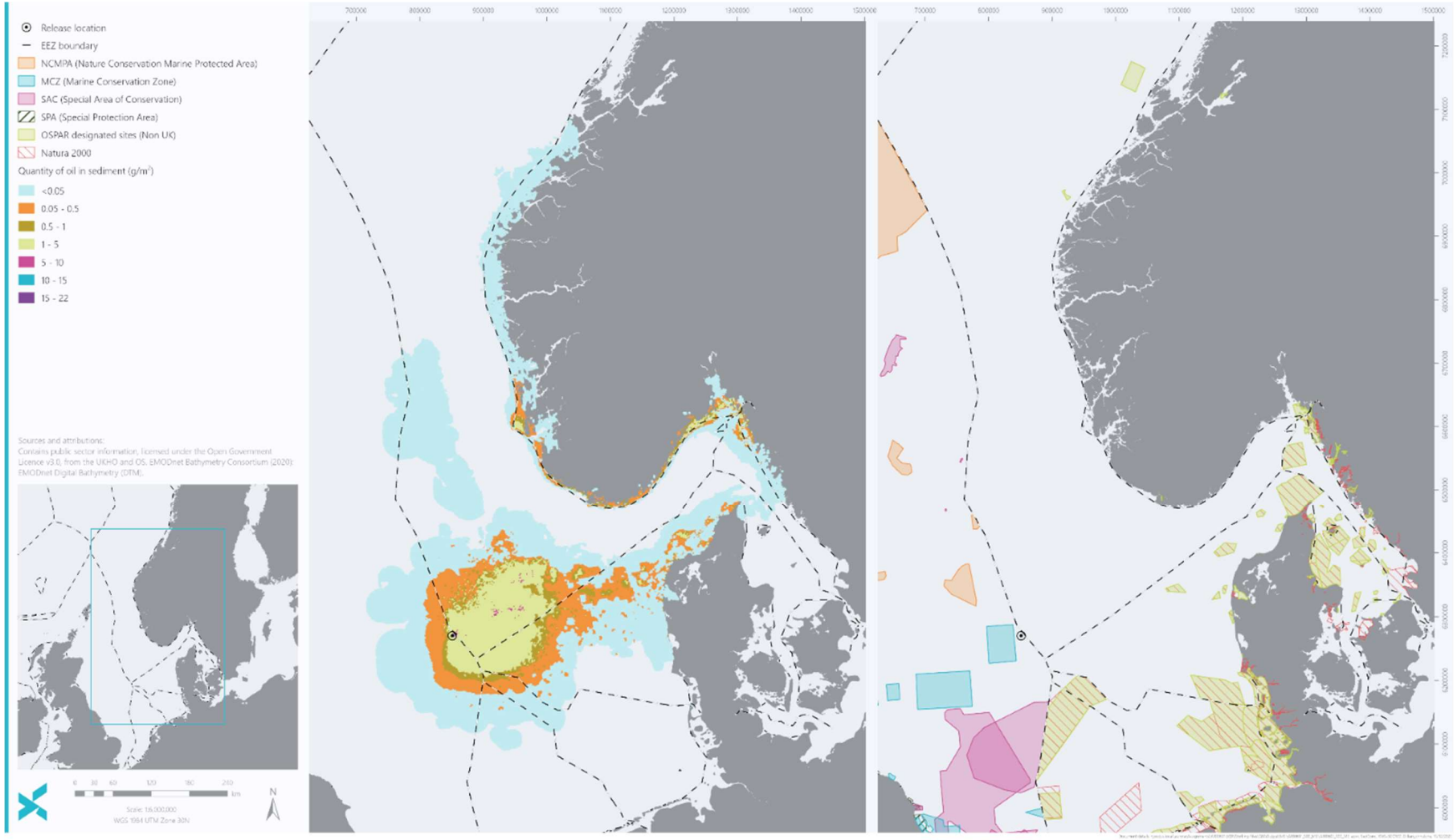

Figure 11-7 Deterministic modelling: Maximum oil in sediment

11.6.7 Oil in Water Column

Oiling which affects the water quality is also of concern to coastal shellfish protection areas and active aquaculture sites. Shellfish production is an important activity in Scotland, economically, socially, and environmentally. The Shellfish Farming Production Survey (Scottish Government, 2020a) states that in 2018, the total value at first sale for all species was calculated at approximately £7.9 million, a decrease of 17% from the £9.5 million estimated in 2018. The industry contributed to approximately 136 full-time jobs and 141 part-time and casual workers during 2019. The number of full-time staff decreased by one and the number of part-time and casual employees decreased by 20 compared with 2018 (Scottish Government, 2020a). Production was dominated by mussel and Pacific oyster in terms of value and tonnage. Mussel production decreased by 3% and Pacific oyster production increased by 14% during 2019, although small quantities of scallop, queen scallop (queen) and native oyster were also produced (Scottish Government, 2020a). An increase for finfish production was also recorded between 2018 and 2019, where total production was 156,025 Te in 2018 and 203,881 Te in 2019 (Scottish Government, 2020b). Given the likelihood of a release occurring, along with the control measures in place to respond to a release, the risk to fishing (both off and nearshore) is considered to be effectively managed.

Fish juveniles and eggs are particularly sensitive life-stages with respect to oil in the water column, with dispersed oil concentrations as low as 1 mg/l having negative effects (Broderson *et al.* 1977). According to the ITOPF technical paper on effects of oil pollution on fisheries and mariculture (2014), 15 parts per billion (ppb) is the threshold at which oil is considered to have adverse effects on aquaculture production. In determining the extent to which aquaculture would be affected, areas that include significant aquaculture production were compared against the 15 ppb threshold (Figure 11-8). As stated for shoreline oiling in Section 11.6.5, the worst-case deterministic model predominantly avoids the UKCS, although there is potential for water column contamination on the UKCS based on the stochastic blowout model. If this was to occur, the size of the contaminated UKCS area over the 15 ppb threshold could be significant based on the size of the area over 15 ppb in Figure 11-8. Shetland and Orkney support most of the shellfish protection areas and aquaculture sites on the east coast of the UK. Oil is unlikely to drift in the water column as far as either region at a concentration > 15 ppb, however the east coast of mainland Scotland also supports aquaculture and shellfish protection areas in areas such as Aberdeenshire and Fife which may be vulnerable.

In consideration of the potential impacts to the receptors discussed above, water column concentration is considered to have the potential to cause a measurable significant adverse change to the production of aquaculture sites. Therefore, there is potential for a major pollution incident to occur via oil water column contamination.

Using the environmental consequence assessment table generated by Patin (2004), the outcome of this scenario revealed the spatial scale was “regional”, the temporal scale “temporary”, the reversibility of changes was “slightly reversible” and the general assessment “slight”, as per Table 11-7 to Table 11-10.

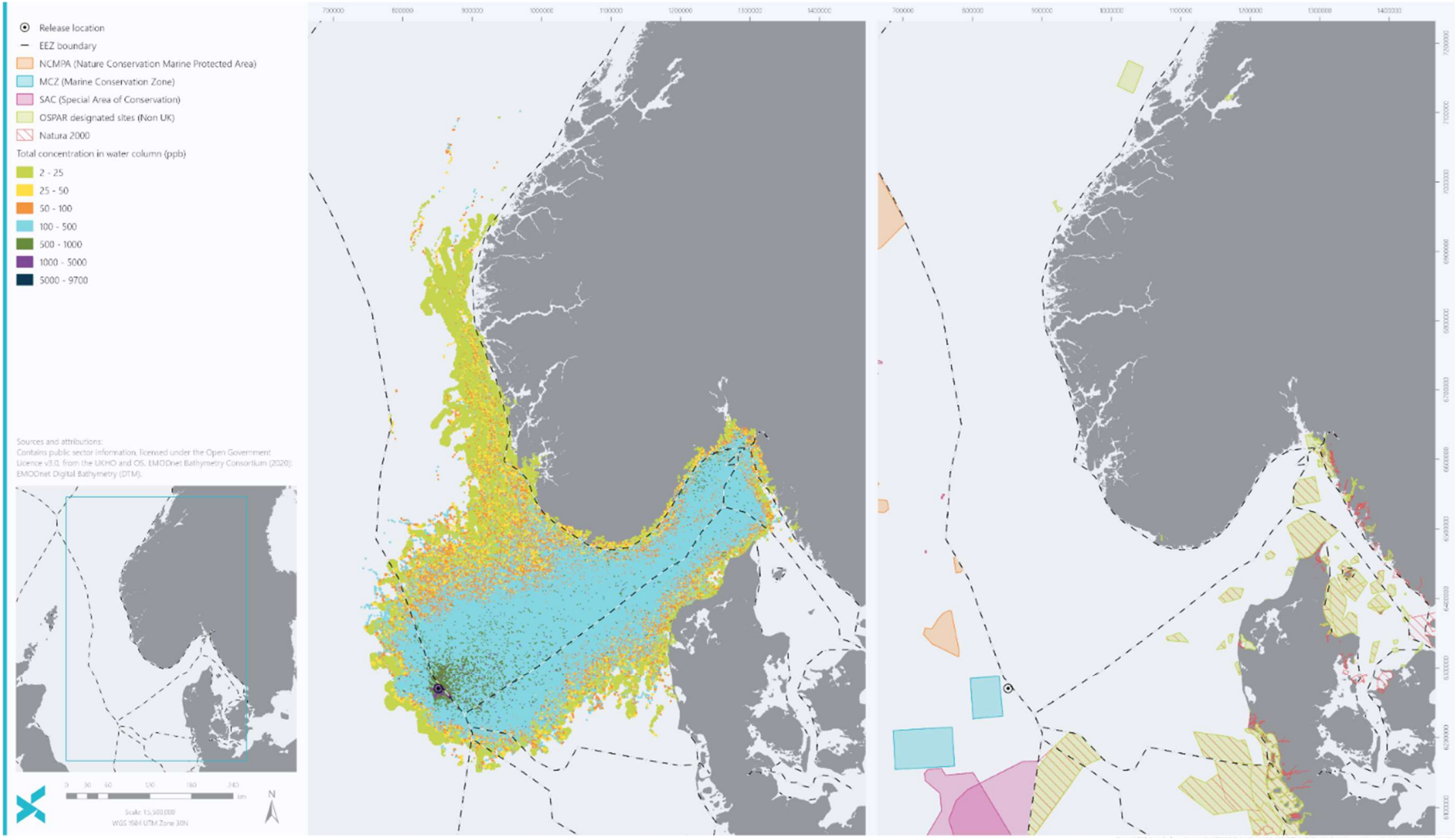

Figure 11-8 Deterministic modelling: Total Oil Concentration in the Water Column

11.6.8 Impacts on European Protected Sites

As shown in Figure 11-5, Figure 11-6, Figure 11-7 and Figure 11-8 hydrocarbon contamination is largely predicted to occur within Norwegian, Danish and Swedish waters, where a number of protected sites have been designated.

Surface oiling above 0.1 µm threshold (O'Hara and Morandin, 2010) was predicted to occur at some time during the simulation within four Norwegian protected sites, 21 Danish, 16 Swedish and one German. However, it should be considered that the oil on the surface is unlikely to be present in the form of a continuous sheen at this distance from the release point and due to the temporary nature of the event, the likelihood of a significant impact on the species within this site may be reduced.

Oil in sediment above the 6.875 g/m^2 threshold is not expected at any European protected sites.

Section 3.12 of the draft MEI guidance (BEIS, 2017), states *"in relation to an incident that could potentially impact the waters of an adjacent State, it is sufficient to confirm that, in the event of an incident that could impact the coastal waters of an adjacent State, the operator would liaise with the relevant national authorities to assess the scale of any potential impacts."* In line with recent regulatory discussions that only UK sites are to be assessed as part of any MEI Assessment, BEIS requires a brief determination of whether there is a potential for a European MEI to occur (i.e., beaching out with the UKCS). The predicted shoreline hydrocarbon concentrations at 1 Norwegian National Marine Protection Plan Site (i.e., Natura 2000 and OSPAR sites) is quantified as heavy oiling under ITOPF (approximately 1.12 kg/m^2 of oiling), therefore it is concluded that there is potential for a European MEI to occur.

11.6.9 Conclusion

Most releases of hydrocarbons to the marine environment, unless very small, have the potential to cause environmental impact. The assessment of the worst-case well blowout scenario in which no action to mitigate the released oil was taken determined that this did have the potential to cause significant adverse change to UKCS protected species or habitats. It should be noted that, whilst this is a possibility, the nature of the Development ensures it is highly unlikely – as discussed in Section 11.3.2, risk of a release is highest during the drilling phase of a project and considering the Development will bypass this and enter the production phase immediately this will reduce the risk of a blowout.

Environmental impacts from oiling in terms of shoreline oiling and oil in the water column have been identified and assessed for the UKCS using the methods described by Patin (2004) as detailed in Table 11-10. This has determined whether there is potential for significant damage, as defined by the Environmental Liability Directive, to protected species or habitats (listed under the Annex I of the Birds Directive and/or Annex I, II and IV species listed under the Habitats Directive) in accordance with the Offshore Safety Directive. In the event of a release, there would also be oil present at the UKCS sea surface, however there was not considered to be significant risk to the qualifying features of protected sites in the region. Furthermore, the quantity of oil that would contaminate the sediment is not sufficient to pass a threshold where it would be detrimental to protected habitats or species. The justification for considering that shoreline and water column oiling may constitute an MEI is as follows:

- Although the deterministic modelling shows that shoreline oiling is mostly expected on the Norwegian and Danish coast, the stochastic modelling shows that there is potential for oiling on the UK coast in a winter or spring release. Due to the high number of protected sites and sensitive habitats on the east UK coast, shoreline oiling is considered to constitute an MEI; and
- As shown in the stochastic modelling, there is potential for water column contamination to affect UKCS waters above the threshold that is considered to be harmful to aquaculture or shellfish protection waters. Due to a number of these sites on the east UK coast and considering their sensitivity, water column contamination is considered to constitute an MEI.

11.7 MANAGEMENT CONTROLS

NEO will ensure that appropriate controls are in place to either reduce the probability of failure of a control resulting in a release or reduce the consequences in the event of a release. SECEs performance standards with verification, equipment inspection, maintenance routines and management of operations will be in place during the operations. Corrosion management will be of paramount importance for the Development as corrosion is often biggest risk to pipeline integrity, especially if the hydrocarbons are wet. A pipe-in-pipe system will be employed, whereby an insulated inner pipe is surrounded by a protective outer pipe. The outer pipe protects the insulation material from external hydrostatic pressure and other mechanical damage, therefore improving the reliability of the system and minimising the risk of a release due to corrosion.

11.8 CUMULATIVE AND TRANSBOUNDARY IMPACT ASSESSMENT

Existing hydrocarbon release risks in the North Sea are associated primarily with oil and gas industry activities as well as other marine industries such as merchant shipping and fishing. As indicated by historical data, the likelihood of one major accidental release occurring is remote or extremely remote, limiting the cumulative impact from the Development and other existing installations. An OPEP and TOOPEP will be in place, outlining the response measures to be implemented in the event of any accidental release.

Worst-case scenario modelling undertaken for the Development indicates a 100% probability of hydrocarbons crossing a EEZ (UK/Norway), with the potential to reach Norwegian, Danish, Netherlands, Swedish and German waters. Therefore, consultation under the Espoo Convention is likely to be required. The Espoo Convention requires notification and consultation only for projects likely to have a significant adverse environmental impact across boundaries. In the event that a release crosses the median line, NEO can confirm that there are relevant processes and procedures in place to liaise with member states as outlined in the NEO Onshore OPEP.

The risk of an accidental hydrocarbon release having a transboundary impact, particularly from UKCS operations, is recognised by the UK Government and other governments around the North Sea. Agreements are in existence for dealing with international releases with states bordering the UK (e.g., Bonn Agreement). These agreements would operate within the framework of the National Contingency Plans (NCPs) and are oriented towards major releases. This becomes operational when agreement to the request for its implementation is reached. Responsibility for implementing joint action with neighbouring states rests with the Action Co-ordinating Authority (ACA) of the country on whose side of the median line a spill originated. The UK's ACA is the Counter Pollution Branch of the Maritime Coastguard Agency. In the event of a major accidental release, which would likely have the potential to drift into Norwegian waters, the Norwegian/British oil spill response (NORBRIT) plan will be activated. All other countries which have the potential to receive oil across a median line are members of the EU and therefore the European Maritime Safety Agency (EMSA) would be consulted in this instance. EMSA provides operational services to Member States including a network of stand-by oil spill response vessels, satellite imagery, pollution response experts and information service for chemical spills at sea.

