Liverpool Bay CCS Ltd

HYNET CARBON DIOXIDE TRANSPORTATION AND STORAGE PROJECT - OFFSHORE

Environmental Statement
Volume 1, chapters 1 to 5: Introductory Chapters

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Liverpool Bay CCS Limited
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Glossary

Term	Meaning
"Do Nothing" Scenario	The environment as it would be in the future should the proposed project not be developed.
Baseline	The existing conditions as represented by the latest available survey and other data which is used as a benchmark for making comparisons to assess the impact of the Proposed Development.
CCS	Integrated process of three stages: capture of CO_2 from power stations and large industrial sources; transporting CO_2 to a storage site; and permanent storage of CO_2 in deep geological features.
Climate Change	A change in global or regional climate patterns, in particular a change apparent from the mid to late 20th century onwards and attributed largely to the increased levels of atmospheric CO_2 produced by the use of fossil fuels.
Climate Emergency	A situation in which urgent action is required to reduce or halt climate change and avoid potentially irreversible environmental damage resulting from it.
Cumulative Effect Assessment	Assessment of the likely effects arising from the offshore components of the HyNet CO_2 Transportation and Storage Project ('Proposed Development') alongside the likely effects of other development activities in the vicinity of the Proposed Development.
Effect	The consequence of an impact.
EIA Directive	European Union Directive 2011/92/EU of 13 December 2011 (as amended in 2014 by Directive 2014/52/EU).
EIA Regulations	Collectively the term used to refer to The Offshore Oil and Gas Exploration, Production, Unloading and Storage (Environmental Impact Assessment) Regulations 2020; and The Marine Works (Environmental Impact Assessment Regulations) 2007 (as amended).
Embedded Mitigation Measures	Mitigation measures to avoid or reduce environmental effects that are directly incorporated into the design of the Proposed Development.
Emissions	An amount of a substance that is produced and sent out into the air that is harmful to the environment, especially CO_2.
English Inshore Waters	English waters within 12 nm from the English coast.
English Offshore Waters	English waters beyond 12 nm from the English coast.
Environmental Impact Assessment	A statutory process by which certain planned projects must be assessed before a formal decision to proceed can be made. It involves the collection and consideration of environmental information, which fulfils the assessment requirements of the Environmental Impact Assessment Directive and Environmental Impact Assessment Regulations, including the publication of an Environmental Statement.
Environmental Statement	The document presenting the results of the Environmental Impact Assessment process for the Proposed Development.
European Protected Species	European Protected Species (such as cetaceans, marine turtles and otters) receive full protection under The Conservation of Species and Habitats Regulations 2010.
Favourable Conservation Status	Describes the situation in which a habitat or species is thriving throughout its natural range and is expected to continue to thrive in the future.
Fossil Fuel	A hydrocarbon containing material formed naturally in the earth's crust from the remains of dead plants and animals.
Greenhouse Effect	The trapping of the sun's warmth in a planet's lower atmosphere, due to the greater transparency of the atmosphere to visible radiation from the sun than to infrared radiation emitted from the planet's surface.
Greenhouse Gas	A gas that absorbs and emits radiant energy within the thermal infrared range, causing the greenhouse effect. Examples include carbon dioxide and methane.
Habitat	The environment that a plant or animal lives in.
Impact	A change that is caused by an action.

Term	Meaning
International Commitments	Commitments made publicly on the international level.
Inter-related Effects	Interrelationships between ES topics that may lead to environmental effects.
Magnitude	A combination of the extent, duration, frequency and reversibility of an impact.
Major Significance	These beneficial or adverse effects are considered to be important considerations and are likely to be material in the decision-making process.
Marine Licence	The Marine and Coastal Access Act 2009 requires a marine licence to be obtained for licensable marine activities. In addition, licensable activities within 12 nm of the Welsh coast require a separate marine licence from Natural Resource Wales.
Marine Spatial Planning	A public process of analysing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic and social objectives that have been specified through a political process.
Maximum Design Scenario	The maximum design parameters of the Proposed Development considered to be a worst case for any given assessment but within the range of the Project Description Envelope.
Mean High Water Spring	The highest level reached by the sea at high tide during mean high water spring tide. This is defined as the average throughout the year, of two successive high waters, during a 24-hour period in each month when the range of the tide is at its greatest.
Mean Low Water Spring	The lowest level reached by the sea at low tide during mean low water spring tide. This is defined as the average throughout the year, of two successive low waters, during a 24-hour period in each month when the range of the tide is at its greatest.
Minor Significance	These beneficial or adverse effects are generally, but not exclusively, raised as local factors. They are unlikely to be critical in the decision making process, but are important in enhancing the subsequent design of the project.
Mitigation Measure	Measure which would avoid, reduce, or remediate an impact.
National Policy Statement	A document setting out national policy for the energy infrastructure against which proposals are assessed and decided upon.
Net Zero	A target of completely negating the amount of greenhouse gases produced by human activity either worldwide or by a country or organisation, to be achieved by reducing emissions and implementing methods of absorbing carbon dioxide from the atmosphere.
Policy	A set of decisions by governments and other political actors to influence, change, or frame a problem or issue that has been recognized as in the political realm by policy makers and/or the wider public.
Project	The HyNet Carbon Dioxide Transportation and Storage Project.
Project Design Envelope	Also known as the Rochdale Envelope, the Project Design Envelope concept is routinely utilised in both onshore and offshore planning applications to allow for some flexibility in design options, particularly offshore, and more particularly for foundations and turbine type, where the full details of the project are not known at application submission but where sufficient detail is available to enable all environmental impacts to be appropriately considered during the Environmental Impact Assessment.
Project Lifetime Effects	Effects that occur throughout more than one phase of the project (construction, operations and maintenance, and decommissioning) interacting to potentially create a more significant effect upon a receptor than if just assessed in isolation in a single phase.
Proposed Development	The offshore components of the Project which are subject of this Environmental Statement, as described in volume 1, chapter 3.
Protected Species	A species of animal or plant which it is forbidden by law to harm or destroy.
Receptor	A component of the natural or man-made environment that is potentially affected by an impact.
Receptor-led Effects	Effects that interact spatially and/or temporally resulting in inter-related effects upon a single receptor.