11.9 RESIDUAL IMPACT

Although the probability of catastrophic releases from the Development is remote, even with comprehensive prevention measures in place the residual risk of accidental release, and thus impact on the marine environment, remains. This is recognised to be true for the offshore oil and gas industry in general and the formulation of detailed and fully tested contingency response plans is thus integral to such projects. As such, NEO will have in place a range of response/mitigation measures to address these risks (detailed in Section 11.7). All activities will be covered by appropriate OPEPs and Shipboard Oil Pollution Emergency Plans (SOPEPs) which will set out the responses required and the available resources for dealing with releases of all sizes. The planning, design, and support of all activities for the

development will aim to eliminate or minimise potential environmental risks. NEOs management processes will ensure that these mitigation commitments are implemented and monitored.

The residual impact for the receptors of protected sites and socio-economic features is described below. It concludes that the residual impact is considered not significant. This is due to the mitigation measures in place and the remote likelihood of a release in the first place. It should also be noted that this modelling represents a worst-case blowout scenario where no response measures are in place, therefore this represents a conservative estimate as to the magnitude of the impact and also the vulnerability of receptors as it assumes, for example, birds will be present at protected sites when hydrocarbons arrive.

Receptor	Sensitivity	Vulnerability	Value	Magnitude
Protected sites and socio-economic features	High	High	High	Moderate
Rationale				
Given the possibility of interaction between a range of potential receptors following a release of hydrocarbons, the receptor sensitivity has been designated as **high**. Furthermore, it is anticipated that some features, particularly on the shoreline, could exhibit **high** value as some protected sites contain habitats and species protected under the EU Habitats Directive therefore the value has been assigned as such. The worst-case release assessment determined that, although highly unlikely, a potential spill is likely to have a long-term effect on the populations of the receptors, but with eventual recovery. Therefore, vulnerability was designated as **high**. The magnitude of the release is expected to be **moderate** as, although the potential hydrocarbon release is expected to extend across a large area of UKCS and has a transboundary impact, the likelihood of the release happening is very remote and the dispersion of the release would be aided by wave action prior to reaching any particularly sensitive habitats likely to be on the coast. It is recognised that a hydrocarbon release could result in demonstrable change in receptors. However, for this type of accidental event, it is especially important to assess the likelihood of the impact occurring. A release of this nature can be considered **high** consequence. However, it is also considered a very remote probability. A review of UKCS historical data relating to hydrocarbon release events confirms that the likelihood of an event like this is indeed very remote. Given the mitigation measures that are in place (Section 11.7) and the remote likelihood of the release happening, the impact is considered **not significant.**				
Consequence	**Impact Significance**			
High	Not significant			

12 ENVIRONMENTAL MANAGEMENT SYSTEM

The commitment to responsible environmental stewardship is embodied in NEO's Health, Safety, Environment and Social Responsibility (NEO-GMT-L1-PY-00002) and the Corporate Major Accident Prevention (NEO-GMT-L1-LY-00009) policies. NEO delivers the policy commitments with an integrated HSE management system systematic framework of standards, processes, and procedures. The environmental components of the management system are routinely assessed to verify that it continues to meet the requirements of the ISO 14001:2015 standard, in line with the OSPAR Recommendation 2003/5 (Promote the Use and Implementation of Environmental Management Systems by the Offshore Industry) and BEIS guidance (Gov.UK, 2013). All operations are required to adhere to the management system to ensure legal compliance, delivery of commitments, and to remain an environmentally responsible operator.

The methodology of delivery of the commitments made in the above EIA is detailed below in the management system description.

12.1 NET-ZERO EMISSIONS COMMITMENTS

NEO is committed to supporting the achievement of the Net Zero targets and the OEUK 2035 Roadmap. The scope of the NEO Low Carbon Transition Plan (LCTP) is in alignment with the NSTA (2020)

(Stewardship Expectations 11: Net Zero) and covers the organisation and assets. The work carried out by NEO focuses on climate change and emissions to atmosphere and will be reported in line with the Taskforce for Climate related Financial Disclosure (TCFD, 2022) for the financial year 2020/2021. The scope of the LCTP also covers the Joint Venture portfolio as well as the operated assets and reflects the level of ambition of NEO to influence decarbonization of the industry.

The commitments and plans within the LCTP are delivered through the management system as described below.

12.2 LEADERSHIP

NEO has a company structure with defined roles and responsibilities (Figure 12-1 and Figure 12-2) within which the environmental accountabilities and responsibilities are embedded. The Board of Directors also governs environmental management through a dedicated Environmental, Social and Governance Committee. The CEO is accountable for ensuring policies are set, and that the management system is implemented and resourced appropriately. Responsibility for implementation, maintenance and improvement sits with the executive leadership in NEO. The NEO Energy Board, CEO and Executive Leadership Team ensure the availability of resources to establish, implement, maintain and improve the EMS. These resources may include financial, human, specialised skills, and commitments from personnel.

The functional managers have the responsibility to ensure that the environmental requirements and commitments are disseminated and embedded within their operational activity areas. In this way Environmental focus is held across the NEO organisation in all enabling and supporting functions, with a reporting line direct from the HSE Function into both the CEO and the COO, bringing a level of independence to the performance management, conformance, and compliance. Supporting Functions consider HSE in their activities and ensure the HSE Function is supported in implementation of environmental aspects throughout the business.

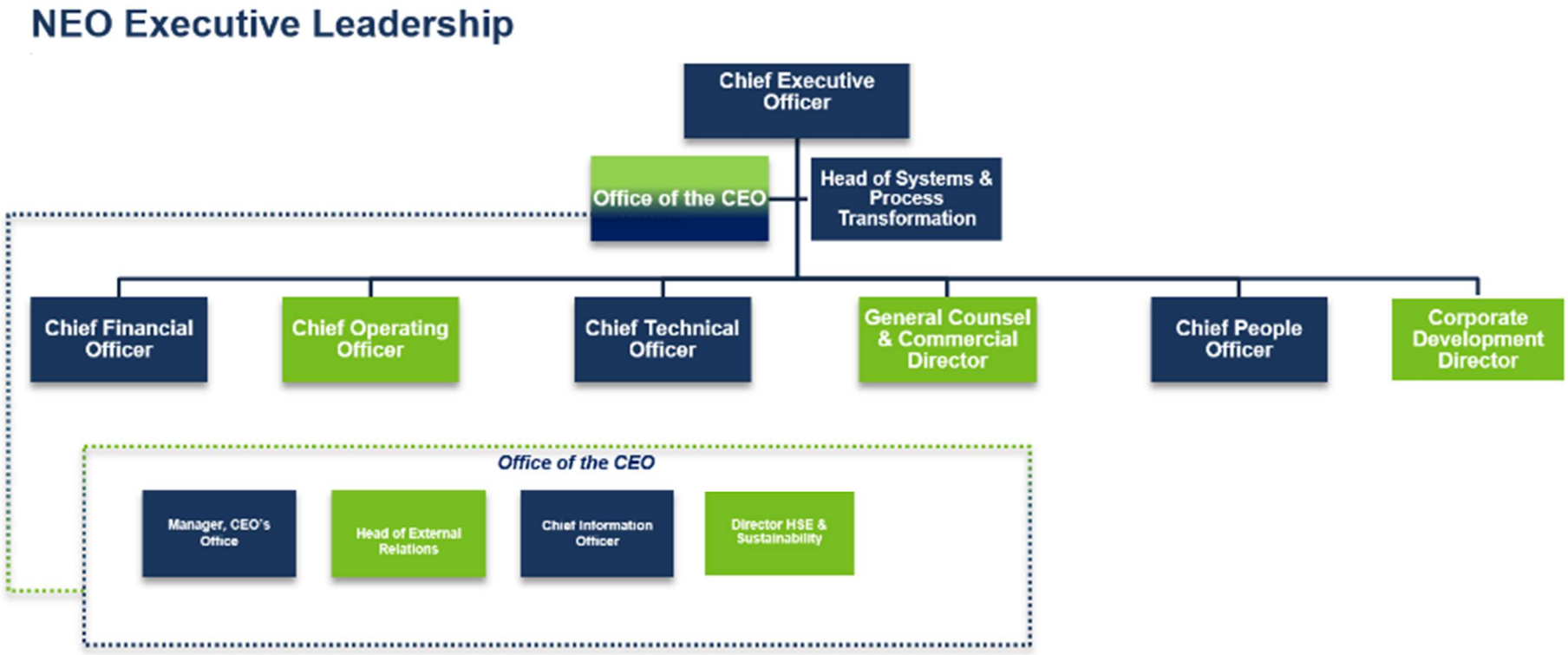

Figure 12-1 NEO Energy Executive Leadership Team

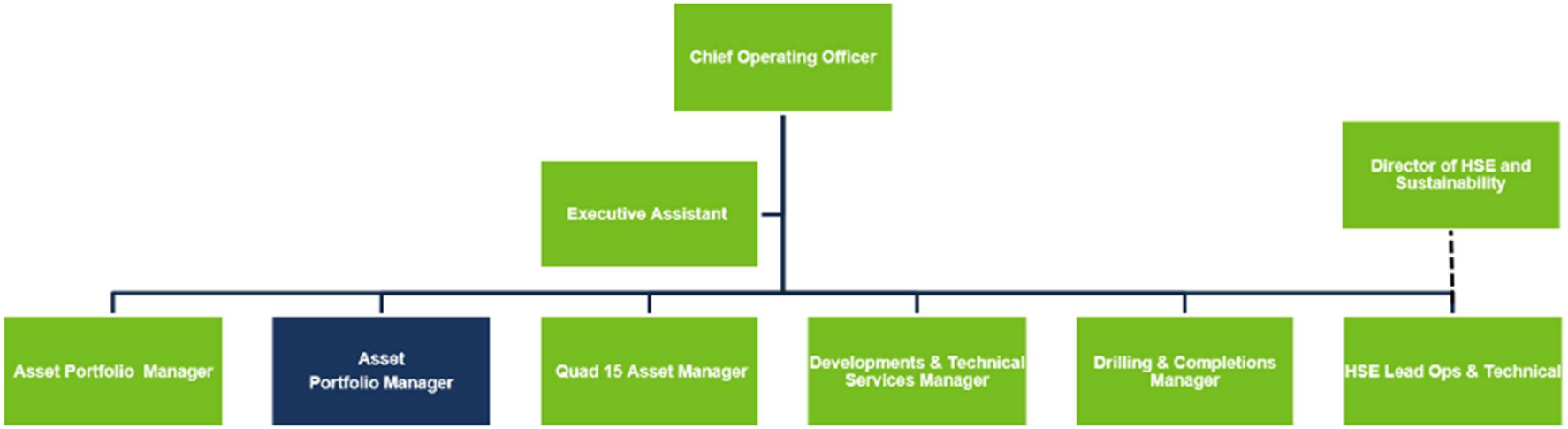

Figure 12-2 NEO Energy Operations & Technical Leadership Team

12.3 MANAGEMENT SYSTEMS

NEOs management system sets out requirements for operations to follow, including risk, audit and assurance, crisis and emergency response, performance and reporting, training and competence and management of change. Policies, objectives and targets, standards, and processes to be followed are cascaded through the business within the annual planning cycle and HSE plans specific to the activities. The NSTA Net Zero Stewardship Expectations are embedded throughout the NEO management system as appropriate for optimal effect. The NEO business management framework in which all the functions in the oil and gas value chain from exploration to decommissioning including the development projects operate, is outlined in Figure 12-3.

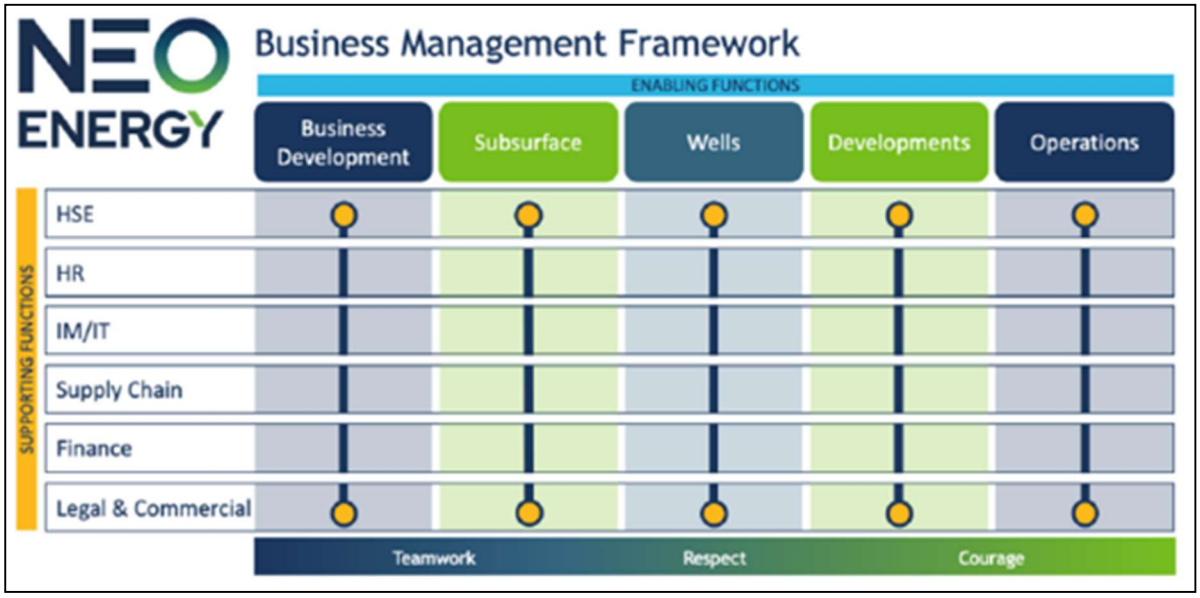

Figure 12-3 The NEO Energy Business management system framework

NEO's integrated HSE management system has common core management processes e.g., of risk management, contractor management, assurance, and document control. The environmental management approach NEO takes across its portfolio is set out in the Environmental Management Standard (NEO-HSE-L2-ST-00011) standard to ensure consistent application across the Company and supports each asset and function to meet their compliance requirements. Within NEO, the EMS encompasses Environmental, Social and Governance (ESG).

Environmental management in NEO follows the **Plan, Do, Check and Act** cycle which is embedded throughout the business.

12.4 PLAN

A stage-gate planning system is in place to facilitate the design and planning of Development projects. NEO has placed a commitment on the project teams to consider a Net Zero performance report as part of the Development select process stage gate. This requirement ensures that the project team specifically includes carbon as a differentiator between options together with the technical/HSE and economic considerations and is also in line with the NSTA FDP process (Oil and Gas Authority, 2018).

All environmental objectives and targets are included in the project specific HSE plans which are cascaded to the team and 3rd party contractors. As part of the planning process NEO identifies, assesses, and plans for the minimisation and management of all environmental aspects and impacts including GHG emissions. Environmental impacts and risks from operations have been identified in planning with the results of this assessment presented in this environmental statement report. The

mitigations to manage those risks and impacts presented in this document, will be tracked to delivery by the project team as per the schedule for the development. A permits, licences, consents, and notifications tracker is currently in place for the Development, and this will be extended as the Development develops to installation and beyond into operation.

Figure 12-4 The NEO Energy culture and basis of the management system

12.5 DO

It is essential that all personnel understand their role in delivering the commitments in this ES, maintain legal compliance and to minimise potential impacts on the environment. Accordingly, specific training is provided for personnel whose work has the potential to result in environmental impact, and/or realisation of the objectives and targets, and in ensuring legal compliance. In addition, specific roles and responsibilities to deliver the project legal and EMS compliance commitments are outlined in the business management system for the stage of the project. This definition supports the project personnel to understand their individual accountabilities and responsibilities to deliver the mitigations detailed in this document.

Good environmental management requires clear communications externally with stakeholders, internally within the project team and with 3rd party contractors, such as for installation of subsea infrastructure. NEO has established processes and procedures for a variety of communication routes to enable the commitments in this ES. and legal compliance requirements to be cascaded to ensure delivery.

Routine review is carried out by the project team on the project risks and legal compliance status throughout the installation and commissioning phase of the Development. To ensure maintenance of focus on the environmental commitments, the tracker collated at the planning stage is reviewed on a regular basis by the project team until the Development is completed. Once the project has handed the installed and commissioned project to the operating asset, any long-term commitments will be retained and managed through the asset aspects and impacts register. The asset will also review the operational risks and legal compliance requirements on a regular basis through the life of field.

NEO is ultimately accountable and responsible for the environmental management of all its operations and activities associated with their assets. Where execution and management of associated activities is contracted to third parties, the responsibility for environmental management is embedded in the contractual agreement and will be included within interface documents where appropriate. Commitments made in this ES are cascaded to the 3rd Party as required to ensure delivery. Selection and management of contractors that will be engaged by NEO will be carried out in line with standard UK industry contractor management processes and best practice, and is detailed in the NEO supply chain process.

NEO also recognises its position of influence as the purchaser of services to drive good environmental stewardship including decarbonisation and to support the delivery of the UK Net Zero emissions targets. Net Zero requirements are therefore being introduced into the supply chain with consideration and commitment to climate and wider ESG. Questions relating to emission reduction opportunities have been incorporated into NEO's tendering process. Examples include but are not limited to the vessel selection process.

12.6 CHECK

Several assurance activities will be carried out by NEO to ensure the environmental requirements including commitments in this document are communicated and delivered. There are assurance points at each stage in the project gated process in which due diligence is carried out covering both the legal and corporate requirements. Areas of assurance range from interface documentation and contractor procedure review to vessel and site inspections. All assurance activities will have a focus on legal compliance as appropriate to the work scope. Performance will be monitored, measured and reported as per legal and NEO's requirements. The process for ensuring compliance with the legal and other requirements made in this statement will be assured by the project team.

Appropriate assurance activities will be carried out throughout any 3rd party contracted activities as appropriate to the stage of the contract and the scope of the activities. Contract performance reviews will form part of the supply chain management process as will routine operational HSE performance reporting and meetings. Both leading (observations, awareness and training) and lagging (incidents and near-misses) will be reviewed at these meetings with the contractors. The reporting requirements will be identified to any 3rd party within the interface document. Assurance activities will be carried out before, during and after the activities to ensure that the reporting requirements are embedded in the operations teams and delivered as per legal requirements.

NEO will also carry out assurance activities on the emissions management on Judy to ensure that the emissions reduction is delivered through the life of the Affleck field. NEO will also engage with the HE Energy Transition JV forum. Performance relating to the Affleck field will also be measured via incident recording and investigation for non-compliances and reporting of emissions, discharges and wastes as per legal and NEO's requirements.

12.7 ACT

Learnings will be collated and reviewed throughout the development project and the management of the asset during operations and decommissioning as per the NEO management system requirements. At execute when the activities are underway there will be three types of non-compliances that will be monitored:

- Compliance with the legal requirements;
- NEO Policy Statements; and
- Approved processes as specified in system and operational procedures.

Processes by which non-compliances are identified include the assurance activities in the 'Check' section of the management system. The non-compliance incidents are reported within the business on a daily, weekly, monthly, and annual basis depending on the operational focus and the severity or potential severity of the incidents. All nonconformances are investigated and the root causes, corrective actions undertaken, and lessons learnt are communicated to the operations as applicable. The frequency and category of non-conformances is reviewed for trends and with the efficacy of corrective actions is reviewed during the annual EMS Management Review.

13 CONCLUSIONS

13.1 NATIONAL MARINE PLANS

The Development EIA has considered the objective and marine planning policies of Scotland's National Marine Plan across the range of policy topics including natural heritage, air quality, cumulative impacts and oil and gas. The EIA has also considered England's North East Offshore Marine Plan which aims to enhance and protect the marine environment and achieve sustainable economic growth, whilst respecting local communities both within and adjacent to the marine plan areas. NEO considers that the Development is in broad alignment with such objectives and policies. The extent to which the Development is aligned with the oil and gas objectives and policies relevant to the Development is summarised in Sections 1.5.4 and 1.5.5

13.2 PROTECTED SPECIES AND SITES

The majority of species protected under Annex I of the Birds Directive that are present within the North Sea will generally be found much closer to shore and only a small proportion of the seabird populations may interact with the Development during the drilling, installation, operation and decommissioning phases.

The Affleck pipeline and umbilical are partially located within the Fulmar MCZ. No other protected sites are located within 50 km of the Development. The Fulmar MCZ is designated for subtidal sand, subtidal mud, subtidal mixed sediments, and ocean quahog (JNCC, 2018a). The seabed within the MCZ is considered to provide important resources to marine fauna, such as food, spawning and shelter. Three sampling stations of the Affleck pipeline route survey and eight sampling stations of the Talbot route survey, relevant to the section of the Affleck umbilical between Talbot and Just, were located within the Fulmar MCZ. Ocean quahog were present at 0 – 6% of seabed images in the Affleck pipeline route survey and three juveniles were identified in the macrofaunal analysis at one of the three stations. Ocean quahog were recorded at one of the two camera stations in the Talbot route survey and were identified in four of the six grab samples (Gardline, 2019c, Gardline, 2021b). Ocean quahog siphons were recorded at seven sampling locations in the Talbot survey area and dead shells were also recorded across almost all stations. The presence of ocean quahog could not be confirmed.

Seabed imagery recorded three small pencil burrows and a single seapen at one station. The burrows were not considered to be consistent with, or in sufficient density to be, the OSPAR (2009) threatened and/or declining habitat, seapen and burrowing megafauna communities (Gardline, 2021b). Faunal burrows were observed across almost all sampling locations in the Talbot survey, although no seapens were observed. An assessment for the presence of the OSPAR (2008) declining and/or threatened habitat, 'seapen and burrowing megafauna communities' concluded that the density of burrows observed in the seabed images was 'rare', and in conjunction with the absence of any visible burrowing megafauna, the burrows were not considered to resemble the seapen and burrowing megafauna community habitat (Gardline 2019b).

Horse mussels were recorded across all camera and video sampling locations in the Talbot survey area. An assessment for the potential for the horse mussels recorded in the seabed images and video footage to be biogenic reefs, an Annex I of the Habitats Directive (1992) and an OSPAR (2008) threatened and/or declining habitat was undertaken. Areas of *M. modiolus* across 11 sampling locations

were considered with medium confidence to likely form Annex I reef habitat. However, the assessment also notes that this conclusion should be treated with caution. Porifera were observed across all stations in the Talbot survey except two, and therefore, an assessment of the resemblance of the Porifera to be the OSPAR (2008) threatened and/or declining habitat 'deep-sea sponge aggregations' was made. The coverage of Porifera across all stations and transects was <0.01% of the seabed, which was considered to be rare.

The seabed type within the Development area is mostly classified under the habitat complex 'deep circalittoral sand', EUNIS habitat code A5.27, with a small area to the southwest of the pipeline classified as 'deep circalittoral coarse sediment', EUNIS habitat code A5.15. EUNIS habitats A5.27 and A5.15 are associated with the UKBAP habitat 'Subtidal sands and gravels' as well as the PMF 'Offshore subtidal sands and gravels' and EUNIS habitat A5.27 may occur within Annex I sandbanks, although the presence of EUNIS habitat A5.27 does not always mean that Annex I sandbanks are present (JNCC, 2018a).

There are spawning or nursery grounds in the vicinity of the Development for several fish species, a number of which are listed as PMF in Scottish waters: anglerfish, blue whiting, cod (also listed on the OSPAR List of Threatened and/or Declining Species and Habitats), herring, ling, mackerel, Norway pout, sandeels, and whiting. Blue whiting, cod, haddock, herring, lemon sole, plaice, spotted ray, sprat, spurdog and whiting are on the International Union for Conservation of Nature (IUCN) Red List. All species are listed as 'Least Concern' with the exception of cod, haddock and spurdog which are listed as globally vulnerable (IUCN, 2021). Herring, cod, whiting, European hake, blue whiting, ling and mackerel are also on the UK BAP Priority species list and listed on the Scottish Biodiversity List.

The presence within the Development area of species protected under Annex II of the Habitats Directive is limited to marine mammals. The species that are most likely to occur in the Development area include harbour porpoise (protected under Annex II), bottlenose dolphin, white-beaked dolphin, minke whale, fin whale, Atlantic white-sided dolphin, short-beaked common dolphin, Risso's dolphin, killer whale, long-finned pilot whale and sperm whale. Harbour porpoise is the most abundant cetacean species in the Development area, followed by minke whale. Harbour porpoise, white-sided dolphin, white-beaked dolphin, minke whale are listed as PMFs in Scottish waters. Minke whale, Atlantic white-side dolphin and white-beaked dolphin are also listed on the Scottish Biodiversity List and UK BAP Priority marine species list. Harbour porpoise is also on the UK BAP priority marine species list.

NEO has assessed whether the noise emitting activities associated with the Development have the potential to result in injury or disturbance to any species. The impact assessment concluded that negligible injury impacts on marine mammals following the implementation of proposed mitigation measures. Residual impacts to marine mammals are therefore limited to behavioural effects, in which the assessment determined that the likelihood of behavioural change is <0.001% for all species present. There is a very low likelihood of injury or non-trivial disturbance to marine mammals occurring as a result of the activities associated with the planned activities. NEO considers that the proposed activities including piling, will not have any significant adverse impacts on the environment. Mortal injury impacts to fish will be limited to within 5 m of the sound source, whilst recoverable injury or TTS would be limited to 10 m. It is expected that fish will move out of this nearfield impact range of the mobile seismic equipment upon its approach, thus reducing the likelihood of an injury impact. In addition, behavioural effects would be negligible against background variation in fish distributions and do not form a pathway for possible population-level effects on any fish species.

There are a number of offshore and coastal conservation areas on the UK mainland that have been designated under the Habitats Directive as SACs, under the EU Birds Directive as SPAs and under the Marine and Coastal Access Act 2009 as NCMPAs and MCZs. The potential for significant impacts on any such sites has been considered within each impact assessment, with particular focus given to the potential for an accidental hydrocarbon release to interact with such sites. Despite the proximity of the Development and the proposed activities at Affleck to designated conservation areas, with the mitigation and management measures in place it has been assessed that the Development is considered unlikely to affect the conservation objectives or site integrity of any SAC, SPA and MCZ and neither is there a

significant risk to the conservation objectives of any NCMPAs. Considering all of the above, no significant impacts are expected upon protected species and habitats. As such, there is considered to be no LSE on SACs, SPAs, NCMPAs and MCZs; hence no impact on any conservation objectives or site integrity.

13.3 CUMULATIVE AND TRANSBOUNDARY IMPACTS

A review of each of the potentially significant environmental impacts associated with the Development and the mitigation measures proposed against the range of other activities in the region (detailed in Chapters 6 to 11) indicates that no significant cumulative impacts are expected.

A review of each of the potentially significant environmental impacts associated with the planned activities of the Development and the mitigation measures proposed indicates that no significant transboundary impacts are expected.

With respect to the risk from accidental events, hydrocarbon release modelling undertaken for the worst-case scenario of a well blowout indicates a 100% probability of hydrocarbons crossing a median line (UK/Norway), with the potential to reach Norwegian, Danish, Netherlands, Swedish and German waters. The Espoo Convention requires consultation of affected parties only for projects likely to have a significant adverse environmental impact across boundaries. Therefore, consultation under the Espoo Convention is likely to be required.

13.4 ENVIRONMENTAL IMPACTS

The residual environmental impacts for the Development, following application of any mitigation, is summarised below.

Discharges from the proposed Development activities may lead to potential impacts to the seabed or water column as they are likely to cause a small and temporary plume of potentially toxic levels of chemicals thereby impacting organisms, such as plankton, within the water column. Discharges will include inhibited seawater during pre-commissioning and commissioning of the pipelines and produced water and associated production chemicals during the operational phase. Very little produced water is expected during the first two years of production. Produced water from Affleck shall be treated by the existing Judy PW system where it will be discharged to sea. Any produced water discharges will be processed to achieve an average an oil-in-water concentration as low as possible with a target of <30 mg/l, within the regulatory requirements. Any produced water discharges are likely to be rapidly dispersed in the turbulent offshore environment meaning that the extent of any change is expected to be small and transient and therefore the magnitude of impact is negligible.

The seabed surrounding the Development is typical of this region of the CNS and predominantly consists of sands and muds. The Development activities will lead to a loss of seabed habitats and species within the immediate footprint of seabed infrastructure, including pipelines, EHC umbilical, tie-in structure, tie-in spools, subsea manifold and stabilization/protection material. The direct footprint of the infrastructure has been estimated as 0.26 km2. The temporary indirect impact associated with sediment suspension generated by installation activities will affect twice the area: 0.52 km^2. Within the direct footprint of impact, 0.058 km^2 of habitat will be lost due to the placement of stabilisation materials, the majority of which will be rock placement.

As described in Section 4.3.2, six ocean quahog were observed across five stations during the Affleck pipeline survey, as well as a single pair of siphons at one sampling location and dead and broken shells of this species throughout the survey area. Three juvenile ocean quahog were recorded across the survey area, all at a single station (AFF-11). The seabed imagery recorded three small pencil burrows and a single seapen at one station. The burrows were not considered to be consistent with, or in sufficient density to be, the OSPAR (2009) threatened and/or declining habitat, seapen and burrowing megafauna communities. The seabed type within the Development area is mostly classified under the habitat complex ‘deep circalittoral sand’, EUNIS habitat code A5.27, with a small area to the southwest

of the pipeline classified as 'deep circalittoral coarse sediment', EUNIS habitat code A5.15. EUNIS habitat A5.27 is described by the European Environment Agency (2021) as 'offshore (deep) circalittoral habitats with fine sands or non-cohesive muddy sands'. EUNIS habitat A5.15 is described as 'offshore (deep) circalittoral habitats with coarse sands and gravel or shell'. EUNIS habitats A5.27 and A5.15 are associated with the UK Biodiversity Action Plan (UKBAP) habitat 'Subtidal sands and gravels' as well as the Priority Marine Feature (PMF) 'Offshore subtidal sands and gravels' and EUNIS habitat A5.27 may occur within Annex I sandbanks, although the presence of EUNIS habitat A5.27 does not always mean that Annex I sandbanks are present. Nonetheless, due to the small footprint of the Development, the long-term function of the ocean A. islandica population and 'seapens and burrowing megafauna communities' that may be present at Development area are not expected to be affected. The seabed impacts are assessed as minor and not significant.

The Development activities will generate underwater noise which may impact hearing sensitive animals. The activity identified as potential to cause significant effects to marine mammals from underwater noise emissions is from the proposed piling of the new subsea manifold. An underwater noise modelling study was conducted to estimate the maximum theoretical distances from the noise sources at which animals may experience disturbance or injury and assess potential impacts. As there is expected to be no change at the population level for all cetacean receptor groups, any impacts are unlikely to affect long-term function or status of any populations. The consequence of underwater noise impacts is considered to be negligible and impacts from underwater noise generated by the Development survey activities are considered not significant.

The Development area is considered to have low to moderate commercial fishing intensity, primarily targeted for demersal fish. Shipping density at the proposed Development Area (Blocks 30/12, 30/13, 30/14 and 30/19) is very low compared to the rest of the UK, with cargo ships and tankers as the most dominant vessel type in the Development area. The Development infrastructure will be located in Block 30/19. Communication and notification procedures will be in place to ensure that all vessels operating in the area are aware of activities and project-associated vessels. A 500 m safety exclusion zone will be in place and is intended to minimise the potential for vessel collision. This safety zone will be implemented when the DSV comes onto location, be maintained during the activities and will be maintained around the wellhead upon completion of operations. Given the spatial and temporal constraints of the exclusion zone, and the area usage by other sea users (including commercial fisheries), no significant impacts to other sea users are anticipated from temporary or permanent exclusion. The location of subsea infrastructure and vessel operations will be communicated to other sea users via standard communication channels. With regards to dropped objects, the mitigation measures will ensure the potential for such occurrences will be minimised and dealt with appropriately. Overall, risk of snagging is expected to be minimal. No prolonged effects on commercial fisheries and shipping are anticipated. The consequence of impacts on other sea users is therefore low and is not significant.

Atmospheric emissions from the Development will be related arise during all phases of the lifecycle, from fabrication (of the new infrastructure to be installed), installation and commissioning, operation (power generation, flaring, venting and potentially fugitives) and decommissioning. It is anticipated that the emissions will be extremely small scale, contributing to less than 3% (Judy, Talbot and Affleck) of the average offshore CO_2e emissions in the CNS from the last 4 years. The developments contribution to global warming will be negligible or minor in relation to those from the wider offshore industry and outputs at a national or international level. On this basis, the consequence of atmospheric emissions impacts is negligible and the impact not significant.

Although the probability of catastrophic releases from the Development is remote, even with comprehensive prevention measures in place, the residual risk of accidental release, and thus impact on the marine environment, remains. All activities will be covered by appropriate OPEPs and SOPEPs which will set out the responses required and the available resources for dealing with spills of all sizes. Worst-case accidental releases from a well blowout and loss of drill rig inventory were modelled for this EIA. The MEI assessment determined that such accidental spills would be likely to have a long-term effect on the populations of the receptors but would eventually recover. The modelling showed that a

worst-case accidental hydrocarbon release from a well blowout could extend across a large area of the UKCS and have a transboundary impact. However, the likelihood of such releases happening is remote. Given the mitigation measures that are in place and the remote likelihood of the release happening, the consequence is considered low and the impact is considered not significant.

The majority of environmental impacts arising from the Development will be temporary. There will be a small permanent impact on seabed habitats and fauna due to the presence of subsea infrastructure. As only short sections of pipeline and umbilical will be located within the site (4 km and 7 km respectively), relatively small volumes of rock placement associated with the trench transitions within the MCZ and the assessed low value of the Development area in terms of seabed sensitivity, no significant impacts are anticipated due to the long-term presence of seabed infrastructures.

NEOs EMS will ensure that all the measures described herein to minimise and mitigate against environmental impact will be delivered by the Development.

Overall, it is concluded that the Development will not result in any significant impacts.

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APPENDIX A ALIGNMENT BETWEEN THE DEVELOPMENT AND RELEVANT MARINE PLANS

Table A-1 Alignment between the Development and the sea fisheries objectives and policies of the Scottish National Marine Plan

Objective/ policy	Development details
General Policies	
GEN 1: There is a presumption in favour of sustainable development and use of the marine environment when consistent with the policies and objectives of this Plan.	The Development and this ES has been developed with consideration of the policies and objectives within the Scottish National Marine Plan.
GEN 2: Sustainable development and use which provides economic benefit to Scottish communities is encouraged when consistent with the objectives and policies of this Plan.	The Development and this ES has been developed with consideration of the policies and objectives within the Scottish National Marine Plan. Local employment opportunities will be provided by the Development. In addition, the Development provides new pipeline infrastructure that may facilitate future developments in the area, i.e. there is also potential longer term social and economic benefit.
GEN 3: Sustainable development and use which provides social benefits is encouraged when consistent with the objectives and policies of this Plan.	The Development and this ES has been developed with consideration of the policies and objectives within the Scottish National Marine Plan. Local employment opportunities will be provided by the Development. In addition, the Development provides new pipeline infrastructure that may facilitate future developments in the area, i.e. there is also potential longer term social and economic benefit.
GEN 4: Proposals which enable coexistence with other development sectors and activities within the Scottish marine area are encouraged in planning and decision making processes, when consistent with policies and objectives of this Plan.	The Project will coexist with other marine developments, without long term exclusion or detriment to other developments in the Project area. This is outlined in Section 9.
GEN 5: Marine planners and decision makers must act in the way best calculated to mitigate, and adapt to, climate change.	The impact of the Development on climate change is outlined in Section 10, which concluded that the impact of the Development on global climate change was not significant. NEO is committed to supporting the achievement of the Net Zero targets and the OGUK 2035 Roadmap.

Objective/ policy	Development details
GEN 6: Development and use of the marine environment should protect and, where appropriate, enhance heritage assets in a manner proportionate to their significance.	The Project is not anticipated to impact on any marine natural heritage features. No wrecks or wreck debris were identified during the geophysical surveys in the vicinity of the Affleck pipeline or Talbot pipeline. Therefore, no loss of marine archaeological remains is expected to result from the Development.
GEN 9: Development and use of the marine environment must: (a) Comply with legal requirements for protected areas and protected species. (b) Not result in significant impact on the national status of Priority Marine Features. (c) Protect and, where appropriate, enhance the health of the marine area.	The Development is not expected to have any significant impacts on any protected sites or species, as outlined within the impact assessment chapters. Where necessary, mitigation measures have been proposed to reduce potential impacts. The Development will comply with all legal requirements for protected sites and species.
GEN 10: Opportunities to reduce the introduction of invasive non-native species to a minimum or proactively improve the practice of existing activity should be taken when decisions are being made.	There are no planned major international movement of vessels for the Development resulting in introduction of non-native species from outwith the North Sea.
GEN 11: Developers, users and those accessing the marine environment must take measures to address marine litter where appropriate. Reduction of litter must be taken into account by decision makers.	As outlined in Section 9, a dropped objects procedure will be developed and adhered to. Personnel will also be trained to minimise the potential for dropped objects.
GEN 12: 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 apply.	The potential impact from accidental spills is considered in Section 11. The assessment concluded that the impact was not significant.
GEN 13: Development and use in the marine environment should avoid significant adverse effects of man-made noise and vibration, especially on species sensitive to such effects.	The potential impact from underwater noise generated from the Development is assessed in Section 8. The assessment concluded that no significant adverse effects were expected.
GEN 14: 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.	The potential impact of the Development on air quality is considered in Section 10. No significant effects on local air quality are anticipated.
GEN 17: All marine interests will be treated with fairness and in a transparent manner when decisions are being made in the marine environment.	This ES presents an assessment of the potential impacts from the Development across a range of receptors.
GEN 18: Early and effective engagement should be undertaken with the general public and all interested stakeholders to facilitate planning and consenting processes.	NEO has engaged with statutory and non-statutory consultees and will continue to do so through the life of the Development.
GEN 19: Decision making in the marine environment will be based on sound scientific and socio–economic evidence.	This ES presents an assessment of the potential impacts from the Development across a range of receptors using scientific and socio-economic evidence.

Objective/ policy	Development details
GEN 21: Cumulative impacts affecting the ecosystem of the marine plan area should be addressed in decision making and plan implementation.	Cumulative impacts are assessed within each assessment chapter.
Oil and Gas	
Oil and Gas – Objective 1: Maximise the recovery of reserves through a focus on industry-led innovation, enhancing the skills base and supply chain growth.	New oil and gas source making use of up to date and innovative technology, providing jobs and training.
Oil and Gas – Objective 2: An industry which delivers high-level risk management across all its operations and that it is especially vigilant in more testing current and future environments.	Extensive mitigation measures and response strategies developed for identified risks.
Oil and Gas – Objective 3: Continued technical development of enhanced oil recovery and exploration, according to the principles of BAT and BEP.	Use of up to date and innovative technology in the development of a North Sea oil reserve, aligned with the principles of BAT and BEP.
Oil and Gas – Objective 4: Where possible, to work with emerging sectors to transfer the experience, skills and knowledge built up in the oil and gas industry to allow other sectors to benefit and reduce their environmental impact.	The Development will draw on experienced engineers, environmental specialists and other groups that are not necessarily limited to oil and gas experience throughout the Development life time.
Policy – OIL & GAS 1: The Scottish Government will work with BEIS, the NSTA and the industry to maximise and prolong oil and gas exploration and production whilst ensuring that the level of environmental risks associated with these activities are regulated. Activity should be carried out using the principles of BAT and BEP. Consideration will be given to key environmental risks including the impacts of releases to atmosphere, oil and chemical contamination and habitat change.	BAT has been used as a key tool in developing the Development design. The potentially significant environmental impacts from drilling, installation, flaring activities, accidental release and habitat change have been considered within the EIA.
Policy – OIL & GAS 2: 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.	NEO will review decommissioning best practice closer to the point at which the Development area will be decommissioned. Full consideration will be given to available decommissioning options, including reuse and removal. However, the design of the new installed infrastructure at Affleck will take into account considerations for its potential removal at end of field life.
Policy – OIL & GAS 4: All oil and gas platforms will be subject to 9 NM consultation zones in line with Civil Aviation Authority guidance.	NEO will engage as necessary with any relevant future developments that may be proposed within 9 NM of the Development area to ensure all helicopter flight routes remain free of obstacles.
Policy – OIL & GAS 5: Consenting and licensing authorities should have regard to the potential risks, both now and under future climates, to oil and gas operations in Scottish waters, and be satisfied that installations are appropriately sited and designed to take account of current and future conditions.	The Affleck field will be Re-developed in a way that there will not be a significant impact on the physical, biological and socio-economic environment. This demonstrates an appropriate siting within North Sea.
Policy – OIL & GAS 6: 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 NCP and the Offshore Safety Directive.	Potential environmental impacts have been reviewed as part of this EIA and relevant mitigation measures developed. The NEO

Objective/ policy	Development details
	response strategy to accidental hydrocarbon release has been developed with due reference to the NCP.
Sea Fisheries	
Sea Fisheries - Objective 2: A fishing fleet which is seen as an exemplar in global sustainable fishing practices, is confident in securing a long-term income from the available sustainable fishing opportunities across all sectors, and accounts for changes in species distribution and abundance due to climate change.	The potential impact of the Development on commercial fisheries is included in Section 9. No significant impacts are expected, and therefore, no significant adverse effects on the fishing opportunities or fish stocks are anticipated.
Policy - FISHERIES 1: Taking account of the EU's Common Fisheries Policy, Habitats Directive, Birds Directive and Marine Strategy Framework Directive, marine planners and decision makers should aim to ensure: ▪ Existing fishing opportunities and activities are safeguarded wherever possible. ▪ An ecosystem-based approach to the management of fishing which ensures sustainable and resilient fish stocks and avoids damage to fragile habitats. ▪ Protection for vulnerable stocks (in particular for juvenile and spawning stocks through continuation of sea area closures where appropriate). ▪ Improved protection of the seabed and historical and archaeological remains requiring protection through effective identification of high-risk areas and management measures to mitigate the impacts of fishing, where appropriate. ▪ That other sectors take into account the need to protect fish stocks and sustain healthy fisheries for both economic and conservation reasons. ▪ Delivery of Scotland's international commitments in fisheries, including the ban on discards. ▪ Mechanisms for managing conflicts between fishermen and/or between the fishing sector and other users of the marine environment.	The potential impact of the Development on commercial fisheries is included in Section 9. No significant impacts are expected, and therefore, no significant adverse effects on the fishing opportunities or fish stocks are anticipated. A number of mitigation measures have been proposed to ensure that the Development activities are effectively communicated with fishermen.
Policy – FISHERIES 2: The following key factors should be taken into account when deciding on uses of the marine environment and the potential impact on fishing: ▪ The cultural and economic importance of fishing, in particular to vulnerable coastal communities. ▪ The potential impact (positive and negative) of marine developments on the sustainability of fish and shellfish stocks and resultant fishing opportunities in any given area. ▪ The environmental impact on fishing grounds (such as nursery, spawning areas), commercially fished species, habitats and species more generally.	The potential impact of the Development on commercial fisheries is included in Section 9. No significant impacts are expected, and therefore, no significant adverse effects on the fishing opportunities or fish stocks are anticipated. The small-scale nature of the Development, which is within an area of existing oil and gas activity is expected to minimise any potential impacts. A number of mitigation measures have been proposed to ensure that the Development activities are effectively communicated with fishermen.

Objective/ policy	Development details
▪ The potential effect of displacement on: fish stocks; the wider environment; use of fuel; socio-economic costs to fishers and their communities and other marine users.	
Policy – FISHERIES 3: Where existing fishing opportunities or activity cannot be safeguarded, a Fisheries Management and Mitigation Strategy should be prepared by the proposer of development or use, involving full engagement with local fishing interests (and other interests as appropriate) in the development of the Strategy. All efforts should be made to agree the Strategy with those interests. Those interests should also undertake to engage with the proposer and provide transparent and accurate information and data to help complete the Strategy. The Strategy should be drawn up as part of the discharge of conditions of permissions granted. The content of the Strategy should be relevant to the particular circumstances and could include: ▪ An assessment of the potential impact of the development or use on the affected fishery or fisheries, both in socio-economic terms and in terms of environmental sustainability. ▪ A recognition that the disruption to existing fishing opportunities/activity should be minimised as far as possible. ▪ Reasonable measures to mitigate any constraints which the proposed development or use may place on existing or proposed fishing activity. ▪ Reasonable measures to mitigate any potential impacts on sustainability of fish stocks (e.g. impacts on spawning grounds or areas of fish or shellfish abundance) and any socioeconomic impacts. Where it does not prove possible to agree the Strategy with all interests, the reasons for any divergence of views between the parties should be fully explained in the Strategy and dissenting views should be given a platform within the Strategy to make their case.	Appropriate mitigation measures have been proposed in Section 9 to reduce the potential impact on commercial fisheries. NEO will continue to engage with the fishing industry to ensure appropriate mitigation measures are in place to reduce impacts as far as is practicable.
Wild Salmon and Diadromous Fish	
Policy – WILD FISH 1: The impact of development and use of the marine environment on diadromous fish species should be considered in marine planning and decision making processes. Where evidence of impacts on salmon and other diadromous species is inconclusive, mitigation should be adopted where possible and information on impacts on diadromous species from monitoring of developments should be used to inform subsequent marine decision making.	Given the Development's offshore location, no major migratory fish routes are expected to pass through the Development area.
Policy - REC & TOURISM 2: The following key factors should be taken into account when deciding on uses of the marine environment and the potential impact on recreation and tourism: ▪ The extent to which the proposal is likely to adversely affect the qualities important to recreational users, including the extent to which proposals may interfere with the physical infrastructure that underpins a recreational activity.	Given the Development's offshore location, no impacts on recreation and tourism are expected.

Objective/ policy	Development details
▪ The extent to which any proposal interferes with access to and along the shore, to the water, use of the resource for recreation or tourism purposes and existing navigational routes or navigational safety. ▪ Where significant impacts are likely, whether reasonable alternatives can be identified for the proposed activity or development. ▪ Where significant impacts are likely and there are no reasonable alternatives, whether mitigation, through recognised and effective measures, can be achieved at no significant cost to the marine recreation or tourism sector interests	
Shipping, Ports, Harbours and Ferries	
Policy – TRANSPORT 1: Navigational safety in relevant areas used by shipping now and in the future will be protected, adhering to the rights of innocent passage and freedom of navigation contained in UN Convention on the Law of the Sea (UNCLOS). The following factors will be taken into account when reaching decisions regarding development and use: ▪ The extent to which the locational decision interferes with existing or planned routes used by shipping, access to ports and harbours and navigational safety. This includes commercial anchorages and defined approaches to ports. ▪ Where interference is likely, whether reasonable alternatives can be identified. ▪ Where there are no reasonable alternatives, whether mitigation through measures adopted in accordance with the principles and procedures established by the International Maritime Organization can be achieved at no significant cost to the shipping or ports sector.	The interaction between the Development and shipping and navigation is assessed within
Defence	
Defence – Objective 1: The Royal Navy, Army and Royal Air Force use Scotland's seas for defence purposes. They require: ▪ The ability to deploy and develop a flexible and broad range of capabilities. ▪ The exclusive use of certain areas during particular times of the year. ▪ The use of exemptions in planning law for the purposes of national security. ▪ To retain the statutory right to close areas in internal waters and create bylaws for complete closures and exclusions.	There are no military restrictions within the UKCS blocks that the Development overlaps with. Therefore, no impacts on Royal Navy, Army and Royal Air Force activities are expected.
Policy – DEFENCE 1: To maintain operational effectiveness in Scottish waters used by the armed services, development and use will be managed in these areas: ▪ Naval areas including bases and ports: Safety of navigation and access to naval bases and ports will be maintained. The extent to which a development or use interferes with access or	There are no military restrictions within the UKCS blocks that the Development overlaps with. Therefore, no impacts on military activities are expected.

Objective/ policy	Development details
safety of navigation, and whether reasonable alternatives can be identified, will be taken into account by consenting bodies. Proposals for development and use should be discussed with the MOD at an early stage in the process. ▪ Firing Danger Areas: Development of new permanent infrastructure is unlikely to be compatible with the use of Firing Danger Areas by the MOD. Permitted activities may have temporal restrictions imposed. Proposals for development and use should be discussed with the MOD at an early stage in the process. ▪ Exercise Areas: Within Exercise Areas, activities may be subject to temporal restrictions. Development and use that either individually or cumulatively obstructs or otherwise prevents the defence activities supported by an exercise area may not be permitted. Proposals for development and use should be discussed with the MOD at an early stage in the process. ▪ Communications: Navigations and surveillance including radar: Development and use which causes unacceptable interference with radar and other systems necessary for national defence may be prohibited if mitigation cannot be determined. Proposals for development and use should be discussed with the MOD at an early stage in the process.	

Table A-2 Alignment between the Development and the objectives and policies of the North East Inshore and Offshore Marine Plan

Objective / Policy	Development details
NE-CO-1: Proposals that optimise the use of space and incorporate opportunities for co-existence and co-operation with existing activities will be supported. Proposals that may have significant adverse Impacts on, or displace, existing activities must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate – adverse impacts so they are no longer significant. If it is not possible to mitigate significant adverse impacts, proposals must state the case for proceeding.	Section 9 has assessed the impacts from the Physical Presence of the project on other users of the area and indicates that the Development can co-exist alongside other sea users such as shipping and navigation and fisheries.
NE-OG-1: Proposals in areas where a licence for oil and gas has been granted or formally applied for should not be authorised unless it is demonstrated that the other development or activity is compatible with the oil and gas activity.	The Development is within a mature area of oil and gas development. Given the nature of the Development it is deemed to be wholly compatible with other oil and gas activity in the area. The Development has undertaken a thorough assessment of the alternative development options and the chosen development option made use of existing infrastructure as appropriate.
NE-OG-2: Proposals within areas of geological oil and gas extraction potential demonstrating compatibility with future extraction activity will be supported.	The Development will involve the construction of new pipeline and umbilical infrastructure that could facilitate future development.
NE-PS-2: Proposals that require static sea surface infrastructure or that significantly reduce under-keel clearance which encroaches upon high density navigation routes, strategically important navigation routes, or that pose a risk to the viability of passenger services, must not be authorised unless there are exceptional circumstances.	The area of the Development is considered to have a relatively low shipping intensity (see Section 4.4.7). Potential impacts to navigation have been carried out (see Section 9) and it is considered that through employment of the proposed mitigation and management there will be no significant impact to navigation in the area.
NE_HER-1: Proposals that demonstrate they will conserve and enhance the significance of heritage assets will be supported. Where proposals may cause harm to the significance of heritage assets, proponents must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate - any harm to the significance of heritage assets.	No significant harm is expected to result from the Development on cultural heritage assets. The closest charted wreck is approximately 1.7 km from the Affleck umbilical and no archaeological features were identified during recent surveys.

Objective / Policy	Development details
If it is not possible to mitigate, then public benefits for proceeding with the proposal must outweigh the harm to the significance of heritage assets.	
NE-FISH-2: Proposals that enhance access for fishing activities should be supported. Proposals that may have significant adverse impacts on access for fishing activities must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate - adverse impacts so they are no longer significant. If it is not possible to mitigate significant adverse impacts, proposals should state the case for proceeding.	An assessment into the potential impacts to fisheries has been undertaken in Section 9. Whilst it is acknowledged that there could be some temporary access restrictions during pipeline installation, no long-term exclusion is expected. As noted in the impact assessment in Section 9, temporary exclusion is not expected to significantly impact on the fishing industry.
NE-FISH-3: Proposals that enhance essential fish habitat, including spawning, nursery and feeding grounds, and migratory routes, should be supported. Proposals that may have significant adverse impacts on essential fish habitat, including spawning, nursery and feeding grounds, and migratory routes, must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate - adverse impacts so they are no longer significant.	The potential impact on nursery and spawning areas has been considered in the seabed impacts impact assessment (See Section 7). Although the Development area is considered to be within spawning and nursery grounds for some species, as discussed in the environmental baseline (see Section 4.3.3), the only potential for impact is during the installation of the seabed infrastructure. These activities will be short-lived and cover only a small area of the available spawning habitat. The Development will not have any long term impacts.
NE-EMP-1: Proposals that result in a net increase in marine related employment will be supported, particularly where they meet one or more of the following: 1) are aligned with local skills strategies and support the skills available 2) create a diversity of opportunities 3) create employment in locations identified as the most deprived 4) implement new technologies - in, and adjacent to, the north east marine plan areas.	Local employment opportunities will be provided by the Development. In addition, the Development provides new pipeline and umbilical infrastructure that may facilitate future gas developments in the area, i.e. there is also potential longer term economic benefit.
NE-CC-1: Proposals that conserve, restore or enhance habitats that provide flood defence or carbon sequestration will be supported. Proposals that may have significant adverse impacts on habitats that provide a flood defence or carbon sequestration ecosystem service must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate	The potential impact of the Development on carbon sequestration is assessed in Section 7. There are not expected to be any impacts on flood defences given the offshore location of the Development.

Objective / Policy	Development details
- adverse impacts so they are no longer significant d) compensate for significant adverse impacts that cannot be mitigated.	
NE-CC-2: Proposals in the north east marine plan areas should demonstrate for the lifetime of the project that they are resilient to the impacts of climate change and coastal change.	The Development has been designed to be resilient to climate change. NEO has assessed the impact of the Development on climate and the UK Net Zero targets and has embedded the identification, assessment, and minimisation of GHG emissions associated with the Development.
NE-CC-3: Proposals in the north east marine plan areas, and adjacent marine plan areas, that are likely to have significant adverse impacts on coastal change, or on climate change adaptation measures inside and outside of the proposed project areas, should only be supported if they can demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate - adverse impacts so they are no longer significant.	An impact assessment for atmospheric emissions has been carried out and is presented in Section 10. This has concluded that the impact of the Development on global climate change is not significant.
NE-AIR-1: Proposals must assess their direct and indirect impacts upon local air quality and emissions of greenhouse gases. Proposals that are likely to result in increased air pollution or increased emissions of greenhouse gases must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate - air pollution and/or greenhouse gas emissions in line with current national and local air quality objectives and legal requirements.	An impact assessment for atmospheric emissions has been carried out and is presented in Section 10. This has concluded that the impact of the Development on air quality is not significant.
NE-WQ-1: Proposals that protect, enhance and restore water quality will be supported. Proposals that cause deterioration of water quality must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate - deterioration of water quality in the marine	Discharges to sea as a result of the Development are assessed in Section 6. The potential risk posed from accidental events is assessed in Section 11. No significant impacts were identified within these assessments.

Objective / Policy	Development details
environment.	
NE-MPA-1: Proposals that support the objectives of marine protected areas and the ecological coherence of the marine protected area network will be supported. Proposals that may have adverse impacts on the objectives of marine protected areas must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate - adverse impacts, with due regard given to statutory advice on an ecologically coherent network.	As part of each impact assessment the potential for impacts to Marine Protected Areas is considered. As described in the assessment chapters, interaction with protected features in some protected sites is expected. For example, there will be installation activities in the Fulmar MCZ which is designated for seabed features. Considering the scale of Development activities and the mitigation measures planned, significant impacts to the features and sites levels are not expected and therefore impacts on the overall network are not expected.
NE-MPA-2: Proposals that enhance a marine protected area's ability to adapt to climate change, enhancing the resilience of the marine protected area network, will be supported. Proposals that may have adverse impacts on an individual marine protected area's ability to adapt to the effects of climate change, and so reduce the resilience of the marine protected area network, must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate - adverse impacts.	
NE-BIO-1: Proposals that enhance the distribution of priority habitats and priority species will be supported. Proposals that may have significant adverse impacts on the distribution of priority habitats and priority species must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate - adverse impacts so they are no longer significant d) compensate for significant adverse impacts that cannot be mitigated.	The impacts on priority habitats and species have been assessed within the impact assessment chapters where relevant.
NE-BIO-2: Proposals that enhance or facilitate native species or habitat adaptation or connectivity, or native species migration, will be supported.	Where necessary, mitigation measures have been implemented to reduce the risk of adverse impacts on native species or habitat adaptation or connectivity.

Objective / Policy	Development details
Proposals that may cause significant adverse impacts on native species or habitat adaptation or connectivity, or native species migration, must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate - adverse impacts so they are no longer significant d) compensate for significant adverse impacts that cannot be mitigated.	
NE-INNS-1: Proposals that reduce the risk of introduction and/or spread of invasive non-native species should be supported. Proposals must put in place appropriate measures to avoid or minimise significant adverse impacts that would arise through the introduction and transport of invasive non-native species, particularly when: 1) moving equipment, boats or livestock (for example fish or shellfish) from one water body to another 2) introducing structures suitable for settlement of invasive non-native species, or the spread of invasive non-native species known to exist in the area.	There are no planned major international movement of vessels for the Development resulting in introduction of non-native species from outwith the North Sea.
NE-DIST-1: Proposals that may have significant adverse impacts on highly mobile species through disturbance or displacement must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate - adverse impacts so they are no longer significant.	Where necessary, mitigation measures have been implemented to protect highly mobile species from impacts associated with underwater noise, as presented in Section 8. All other impacts were scoped out of the assessment as impacts were expected to be minimal considering the short-duration of the construction period and the absence of surface infrastructure associated with the Development.
NE-UWN-2: Proposals that result in the generation of impulsive or non-impulsive noise must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate - adverse impacts on highly mobile species so they are no longer significant. If it is not possible to mitigate significant adverse impacts, proposals must state the case for proceeding.	An impact assessment for underwater noise has been carried out and is presented in Section 8.
NE-CE-1: Proposals which may have adverse cumulative effects with other existing, authorised, or reasonably foreseeable proposals must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate	As part of the Cumulative Impact Assessment for the Development presented within each impact assessment chapter, consideration has been given to all projects in the area including those already in operation and those with consent in place but not yet

Objective / Policy	Development details
- adverse cumulative and/or in-combination effects so they are no longer significant.	constructed. The Development will not result in the displacement of other existing or authorised infrastructure. The new subsea infrastructure will cross existing pipelines and cables, and the crossing points will be designed to ensure no impact on the existing pipelines.

APPENDIX B ENVIRONMENTAL ISSUES IDENTIFICATION (ENVID) MATRIX

ID	Project aspect	Project stage relevance?		Description of potential effects	Mitigation	Potentially significant in EIA terms?	Stakeholder expectation to assess in ES?	Take forward further in EIA?	Justification for Scoping Decision
	Discharges to Sea								
1	Routine chemical use and discharge to sea during pipeline and subsea structure commissioning. Once the production and pipeline systems have been demonstrated to be leak tight and all pre-commissioning / start-up checks have been successfully completed, then commissioning of the Affleck system will proceed with all water/MEG linefill from both the gas lift and production pipelines being received back at Judy.	Subsea installation	Yes	Chemicals discharged to sea may cause contamination of seawater and disturbance to aquatic ecosystem.	All chemicals to be used will be selected based on their technical specifications and environmental performance. Chemicals with sub warnings will be avoided where technically possible. All chemicals to be used will be selected following NEO's chemical management and selection policy.	No	Yes	**Scoped In**	Stakeholders would expect an assessment of the potential impacts of routine chemical discharges on the seabed and water column. Given that installation activities will be taking place within the Fulmar MCZ (protected for ocean quahog) this deserves further scrutiny in an ES.
		Topsides modifications	No						
		Operations	No						
		Decommissioning	No						
2	Routine chemical use and discharge during operation (e.g., subsea valves, leak detection dyes) and any incremental use and discharge (e.g., deck cleaning, deck drainage run-off).	Subsea installation	No	Chemicals discharged to sea may cause contamination of seawater and disturbance to aquatic ecosystem.	Selection of chemicals with less potential for environmental impact. Environmental risk assessment through the MATs/SATs system (OCR).	No	No	Scoped Out	Volumes that will be discharged will be incremental, small and limited in nature and extent, which will be assessed in environmental risk assessments through the MATs/SATs system.
		Topsides modifications	No						
		Operations	Yes						

ID	Project aspect	Project stage relevance?		Description of potential effects	Mitigation	Potentially significant in EIA terms?	Stakeholder expectation to assess in ES?	Take forward further in EIA?	Justification for Scoping Decision
		Decommissioning	No						
3	Routine discharge of ballast water and removal/fall-off of fouling growth from vessels.	Subsea installation	Yes	Ballast water and marine growth on ships coming into the Project area may contain non-native organisms. Some species may survive and establish themselves. Non-native species may cause serious ecological impacts, particularly if they become invasive.	IMO Ballast Water Management Convention, including Ballast water plan and log book (all). Fouling procedures for vessels under hire (all). It is not expected that any of the vessels will come from outside of UK waters.	No	No	Scoped Out	The Development is located within the Fulmar MCZ. Neo will discourage all vessel operators from undertaking un-necessary discharge operations during the planned works. Discharges from vessels during the installation are typically well-controlled activities that are managed on an ongoing basis as per the International Maritime Organisation (IMO) standards. The duration of the installation campaign is relatively short-term.
		Topsides modifications	Yes						
		Operations	Yes						
		Decommissioning	Yes						
4	Routine blackwater production (i.e., sewage), grey water (i.e. from showers, laundry, hand and eye wash basins and drinking fountains) and food waste (macerated) disposal (from vessels and any incremental occurrence at Judy).	Subsea installation	Yes	Additional survey inspection and maintenance vessels required only periodically. Discharge of sewage, grey water and macerated food has an associated BOD and may contribute to organic enrichment in the vicinity of the discharge possibly leading to a small increase in plankton and fish population.	Treatment to IMO standards (all).	No	No	Scoped Out	Implementation of IMO Standards.
		Topsides modifications	Yes						
		Operations	Yes						

ID	Project aspect	Project stage relevance?		Description of potential effects	Mitigation	Potentially significant in EIA terms?	Stakeholder expectation to assess in ES?	Take forward further in EIA?	Justification for Scoping Decision
		Decommissioning	Yes						
5	Produced water from Affleck will be treated by the existing Judy facilities prior to disposal overboard. Additional Affleck produced water design rate of 7000 barrels water per day. Produced water will be filtered to less than 30mg/l oil content prior to discharge.	Subsea installation	No	Oil, dissolved metals, dissolved organics and chemicals released to sea in produced water may cause detrimental impacts on local water quality and marine flora and fauna. Potential for oily sheens to appear and possible seabird contamination.	Within existing consent limits.	Unsure	Yes	Scoped In	Stakeholders would expect an assessment of the potential impacts of increased discharge of produced water.
		Topsides modifications	No						
		Operations	Yes						
		Decommissioning	No						
	Physical Presence								
6	Seabed disturbance. Installation of infrastructure on the seabed.	Subsea installation	Yes	Installation of a new 21 km 8"/12" PiP (Pipe in Pipe) multiphase pipeline and an EHC umbilical will be laid between the existing Affleck manifold and a new tie in structure will be connected to the Talbot DC1 Manifold The Affleck PiP pipeline and umbilical are to be trenched and backfilled within the same trench. Protection material is anticipated to include rock cover (37.326 tonnes) concrete mattresses and grout bags. Concrete mattresses will be used to facilitate crossings with	The number and locations of concrete mattresses will be refined during detailed design to reduce the footprint on the seabed to the extent practicable. The pipelines and umbilical shall be trenched and buried over the majority of their lengths with protection mattresses only being used where necessary. Rock dump will be limited to as low a volume as reasonably practicable. Environmental survey data	Yes	Yes	Scoped In	Potentially significant in terms of location within Fulmar MCZ. Stakeholders would also expect an assessment of the impacts on other users to be included in the ES.
		Topsides modifications	No						
		Operations	Yes						
		Decommissioning	Yes						

ID	Project aspect	Project stage relevance?		Description of potential effects	Mitigation	Potentially significant in EIA terms?	Stakeholder expectation to assess in ES?	Take forward further in EIA?	Justification for Scoping Decision
				rock dump protection as required. Rock dump requirements along the route have been estimated for UHB mitigation, crossings and trench transitions. Seabed preparation procedures; geotechnical/geophysical survey plus prelay surveys will be conducted to confirm no obstructions prior to installation operations. Direct damage to benthic habitats and fauna, particularly of interest are those protected by the Fulmar MCZ, notable the ocean quahog which is an OSPAR threatened and/or declining species. Increased turbidity of water column and wider smothering may be caused by any resultant sediment plumes.	will be used to inform the placement of concrete mattresses/grout bags. Guidance and best practice at time of decommissioning will be followed.				
7	Physical presence of the subsea infrastructure, including deposited material - exclusion/obstruction for the life of the development.	Subsea installation	Yes	Long term potential obstruction or exclusion from area by structures laid/fixed on seabed, i.e. pipelines and umbilical and tie in structure. 500 m safety zones will remain in place around the Affleck wells. The new structures may provide a hard substrate in soft sediment environment affecting benthic communities. Of particular interest are those within the Fulmar MCZ.	Environmental survey data will inform baseline. UKHO standard communication channels including Kingfisher, Notice to Mariners and radio navigation warnings (all) Consultation will be undertaken with relevant authorities and organisations (all) Development and implementation of a fishery liaison strategy (all) Regular maintenance and pipeline route inspection surveys. Fishing friendly structures will be installed.	Yes	Yes	Scoped In	Potentially significant in terms of location within Fulmar MCZ. Area targeted primarily for demersal fish species. Stakeholders would also expect an assessment of the impacts on other users to be included in the ES.
		Topsides modifications	No						
		Operations	Yes						
		Decommissioning	Yes						

ID	Project aspect	Project stage relevance?		Description of potential effects	Mitigation	Potentially significant in EIA terms?	Stakeholder expectation to assess in ES?	Take forward further in EIA?	Justification for Scoping Decision
					Guidance and best practice at time of decommissioning will be followed.				
8	Temporary physical presence of vessels.	Subsea installation	Yes	Vessels will include supply vessel, standby vessel, survey vessels, pipelay/ umbilical lay vessel, trenching vessel, dive support vessel, other support vessels and helicopters etc including during installation and survey activities. Short term potential obstruction or exclusion from vessel use may impede commercial fishing activities and other sea users. 500 m safety zones will remain in place around the Affleck wells.	As above (all) The number of vessels and length of time they are required on site will be reduced as far as practicable through careful planning of operations (all) Regular maintenance and pipeline route inspection surveys. Guidance and best practice at time of decommissioning will be followed.	Yes	Yes	Scoped In	Stakeholders would expect an assessment of the impacts on other users to be included in the ES.
		Topsides modifications	Yes						
		Operations	Yes						
		Decommissioning	Yes						
9	Light from installation and vessel activities.	Subsea installation	Yes	Disturbances to the seabird communities, particularly migrating species. No additional lighting at the Judy platform.	Lighting directed below the horizontal plane unless required for technical or safety reasons (all). Guidance and best practice at time of decommissioning will be followed.	No	No	Scoped Out	Not considered to be a major issue for the Project (a few vessels present on site for short duration) nor industry.
		Topsides modifications	No						
		Operations	Yes						
		Decommissioning	Yes						
10	Physical interaction between vessels and wildlife	Subsea installation	Yes	Presence could lead to exclusion of marine species from an area, or to collision between vessel and animals	Guidance and best practice for lifetime and at time of decommissioning will be followed.	No	No	Scoped Out	Not considered to be a major issue for the Project (a few vessels present on site for short duration) nor industry.
		Topsides modifications	Yes						
		Operations	Yes						
		Decommissioning	Yes						
11	Impact on seascape	Subsea installation	Yes	Presence of vessels or new surface infrastructure which could potentially affect visual amenity.	Guidance and best practice for lifetime and at time of decommissioning will be followed.	No	No	Scoped Out	There is no surface infrastructure and the limited vessel presence will be sufficiently offshore not to affect visual amenity.
		Topsides modifications	Yes						
		Operations	Yes						

ID	Project aspect	Project stage relevance?		Description of potential effects	Mitigation	Potentially significant in EIA terms?	Stakeholder expectation to assess in ES?	Take forward further in EIA?	Justification for Scoping Decision
		Decommissioning	Yes						
	Atmospheric Emissions								
12	Vessel use of diesel for transit and working.	Subsea installation	Yes	Vessels will include supply vessel, standby vessel, survey vessels, pipelay/ umbilical lay vessel, trenching vessel, dive support vessel, other support vessels and helicopters etc including during installation and survey activities. Emissions of CO2, CH4, CO, VOCs, SOx, NOx and particles of carbon (soot) may contribute to global warming, acid precipitation, ozone depletion and deterioration of local air quality. Possible transboundary issues.	Low sulphur diesel (all) Sulphur content in bunkered fuels must be ≤ 0.10%. Vessel audits (all) Implement Slow Steaming with speed reduction of 20% during transit operations (all). Guidance and best practice at time of decommissioning will be followed.	Yes	Yes	**Scoped In**	Stakeholder expectation that this would be considered in the ES.
		Topsides modifications	Yes						
		Operations	Yes						
		Decommissioning	Yes						
13	Minimal increased fuel usage as a result of the new well coming online at the Judy platform. The existing installed power generation on the Judy platform will be sufficient to produce the Affleck field.	Subsea installation	No	Emissions of CO2, CH4, CO, VOCs, SOx, NOx and particles of carbon (soot) may contribute to global warming, acid precipitation, ozone depletion and deterioration of local air quality. Possible transboundary issues.	Demonstration of BAT/energy optimisation.	No	Yes	**Scoped In**	Small increase, not likely to be significant in terms of EIA. However, Stakeholder expectation that this would be considered in the ES.
		Topsides modifications	No						
		Operations	Yes						
		Decommissioning	No						
14	Increase in operational flaring of excess hydrocarbons (e.g. for pressure relief and gas disposal/testing) at Judy.	Subsea installation	No	Emissions of CO2, CH4, CO, VOCs, SOx, NOx and particles of carbon (soot) may contribute to global warming, acid precipitation, ozone depletion and deterioration of local air quality. Dense particles may contaminate seawater. Possible transboundary issues. Increase in flaring expected from operating the Affleck wells.	Flare Consent Demonstration of BAT Length of flaring will be limited as far as is practicable.	Yes	Yes	**Scoped In**	Increase potentially significant and will be assessed in EIA.
		Topsides modifications	No						
		Operations	Yes						
		Decommissioning	No						

ID	Project aspect	Project stage relevance?		Description of potential effects	Mitigation	Potentially significant in EIA terms?	Stakeholder expectation to assess in ES?	Take forward further in EIA?	Justification for Scoping Decision
15	Increase in venting rate of unburnt hydrocarbons (e.g. tank & process vents) predicted at Judy platform as a result of Affleck well production.	Subsea installation	No	Emissions of VOCs and CH4 may contribute to global warming (unburned VOCs and methane have a high global warming potential), formation of localised photochemical smog, and deterioration of local air quality.	Venting management plan Demonstration of BAT Venting operations will be limited as far as is practicable.	No	No	Scoped Out	Small increase, not likely to be significant in terms of EIA.
		Topsides modifications	No						
		Operations	Yes						
		Decommissioning	No						
	Noise								
16	Noise emissions from installation, trenching, drilling rig and vessel activities (including operations). Subsea installation and supply vessels will utilise DP. No piling operations expected. No Vertical Seismic Profiling.	Subsea installation	Yes	Disturbances to the animal communities may occur within a range of hundreds of metres. Potential disturbance to fauna (e.g. birds and cetaceans) by short range exposure (tens of metres).	Limit the duration of the noise emitting activities (all). Vessel audits (all). No explosives to be used. Environmental risk assessment through the MATs/SATs system Stakeholder consultation (all) Helicopter operations will be minimal Guidance and best practice at time of decommissioning will be followed. Adoption of JNCC measures.	No	Yes	**Scoped In**	Disturbance will be limited to a matter of days or weeks in most cases. Harbour porpoise is the most abundant cetacean species around the UKCS, and this is also true of the Affleck Development area. Peak abundance in the North Sea occurs between June and September. Other cetaceans expected to be sighted in low to moderate densities (relative to the UKCS population). Vessel activity for the installation activity is expected to be short-term. Adoption of JNCC mitigation measures will be adopted where appropriate.
		Topsides modifications	No						
		Operations	Yes						
		Decommissioning	Yes						
	Waste								
17	Routine generation and disposal of all waste streams.	Subsea installation	Yes	Disposal to land of inert waste materials.	Project waste management plan, use of licensed waste contractors/sites, waste	No	No	Scoped Out	Through the implementation of mitigation measures,
		Topsides modifications	No						

ID	Project aspect	Project stage relevance?		Description of potential effects	Mitigation	Potentially significant in EIA terms?	Stakeholder expectation to assess in ES?	Take forward further in EIA?	Justification for Scoping Decision
		Operations	Yes		transfer notes/ Garbage Record Book/ maceration of food/ Skip audit carried out by waste Contractor/ Monthly waste report. Modifications to Judy platform waste management plan (if required)				including waste management plans the impacts are not expected to be significant in terms of EIA not are they expected by stakeholders to be included in an ES.
		Decommissioning	Yes						
18	Routine generation and disposal of special/ hazardous wastes, e.g. oily rags, medical waste, solvents, batteries, computers, fluorescent tubes, oil/grease/chemical cans/drums/sacks, contaminated produced sand, contaminated cuttings, pigging waste, and halons.	Subsea installation	Yes	Disposal to land of special/ hazardous waste materials.	Project waste management plan, use of licensed waste contractors/sites, waste consignment notes Skip and ship of OBM managed through Neo EMS/existing contractors/ Monthly waste report. Modifications to Judy platform waste management plan (if required)	No	No	Scoped Out	Through the implementation of mitigation measures, including waste management plans the impacts are not expected to be significant in terms of EIA not are they expected by stakeholders to be included in an ES.
		Topsides modifications	Yes						
		Operations	Yes						
		Decommissioning	Yes						
19	Routine generation and disposal of wastes for recycling, e.g. paper, card, toner cartridges, fluorescent tubes, wood and clean metal drums.	Subsea installation	Yes	Recycling activities.	Project waste management plan, use of licensed waste contractors/sites, waste transfer notes/ Garbage Record Book/ maceration of food/ Skip audit carried out by waste Contractor/ Monthly waste report. Modifications to Judy platform waste management plan (if required)	No	No	Scoped Out	
		Topsides modifications	No						
		Operations	Yes						
		Decommissioning	Yes						
20	Routine generation and disposal of radioactive wastes (disposal onshore) (e.g., radiation sources in flare meters).	Subsea installation	No	Disposal to land of radioactive wastes	Project waste management plan, use of licensed waste contractors/sites, waste transfer notes/ Garbage Record Book/ maceration of food/ Skip audit carried out by waste Contractor/ Monthly waste report. Modifications to Judy platform waste	No	No	Scoped Out	Through the implementation of mitigation measures, including waste management plans the impacts are not expected to be significant in terms of EIA not are they expected by
		Topsides modifications	No						
		Operations	No						
		Decommissioning	Yes						

ID	Project aspect	Project stage relevance?		Description of potential effects	Mitigation	Potentially significant in EIA terms?	Stakeholder expectation to assess in ES?	Take forward further in EIA?	Justification for Scoping Decision
					management plan (if required)				stakeholders to be included in an ES.
	Accidental Events								
21	CATASTROPHIC Accidental release/ spill of oil to sea (e.g. spills of crude oil, fuel oil, diesel from vessels, lubricating oil, flare dropout, hydraulic oil, base oil, cable oil, produced water spills over 100 mg/l, well blowout, loss of pipeline containment). Spills caused by e.g. collision, mechanical failure, loss of well control, human error, corrosion & erosion etc.	Subsea installation	Yes	Larger spills may contaminate/pollute surrounding water and cause disturbance to the aquatic ecosystem and other users / communities. Impact on seabird populations and protected habitats and species (e.g. mammals). Potential shoreline impact and associated environmental concerns. Possible transboundary impacts.	SOPEP OPEP, including modelling and appropriate response planning and MEI Safety Case SIMOPS Management of ECE (all) Bridging Document Regular & documented kick drills. Maintenance procedures (all).	Yes	Yes	**Scoped In**	Potentially significant in EIA terms and expectation from regulator.
		Topsides modifications	Yes						
		Operations	Yes						
		Decommissioning	Yes						
22	SMALL SCALE Accidental release/ spill of oil to sea.	Subsea installation	Yes	Sources are the wells and installation diesel bunkering. Smaller spills may cause localised, short-term contamination of seawater and limited damage to the aquatic ecosystem.	Procedures will be put in place for bunker transfer and other bulk storage transfers in order to reduce the risk of release. Bulk handling procedures & personnel training (all) Fail safe valves will be installed on hoses (all) Maintenance procedures (all) Vessels will be selected which comply with IMO/MCA codes for prevention of oil pollution (all) Pre-mobilisation audits will be carried out including a comprehensive review of spill prevention procedures (all) Preferred operational procedures to be in place onboard vessels including use of drip trays under valves, use of pumps to	No	No	Scoped Out	The small volumes being considered and the proposed mitigation control measures, likelihood is expected to be very low, and this is not expected to result in any significant impact. NEO has effective management controls in place therefore impacts are not expected to be significant in terms of EIA not are they expected by stakeholders to be included in an ES.
		Topsides modifications	Yes						
		Operations	Yes						
		Decommissioning	Yes						

ID	Project aspect	Project stage relevance?		Description of potential effects	Mitigation	Potentially significant in EIA terms?	Stakeholder expectation to assess in ES?	Take forward further in EIA?	Justification for Scoping Decision
					decant lubricating oils, use of lockable valves on storage tanks and drums (all) SOPEP (all) OPEP, including modelling and appropriate response planning and MEI Management of ECE (all)				
23	Accidental release/ spill of chemicals to sea.	Subsea installation	Yes	Additional chemicals could include those from vessels and those stored on the Judy platform. Corrosion inhibitor / hydrate inhibitor, volumes? chemical injection rate? etc. Chemicals released to sea may cause contamination of seawater and disturbance to aquatic ecosystem.	Chemical storage areas contained to prevent accidental release of chemicals (all). Maintenance procedures (all). Pre-mobilisation audits will be carried out including a comprehensive review of spill prevention procedures (all) Chemical Permit - Recording daily usage and release of all permitted chemicals (all). Reporting to BEIS using Chemical permit OCR or/and PON1 (all)	No	No	Scoped Out	The small volumes being considered and the proposed mitigation control measures, likelihood is expected to be very low, and this is not expected to result in any significant impact. NEO has effective management controls in place therefore impacts are not expected to be significant in terms of EIA not are they expected by stakeholders to be included in an ES.
		Topsides modifications	Yes						
		Operations	Yes						
		Decommissioning	Yes						
24	Accidental dropping of objects overboard into the sea.	Subsea installation	Yes	Interaction with seabed (direct or indirect) and other sea users (e.g. exclusion, snag risk).	Installation and SIMOPS procedures will be in place to reduce the potential for dropped objects (all). Training and awareness will be provided to installation contractors (all). Lift planning will be undertaken to manage risks during lifting activities, including the consideration of prevailing environmental conditions and the use of specialist equipment where appropriate (all). All lifting equipment will be tested and certified (all).	No	No	Scoped Out	The Industry has effective management controls in place for dropping objects. The impacts are not expected to be significant in terms of EIA not are they expected by stakeholders to be included in an ES.
		Topsides modifications	Yes						
		Operations	Yes						
		Decommissioning	Yes						

ID	Project aspect	Project stage relevance?		Description of potential effects	Mitigation	Potentially significant in EIA terms?	Stakeholder expectation to assess in ES?	Take forward further in EIA?	Justification for Scoping Decision
					Procedures will be put in place to make sure that the location of any lost material is recorded and that significant objects are recovered where practicable (all). Debris clearance surveys will be carried out at appropriate points through the Project life-cycle (including following the completion of drilling activities) and reported to BEIS using PON 2 notification (all). Dropped object protection - lines trenched and buried, manifold protection and trees protection.				

APPENDIX C SCOPING CONSULTATION COMMENTS

Table C-1 below outlines the issues raised by each stakeholder and the details on how these have been addressed within the ES. For brevity some comments have been paraphrased.

NatureScot (formerly Scottish Natural Heritage), the Marine Management Organisation (MMO), and the General Lighthouse Authority each received a copy of the scoping report however no responses was received.

Table C-1 Scoping Comments and Responses

Issues raised	NEO response and ES Section
OPRED	
We would be grateful if you could provide us with a copy of any comments from stakeholders when received, in addition to any comments you have received directly from stakeholders OPRED wish to highlight the following key aspects which should be considered as you prepare the ES.	NEO will ensure that OPRED is provided with a copy of any additional comments from Stakeholders in a timely manner.
You should familiarise yourself with the requirements of the Offshore Oil and Gas Exploration, Production, Unloading and Storage (Environmental Impact Assessment) Regulations 2020, including the requirements set out in Schedule 6 and the requirements of the Department's EIA Guidance which was updated in July 2021. As you have identified proposals which will exceed the Schedule 1 thresholds will require to be supported by ES.	Section 1.5 provides detail on the relevant legislative context which the proposed development will comply with. This includes application of the up-to-date Offshore EIA regulations and associated up-to-date guidance (BEIS, 2020).
The ES should clearly describe the main alternatives for the proposed project which have been considered, the advantages/disadvantages of each option and associated environmental implications, and summarise which option was selected and why (safety, environment, technical feasibility etc) […] Consideration should be given to potential decommissioning requirements and how these have influenced the options selected.	A discussion on the alternatives for the proposed project is provided in Section 2.
ESs should also give due consideration to the potential for operations to result in Major Environmental Incidents (MEI) as defined under OSDR. In most cases, the worst-case scenario relating to the identified major accident hazards will equate to the worst-case potential release assessed under the EIA process. The assessment in the EIA will therefore be relevant and will additionally confirm whether there is likely to be a significant impact that would constitute a MEI.	Consideration of the potential for operations from the proposed development to result in a MEI as defined under OSDR is provided in Section 11.
Consideration should be given to the proposed operations in the context of the relevant Marine Plans.	The proposed Development operations have been considered with regards to relevant Marine Plans as detailed within Section 1.5 and Appendix A of this report.
You should ensure that consideration is given for any potential impacts on Designated sites and Marine Protected Areas, this includes the potential for any cumulative or in combination effects. Particular consideration should be given to any potential impacts on Annex I habitats or priority species in the vicinity.	Potential impacts on designated sites and MPAs are included with regards to each impact assessed within the 'Protected Sites' section of each relevant ES chapter (Section 6-11). Additionally, due consideration of potential impacts on Annex I habitats or priority species in the vicinity of the proposed development is also included within each impact assessment chapter,

Issues raised	NEO response and ES Section
	in line with the EIA methodology presented in Section 5.11.
OPRED confirms that we would not expect a separate Habitat Regulations Assessment document or Appendix to be submitted, any information relevant to consideration of the proposals under the Habitats Regulations should be contained within the ES itself. Sufficient information should be provided to enable OPRED to undertake (if required) an assessment under the Habitats Regulations of the development's potential impact on protected sites (SPAs and SACs) and any assessment required under the MCAA of potential impacts on Marine Protected Areas.	A separate HRA document or appendix will not be submitted along with the ES. Instead, sufficient detail will be presented within each impact assessment chapter (Section 6-11) to allow OPRED to undertake a Habitat Regulation assessment if required.
Noting the increased focus on Net Zero, the ES should set out how the development will help deliver the requirements and commitments which relate to the oil and gas industry as set out in key strategy and policy documents such as: ▪ The North Sea Transition Deal ▪ The UK Net Zero Strategy ▪ The Energy White Paper ▪ Relevant carbon budgets As well as how elements such as the following have been considered: ▪ Reduction of emissions from power generation (e.g. opportunities for electrification) ▪ Reduction of emissions from flaring and or venting ▪ Installation emissions and vessel use emissions reduction ▪ Calculation of emissions should be based on a worst case (high production).	NEO is fully committed to contributing to the Net Zero initiative. Net Zero has been addressed within Section 12.
JNCC	
If avoidance [of MPAs or protected features/habitats] is not possible, we expect to see mitigation measures used to reduce the impact to the protected feature or habitat, an estimated seabed impact footprint, and a justification as to why the impact cannot be avoided.	The footprint of the development and its potential impact on the surrounding environment, including within the Fulmar MCZ, is limited in scale both spatially and temporally. NEO will ensure that all steps will be taken to minimise the impact to ALARP. The impact of the development on the seabed has been fully addressed in Section 7.
JNCC notes that site-specific surveys have been undertaken this year (October 2021) that will provide more detailed environmental baseline data to inform the EIA. The scoping report highlights the potential presence of *Arctica islandica*, and sea-pens and burrowing megafauna in the vicinity of proposed operations. JNCC recommend that the operator avoid these species and habitats as much as practically possible in the proposed operations.	The findings of the 2021 Environmental Baseline Survey and Habitat Assessment have been used to inform the baseline characterisation, the surveys are detailed within Section 4 of the ES. Specifically, the findings for *Arctica islandica* and the 'sea-pens and burrowing megafauna' habitat are presented within Section 4.3.7.2 and 4.3.7.3. These findings have been used to inform the subsequent impact assessment chapters.
JNCC encourage the operator to minimise the amount of hard substrate material used as much as practically possible, and include contingencies to ensure the worst case scenario is assessed. The following should be provided: location of rock dump sites; size / grade of rock to be used; tonnage / volume	NEO will aim to minimise the amount of hard substrate material used. Where required, the use of hard substrate material will be optimised to reduce potential impacts to the seabed. The Project Description (Section 2) provides details of the hard substrate likely to be required as a result of the proposed project activities.

Issues raised	NEO response and ES Section
to be used; contingency tonnage to be used; method of delivery to the seabed; seabed footprint of rock; assessment of impact. Where protective material cannot be avoided, JNCC recommend using a more targeted placement e.g. fall pipe vessel rather than using vessel-side discharge methods.	The fate of these materials during the decommissioning phase of the project is discussed within Section 3.3.10. Specific dimensions / tonnage of these materials is provided within Section 2.
JNCC considers it best practice to present a realistic worst-case scenario to enable a meaningful assessment of the full environmental impacts of a project.	The EIA methodology is based on best practice guidance and is presented within Section 5. As detailed within Section 5.6, where there is uncertainty with regards to impact parameters, the worst-case assumptions have been made to enable a meaningful assessment of the environmental impacts of the Development.
Assessment of cumulative effects of a project is required under EIA regulations. JNCC suggests that the proposed operations are assessed alongside approved developments under construction, approved developments that have not yet commenced construction, developments submitted for approval but not yet approved, as well as any other significant appropriate development for which some realistic figures are available.	The Cumulative Effects Assessment methodology is based on best practice guidance and is presented within Section 5. Publicly available data have been used where possible to identify any developments within the vicinity of the Evelyn Development which may influence cumulative effects. Additionally, the impact assessment has considered these projects when defining the potential for cumulative and in combination impact (Section 6-11).
Cefas	
Requests for comments pertaining to any ongoing or future marine licence application from the MMO can only be accommodated via the MMO.	
MoD	
The MoD had no objection to the proposed Development activities at the location specified.	
NFFO	
The NFFO responded without further comment.	
MCA	
We would expect the EIA to include information on the impact on shipping and navigation during both the construction and operational phase.	The impact of the development on other users of the sea has been fully addressed in Section 9.
The MCA would also expect the relevant Marine Licences and Consent to Locate to be granted for the works, subject to compliance with the conditions, compliance with the recommendations contained in the Consent to Locate Risk Assessment (Shipping and Navigation) and the Collision Risk Management Measures being in place.	The development Commitments Register is available in Appendix D, and outlines all the relevant consents and compliance that NEO will adhere to over the course of the development; including the Consent to Locate Risk Assessment (Shipping and Navigation) and Collision Risk Management Measures.
UKHO	
Once the planned routes and positions are decided, could we be informed on those so that we can issue a notice? Once the works are complete we will need the as laid positions and details to update our charts and database.	The development Commitments Register is available in Appendix D, and outlines all the relevant consents and compliance that NEO will adhere to over the course of the development. Information on the location of subsea infrastructure, safety zones and vessel operations will be communicated to other sea users (via the UKHO) through the standard communication channels including Kingfisher, Notice to Mariners and Radio Navigation Warnings.
SFF	

Issues raised	NEO response and ES Section
The SFF is pleased to note that the pipeline and umbilical are to be trenched and buried within the same trench which should reduce potential issues with clay berm mounds after backfill, but would still take the opportunity to advise that over the years fishermen have voiced serious safety concerns over mud berms being left behind following pipeline trenching operations.	Trenching and burying the umbilical and pipeline in the same trench is no longer considered technically feasible. However, both will be trenched and buried. A post-installation survey will be performed once activities are completed to identify any significant seabed anomalies, such as mud berms. The potential for snagging hazards has been fully addressed within Section 9.
In relation to the use of protection materials such as concrete mattresses to facilitate crossings […] we would recommended that any such mattresses installed in open water are subject to a covering of rock dump. In relation to any rock dump deposits, these should conform to industry standards.	The placement of rock as part of the development is outlined in Section 2. In order to minimise impacts on the seabed, the quantity of rock has been reduced as far as possible. However, the potential for the introduction of snagging hazards to other users of the sea has been assessed fully in Section 9. In addition, regular maintenance inspection surveys will be undertaken throughout the Development's lifetime to ensure structures remain in a favourable condition and that no snagging hazards arise.
Marine Scotland	
A summary table of any feedback received from stakeholders is advised in the ES and detail provided as to how any feedback has been addressed.	NEO have presented all stakeholder comments within this table and have included where the feedback has been addressed.
MSS advise that the UK Offshore Energy Strategic Environmental Assessment 3 (OESEA3) (Available here) is reviewed and incorporated into the ES.	Details in OESEA 3 have been included in Section 4.
As the project area spans English and Scottish waters, MSS advise the ES should discuss how the proposed works comply with Scotland's National Marine Plan and the English North East Marine Plan.	The proposed Development operations have been considered with regards to relevant Marine Plans as detailed within Appendix A of this report.
MSS advise the key facts of the development are highlighted upfront, including but not limited to; grid reference, quadrant / block numbers, field name, ICES rectangles, nature of hydrocarbons expected and anticipated field life.	These details are included within Section 2 and Section 4, as well as within the Non-Technical Summary.
It is not clear if the worst-case scenario of an umbilical routed back to Judy will be considered in this ES or the Talbot ES. If included in this ES, the receptor sections must take account of the route from the Talbot DC1 manifold to Judy. The receptor sections in this scoping letter refer to quadrant / blocks 30/13, 30/14 and 30/19, not 30/8 or 30/7.	NEO can now confirm that the worst-case scenario of an umbilical routed from Affleck to Judy is considered within the ES.
Section 1 (Development Overview) – Net zero comments – One of the key drivers for choosing Judy as a host is given as 'significantly lower than other host operations'. It is not clear what is meant by this.	Details on the decision to choose Judy as the Host have been described in Section 2.
MSS request that information is presented in a visual format where possible and that all graphics included in the ES are legible and clearly labelled.	NEO have included visual aids and graphics throughout the ES.
An option selection and alternatives section is advised, to discuss how the proposed development (including pipeline routes / installation methods and use of protective materials) represents Best Environmental Practice (BEP) using Best Available Technology (BAT) and takes account of sensitivities in the area including the Fulmar Marine Conservation Zone (MCZ). The option selection process should address why tie-backs to closer infrastructure such as the Clyde platform via	A discussion on the alternatives for the proposed project is provided in Section 2.

Issues raised	NEO response and ES Section
Orion or Flyndre were not considered suitable. The option selection process should also take account of the lifecycle of the project and future decommissioning.	
MSS advise an overview is provided of how other adjacent pipelines have been installed, in support of the chosen pipeline installation method. It is particularly important to demonstrate how any crossed pipelines / cables have been installed.	Nearby pipelines were trenched and backfilled. Affleck pipeline will follow the same philosophy.
It is understood that concrete mattresses in addition to rock deposits are proposed at pipeline / cable crossings. Could the ES please detail why concrete mattresses in addition to rock are required.	Concrete mattresses will be used to protect tie-in spools and to facilitate crossings and rock placement is required for upheaval buckling mitigation, crossings and at trench transitions. In order to minimise impacts on the seabed, the quantity of rock has been reduced as far as possible. However, the potential for the introduction of snagging hazards to other users of the sea has been assessed fully in Section 9. In addition, regular maintenance inspection surveys will be undertaken throughout the Development's lifetime to ensure structures remain in a favourable condition and that no snagging hazards arise.
The use of grout bags is not discussed in the scoping letter. If these are to be used, MSS advise these are quantified in the ES.	It is estimated that the volume of grout bags required will be 50 x 1 te grout bags. This is detailed in Section 2.
Where concrete mattresses are used and the individual block units are connected using 'plastic' ropes, or where 25 kg or similar capacity woven sacks made using 'plastic' materials that contain grout or sand are used, in addition to providing an assessment of the potential environmental impacts of the deposits they must also confirm the removal philosophy and that the intention is to recover the deposits at the time of decommissioning.	Details on NEO's approach to the decommissioning of the Development are included in Section 2. The subsea infrastructure associated with the Development (pipelines, umbilical, spools and jumpers) and deposited materials (mattresses and grout bags) can be recovered during decommissioning from the seabed dependent on their integrity status. Prior to the end of field life, there may well be changes to the statutory decommissioning requirements as well as advances in technology and knowledge. NEO will aim to utilise recognised industry standard environmental practice during all decommissioning operations, in line with the legislation and guidance in place at the time of decommissioning. Discussions on what may be required will be held with the Regulator as early as possible before decommissioning commences.
Has minimisation of upheaval buckling been considered in the choice of pipeline material?	Carbon steel has been selected
Has any assessment of soil strength been conducted ahead of installation to inform the worst case rock deposit requirement for upheaval buckling?	Geotechnical evaluation carried out following route survey.
Does the use of 37,326 tonnes of rock represent the worst case scenario?	Information on the worst-case rock requirements are included in Section 2.
MSS advise that rock deposits are put into context / considered cumulatively with rock deposits already in place adjacent to the development area.	The proposed rock placement area has been considered within the context of cumulative impacts in combination with the Talbot development. Affleck and Talbot will spatially overlap (Section 7.5). With regards to the impact within the Fulmar MCZ, the placement of rock associated with Affleck has been combined with other project rock estimates to provide a worst-case cumulative area of habitat loss in the site (Section 7.7).
Are any wax build up or corrosion issues anticipated along the production pipeline? Has the ability to pig the pipeline been considered?	Full wax deposition and corrosion assessment has been carried out. The facility to pig the line is part of the design.

Issues raised	NEO response and ES Section
A detailed schedule of works should be provided with any contingency periods clearly stated.	A schedule of works is provided in Table 1-2.
MSS advise that a high-level overview is provided of any anticipated changes to chemical requirements at Judy. Are the hydrocarbons at Affleck similar to those already being produced at Judy? Detail of the produced water system handling capacity at Judy is advised which takes account of this development and the Talbot development.	Details on how the oil and gas production at Affleck will affect production requirements at Judy, including produced water, chemical usage, incremental power demand and emissions are provided in Section 2.
MSS advise that an upfront description of the environmental survey(s) used in support of the application is provided. This should include detail of the methods used and justification for the location of sampling stations. The location of all sampling stations should be shown on a map.	Details on the surveys conducted along the Affleck pipeline route and the Talbot pipeline, adjacent to the Affleck umbilical are included in Section 4.
MSS would welcome a copy of the 2021 site survey report as and when this becomes available. Please note that survey reports held by Marine Scotland may be made publicly available and published on the Marine Scotland website.	Survey data shared with all relevant stakeholders.
A local scale bathymetry map for the development area is advised, along with any outputs from Side Scan Sonar (SSS) / multibeam surveys, highlighting any significant seabed features.	Relevant survey outputs are provided in the environmental baseline as appropriate (see Section 4).
The physical characteristics of the environment at the location should be fully described and include, for example, information on currents, wind speed, wave height / power, temperature and salinity.	Details on the physical environment at the development area is provided in Section 4.2.
The NPMPi contains map layers showing predicted seabed habitats and sediment types, which are advised, to provide additional regional context.	Predicted EUNIS broadscale habitats via UKSeaMap have been presented in the ES (see Section 4).
Good quality, high resolution images of the local sediment / benthic community, with an accompanying description of the features / species observed, clearly linked to a map showing the location, are advised.	The faunal community at the development area is described in Section 4. Seabed images from the 2021 survey of the proposed Affleck pipeline route and the 2019 survey of the proposed Talbot pipeline route (adjacent to the Affleck umbilical) have been included. The sampling stations have been displayed in a map.
MSS advise that a description of the underlying sediments is also presented. The proposed trenches are relatively deep (up to 1.8 m) and the assessment should consider the potential for berms, capable of posing a hazard to other sea users, to be created as a result of trenching activities.	Details of the underlying sediments along the Affleck pipeline route have been provided in Section 4.2.2, alongside information on the underlying sediments at proposed drill centres for the Talbot development.
MSS advise a section is provided on plankton.	A section on plankton has been included in the environmental baseline (Section 4.3.1). The potential impact of discharges to sea on plankton is included in Section 6.
Where species of conservation concern or species indicative of habitats of conservation concern are identified, it is advised that the abundance of animals is discussed per unit area (m^2). MSS advise use of the SACFOR abundance scale.	Where survey data on density of individuals per m^2 is available, this has been included in Section 4, along with a comparison to the SACFOR abundance scale.
The NMPI contains useful layers showing the known locations of species and habitats of conservation importance. MSS advise this is represented visually.	Species of conservation of concern have been displayed visually in Section 4.

Issues raised	NEO response and ES Section
Reference to Aires et al., (2014) is advised. It is recommended these data are presented visually in future applications in conjunction with the Coull et al, 1998 and Ellis et al, 2012 nursery maps, as there are certain limitations with the data	Information on 0-group fish aggregations from Aires *et al*., 2014 has been included in Section 4.3.3.
MSS advise that mackerel spawning is also recognised by the cited literature in ICES 41F2 and 42F2 and sprat spawning in 41F2.	Details on fish spawning and nursery grounds are included in Section 4.3.3.
MSS advise the timing of spawning for each species including their peak spawning season is presented in a tabular format. High intensity spawning and nursery areas (Ellis et al, 2012) and areas where higher egg concentrations were observed (Coull et al, 1998) should also be highlighted.	A table of the spawning periods is included in Section 4.3.3 which details any high intensity spawning or nursery areas and areas where a high concentration of eggs is observed.
MSS advise that Langton et al., (2021) is incorporated into the assessment. The spatial layers associated with the report showing the predicted probability of presence of suitable sandeel habitat and predicted sandeel density may be viewed on NMPI	The spatial layers on predicted probability of presence of suitable sandeel habitat and predicted sandeel density have been reviewed, with details included in Section 4.3.3.
MSS advise reference to González-Irusta & Wright, 2016.	Reference to González-Irusta & Wright, 2016 is included Section 4.3.3.
A basic assessment of the spawning habits and preferred habitats of the main species identified, as compared to the conditions experienced locally, may highlight additional mitigation opportunities.	The main demersal spawner potentially present in the Development area is sandeel. The preferred spawning habitats of this species have been compared with the sediments present at the Development in Section 4.3.3.
For Scottish waters, MSS advise reference to Priority Marine Feature (PMF) species list rather than the UKBAP list.	As the Development spans across Scottish and English waters, reference has been made to PMF and UKBAP list species in Section 4
MSS advise that the Fulmar MCZ features of conservation concern are clearly shown on a map.	Ocean quahog records and the broad-scale habitat are displayed in Section 4.3.2.
Finalised Scottish Government fisheries statistics for 2020 were published in October 2021.	The latest landings fisheries statistics from the MMO (2016 – 2020) have been analysed and presented in Section 4.4.1. This dataset contains a greater number of gear categories than that which is available through the Scottish Government. However, effort data is not publicly available through the MMO. Therefore, fishing effort has been assessed using the latest Scottish Government statistics.
New aggregated VMS fishing effort data sets for 2009 - 2016 are now available on the NMPI. The data are split into three groups of fishing method: bottom trawls, dredges and crustaceans caught by bottom trawl (i.e. Nephrops). Map layers showing average annual fishing effort (mW fishing hours) in the Greater North Sea Ecoregion during 2015–2018 are also available via EMODNET.	As the Development spans across English and Scottish waters, VMS data from the MMO has been analysed. This dataset covers 2016 – 2019 and is included in Section 4.4.1.
MSS advise visual representation of the recently added nine new spatial layers to the NMPI showing changes over the last five years of published statistics for: 1. tonnage for demersal, pelagic and shellfish species; 2. value (£) for demersal, pelagic and shellfish species; 3. effort (days) (by UK vessels >10m length) for demersal active (bottom trawls, dredges etc.); pelagic active (pelagic trawls, purse seines etc.); and passive (pots/creels, gillnets etc.).	As this dataset does not extend into English waters, and therefore only covers part of the Development area, this data has not been visually represented in the environmental baseline. However, the data available on NMPI has been reviewed. Combined with the presentation of MMO fisheries statistics and VMS data, this is considered to be sufficient to understand the fishing activity in the vicinity of the Development.

Issues raised	NEO response and ES Section
An assessment of 'within-year' seasonality is recommended for fishing effort as this may highlight additional mitigation opportunities.	Fishing effort at a monthly scale has been included within Section 4.4.1.
MSS advise that the location of previously drilled wells is shown. An overview of previously drilled wells along the pipeline / umbilical route is advised.	This is shown in Figure 4-22.
The application states that the closest platform to the new Affleck infrastructure and pipeline, is Judy, approximately 15.2 km NNW. It appears, however, that the Clyde platform is closer to the Affleck field.	NEO can confirm that the closest platform Judy at <0.01 km from the Affleck umbilical and 15.2 km from the Affleck pipeline. The Clyde platform is 18.6 km from the Affleck umbilical and 18.3 km from the Affleck pipeline. These details are provided in Section 2.
The EMODNET Human Activities data portal now contains useful up to date shipping information based on the Automatic Identification System (AIS).	The AIS data available through the EMODnet Human Activities data portal has been incorporated into Section 4.4.7.
It is advised that a systematic impact assessment methodology is applied to allow impacts to be ranked.	Details on the EIA methodology are provided in Section 5.
It is advised that the potential for in-combination, cumulative and transboundary impacts are discussed in the ES.	The Cumulative Effects Assessment methodology is based on best practice guidance and is presented within Section 5. The impact assessment has considered the potential for cumulative impacts with nearby projects (Section 6-11).
MSS advise that the extent of any 500 m safety zone is shown on a figure in relation to the proposed infrastructure and location of any protective materials.	This is shown in Figure 4-22.
MSS advise early engagement with fishing representative organisations such as the Scottish Fishermen's Federation (SFF) for the project and advise that the outcome of these discussions are captured in the ES.	NEO has engaged with SFF to discuss the project and has considered their feedback in the production of the ES.
MSS advise the ES considers the potential hazard that the trench / resultant berms may pose to other sea users during and after installation and that appropriate mitigation measures such as the use of guard vessels (during construction) and post installation surveys / overtrawl trials (post installation) are considered.	The potential impact of the physical presence of the project is assessed in Section 9. Guard vessels will be in place for unprotected assets to mitigate against potential hazards. Furthermore, a post-installation survey will be performed once activities are completed to identify any significant seabed anomalies, such as mud berms.The potential for snagging hazards has been fully addressed within Section 9.
MSS advise use of the Feature Activity Sensitivity Tool (FEAST).	The FEAST tool has been considered in the production of the ES, where appropriate. Reference is also made to the Marine Life Information Network (MARLIN) sensitivities.
MSS advise that the impact area located within the Fulmar MCZ is expressed a percentage of the Fulmar MCZ.	The seabed footprint within the Fulmar MCZ has been calculated as a percentage of the Fulmar MCZ and is included in Section 7.
The water depths and sediments described in this area appear suited to sandeel spawning. MSS advise that careful consideration of timing may be required to avoid the sandeel spawning season and the ES should consider the potential permanency of rock deposits and the impact this may have on sandeel spawning.	The potential impact of the seabed disturbance associated with the Development is described in Section 7. This has considered potential impacts on sandeel spawning and appropriate mitigations have been provided.
MSS advise that information on sandeel spawning preference in sediments with a low clay silt fraction (<10%) is compared to Particle Size Analysis (PSA) results from the site survey.	The PSA results from the Affleck and Talbot surveys has been compared to preferred sandeel spawning habitats (<10% low clay silt fraction). This information is presented in Section 4.3.3.

Issues raised	NEO response and ES Section
A number of exploration and appraisal wells are located around the proposed Talbot DC1 manifold location and MSS advise that the assessment considers the potential impacts associated with the disturbance and re-suspension of contaminated sediments at these locations and at the Judy platform (in the event that the umbilical back to Judy is assessed as part of this application).	No drills cuttings piles were noted during the recent surveys at the Talbot DC1 manifold and pipeline route and along the Affleck Pipeline route. Sediment samples from the 2019 survey at the Talbot Development area and the 2021 surveys at the Development area indicated that contaminant concentrations were generally consistent with the wider area. The impact of resuspended sediments is discussed in Section 7.
Where there is potential for shoreline oiling on the Scottish coastline as a result of an accidental event scenario, MSS advise that impacts on aquaculture and Shellfish Water Protected Areas are considered.	Impacts on aquaculture from shoreline oiling are considered in Section 11.
The predicted effectiveness of the stated mitigation measures should be made clear.	Justification for the stated mitigation measures is included in each impact chapter (Section 6-11).
Any commitments relating to matters addressed in the ES should be drawn together into one section or table and be clearly identifiable.	A commitments register is included as an appendix to the ES (Appendix D).
MSS advise that the ES considers decommissioning upfront and details how all installed infrastructure / protective material would be removed should this be the policy in place at that time or the preferred outcome of the comparative assessment process.	Details on NEO's approach to the decommissioning of the Development are included in Section 2.

APPENDIX D COMMITMENTS REGISTER

Item	ES Section Number	Issue	Mitigation and Management Action	Responsibility
1	6.5	Discharges to sea	Ensuring good mixing of dewatering discharges.	HE operations on Judy platform
2	6.5	Discharges to sea	The oil content of the produced water at the Judy platform due to the additional produced water from Affleck will be less than the 30 mg/l oil-in-water concentration threshold prior to discharge to sea. Judy currently already achieves less than the 30 mg/l threshold which NEO will continue to aim to achieve as low OIW (30 mg/l) as possible.	HE operations on Judy platform
3	6.5	Discharges to sea	Once the final chemical requirements are known, and prior to the commencement of operations, HE/NEO will submit the relevant permit applications, supported by appropriate detailed chemical risk assessments, to OPRED under the OCR to obtain approval prior to chemical use and discharge.	HE operations on Judy platform
4	7.4	Seabed impacts	The number of mattresses, volumes of sandbags to be placed over crossings and tie-in-points and the potential requirement for rock placement will be refined during detailed design to reduce the footprint on the seabed to the extent practicable.	NEO
5	7.4	Seabed impacts	Environmental survey data will be used to inform the placement of concrete mattresses/grout bags.	NEO
6	7.4	Seabed impacts	The pipelines and umbilical shall be trenched and buried over the majority of their lengths with protection mattresses only being used where necessary. Overall, rock placement will be limited to as low a volume as reasonably practicable.	NEO
7	7.4	Seabed impacts	All rock would be installed by a dedicated rock placement vessel will fall pipe, ensuring accurate placement and optimised use of the rock material.	NEO
8	7.4	Seabed impacts	Consultation will be undertaken with relevant authorities, organisations and stakeholders, including Marine Scotland, JNCC and NatureScot.	NEO
9	8.6.3	Underwater noise	A suitably trained marine mammal observer will conduct a pre-piling search over a 30-minute period prior to the commencement of piling. This will involve a visual assessment to determine if any marine mammals are within the 500 m mitigation zone (measured from the location of the piling). In addition, a Passive Acoustic Monitoring (PAM) system will be used concurrently with the marine mammal observer to monitor for submerged marine mammals within the mitigation zone.	NEO
10	8.6.3	Underwater noise	Should any marine mammals be detected within the 500 m mitigation zone during the pre-piling search, operations will be delayed until marine mammals have moved outside the 500 m mitigation zone. In this case, there will be a 20-minute delay from the time of the last marine mammal sighting to the commencement of activities.	NEO

Item	ES Section Number	Issue	Mitigation and Management Action	Responsibility
11	8.6.3	Underwater noise	A soft start will be performed, whereby the total energy of the hammer used during piling will be ramped-up slowly over 20 minutes, in order to give marine mammals time to leave the area. Where possible, increase of power will occur in uniform stages to provide a constant ramp-up in power level. If a marine mammal enters the mitigation zone during the soft start, the energy of the hammer will not be increased further until the animal has left the mitigation zone.	NEO
12	8.6.3	Underwater noise	If piling is required to commence in sub-optimal conditions for visual monitoring (e.g., visibility of less than 1 km; sea state greater than Beaufort 3; and/or during hours of darkness), consideration will be given to using passive acoustic monitoring (PAM) instead of visual monitoring to conduct the pre-start search. Use of PAM allows the detection of vocalising marine mammals, thereby allowing pre-start searches to be implemented when visual observations are not possible.	NEO
13	8.6.3	Underwater noise	Marine mammal observers will keep an open line of communication with the appropriate operations staff to ensure mitigation procedures are adhered to. Marine mammal observers will record all survey and sightings data on relevant forms for entry into the JNCC Noise Registry database.	NEO
14	9.6.1	Increased vessel traffic and collision risk and snagging risk	Information on the location of subsea infrastructure, safety zones and vessel operations will be communicated to other sea users (via the United Kingdom Hydrographic Office) through the standard communication channels including Kingfisher, Notice to Mariners and Radio Navigation Warnings.	NEO
15	9.6.1	Increased vessel traffic and collision risk and snagging risk	Infrastructure and safety zones will be marked as hazards on admiralty charts and entered into the FishSafe system so that it may be avoided by fishing vessels.	NEO
16	9.6.1	Increased vessel traffic and collision risk	During installation, the number of vessels and length of time they are required on site will be reduced as far as practicable through careful planning of the installation activities.	NEO
17	9.6.1	Increased vessel traffic and collision risk	A guard vessel will be present on site in the interim period between the laying of the pipeline and umbilical and arrival of the trenching support vessel to ensure that other sea users are aware of the surface laid pipeline and umbilical.	NEO
18	9.6.1	Increased vessel traffic and collision risk	Consultation will be undertaken with relevant authorities and organisations.	NEO

Item	ES Section Number	Issue	Mitigation and Management Action	Responsibility
19	9.6.1	Increased vessel traffic and collision risk	Environmental awareness training will be given to all relevant crew members to reduce the risk of collisions between vessels and animals.	NEO
20	9.6.1	Increased vessel traffic and collision risk	Development and implementation of a fisheries liaison strategy.	NEO
21	9.6.2	Temporary and permanent obstruction and/or exclusion	NEO has reduced vessel numbers and vessels days as far as practicable whilst adhering to safety and emergency response requirements.	NEO
22	9.6.3	Snagging	Should it be required, the spread of contingency rock will be minimised through the use of a fall pipe vessel.	NEO
23	9.6.3	Snagging	A post-installation survey will be performed once activities are completed to identify any hazards to fishing and shipping and navigation.	NEO
24	9.6.3	Snagging	Regular maintenance inspection surveys will be undertaken throughout the Development's lifetime to ensure structures remain in a favourable condition.	NEO
25	9.6.4	Dropped objects	Personnel will be suitably trained as to minimise the potential for dropped objects: • Lift planning will be undertaken to manage risk during lifting activities, and all lifting equipment will be tested and certified; • All deck items will be securely stowed; • All equipment and material on installation vessels will be adequately stowed or seafastened; • Transfers of objects will use specialist equipment and consider environmental conditions; and • Procedures will be put in place to ensure that the location of any lost material is recorded and that significant objects are recovered where practicable.	NEO
26	9.6.4	Dropped objects	The contractor will have a dropped objects procedure which will be used for the proposed installation operations to minimise any issues with dropped objects.	NEO
27	9.6.4	Dropped objects	Compliance to Lifting Operations and Lifting Equipment Regulations (LOLER) including inspection/testing.	NEO

Item	ES Section Number	Issue	Mitigation and Management Action	Responsibility
28	9.6.4	Dropped objects	A post-installation survey will be performed once activities are completed to identify any significant dropped objects and seabed anomalies.	NEO
29	10.5.1	Operational GHG emissions	The GHG strategy for the Judy facility is within the control of the Harbour J-Area GHG Emissions Reduction Action Plan (Harbour Energy, 2022), NEO will influence and support Harbour Energy (HE) activities during operations, maintenance and decommissioning, to influence delivery of the plan.	HE/NEO
30	10.5.1	Operational GHG emissions	HE aims to establish an Energy Transition (ET) forum (Harbour Energy, 2020) with non-operated partners, and NEO will engage with this forum to support the initiatives in line with the NEO Low Carbon Plan (NEO Energy, 2021).	HE/NEO
31	10.5.1.1	Flare management	Monitoring of flare combustion efficiency is an area of focus for HE who are screening the market for suitable technologies and services that would provide flare combustion efficiency. The tracking of flare unlit periods is now a regulatory requirement under the NSTA flare and vent guidance, and so is tracked as part of HE compliance.	HE operations on Judy platform
32	10.5.2	Atmospheric emissions	Each vessel will have a Shipboard Energy Efficiency Management Plan (SEEMP) which contains information of minimising fuel consumptions e.g., economical speeds when operationally appropriate	NEO
33	10.5.2	Atmospheric emissions	Green DP or economical speeds when operationally appropriate.	NEO
34	10.5.2	Atmospheric emissions	Developing the subsea installation to minimise the number of mobilisations or demobilisations.	NEO
35	10.5.2	Atmospheric emissions	Opportunity to carry out installation, commissioning, maintenance, and decommissioning of the Affleck and Talbot projects together to reduced emissions, (as well as collaboration with other operators and sectors).	HE/NEO
36	10.5.2	Atmospheric emissions	Streamlining of activities through planning to reduce the time required for vessels and helicopters will be required for these activities and will support the drive to reduce emissions.	HE/NEO
37	11.7	Accidental events	NEO will ensure that appropriate controls are in place to either reduce the probability of failure of a control resulting in a release or reduce the consequences in the event of a release.	NEO
38	11.7	Accidental events	Safety and environmental critical elements (SECEs) performance standards with verification, equipment inspection, maintenance routines and management of operations will be in place during the operations.	HE operations on Judy platform
39	11.7	Accidental events	Corrosion management will be of paramount importance for the Development as corrosion is often biggest risk to pipeline integrity, especially if the hydrocarbons are wet.	NEO