Term	Meaning
Residual Impact	Residual impacts are the final impacts that occur after the proposed mitigation measures have been put into place, as planned.
Scoping Opinion	Sets out the Secretary of State's response to the Applicants Scoping Report and contains the range of issues that the Secretary of State, in consultation with statutory stakeholders, has identified should be considered within the Environmental Impact Assessment.
Special Protection Area	A site designation specified in the Conservation of Habitats and Species Regulations 2017, classified for rare and vulnerable birds, and for regularly occurring migratory species. Special Protection Areas contribute to the national site network.
The Applicant	This is Liverpool Bay CCS Ltd.
Topsides	Surface structures and equipment placed on a supporting structure to provide some or all of a platform's functions.
Transboundary Effects	Impacts from a project within one state affect the environment of another state(s).
Welsh Inshore Waters	Welsh waters within 12 nm of the Welsh coast.
Welsh Offshore Waters	Welsh waters beyond 12 nm from the Welsh coast.

Acronyms and Initialisations

Acronym/Initialisation	Description
3D	Three-Dimensional
4D	Four-Dimensional
ADD	Acoustic Deterrent Device
AfL	Agreement For Lease
APM	Association For Project Management
BEIS	The Department For Business, Energy and Industrial Strategy, Now Replaced By The Department For Energy Security And Net Zero.
BSI	British Standards Institute
CCC	Climate Change Committee
CCS	Carbon Capture and Storage
CCUS	Carbon Capture, Usage and Storage
CEA	Cumulative Effect Assessment
CEFAS	Centre For Environment, Fisheries And Aquaculture Science
CEng	Chartered Engineer
CEnv	Chartered Environmentalist
CIEEM	Chartered Institute Of Ecology And Environmental Management
CLV	Cable Lay Vessel
CM	Corrective Measures
CO_2	Carbon Dioxide
CoCP	Code of Construction Practice
COP	Conference of the Parties
CP	Chemical Permit
CSci	Chartered Scientist
CS-SSGS	CO_2 Sequestration In Sub-Seabed Geological Structures
CtL	Consent To Locate

Acronym/Initialisation	Description
DA	Douglas Accommodation
DAERA	Department Of Agriculture, Environment And Rural Affairs Of Northern Ireland
DCO	Development Consent Order
DD	Douglas Deck
DECC	The Department Of Energy And Climate Change, Merged With The Department For Business, Innovation And Skills, To Form The Department For Business, Energy And Industrial Strategy
DEFRA	Department For Environment, Food And Rural Affairs
DESNZ	The Department For Energy Security And Net Zero, Preceded By The Department For Business, Energy, And Industrial Strategy (2016 To 2023) And The Department Of Energy And Climate Change (2008 To 2016)
DMRB	Design Manual For Roads And Bridges
DP	Decommissioning Programme
DR	Drilling Operations
DW	Douglas Wellhead
EA	Environmental Appraisal
EAJ	Environmental Assessment Justification
EBS	Environmental Baseline Survey
EC	European Commission
EcIA	Ecological Impact Assessment
EEA	European Economic Area
EIA	Environmental Impact Assessment
EMF	Electromagnetic Field
EMP	Environmental Management Plan
Eni	Eni UK Limited
EPC	Engineering Procurement Construction
EPS	European Protected Species
ES	Environmental Statement
ESD	Emergency Shut Down
EU	European Union
FEED	Front End Engineering Design
FO	Fibre Optic
FSL	Floating Shear Legs
G&G	Geophysical and Geotechnical
GHG	Greenhouse Gas
GISZ	Gas Importation And Storage Zone
H_2S	Hydrogen Sulphide
HazMat	Hazardous Materials
HDD	Horizontal Directional Drilling
HLV	Heavy Lift Vessel
HRA	Habitats Regulations Assessment
HVAC	Heating, Ventilation, And Air Conditioning

Acronym/Initialisation	Description
IEMA	Institute Of Environmental Management And Assessment
IES	Institution Of Environmental Sciences
INNS	Invasive Non-Native Species
IOA	Institute Of Acoustics
IPCC	Intergovernmental Panel On Climate Change
IROPI	Imperative Reasons Of Overriding Public Interest
ISP	Irish Sea Pioneer
JNCC	Joint Nature Conservation Committee
JT	Joule-Thompson
LAT	Lowest Astronomical Tide
LBA	Liverpool Bay Area
LCA/SCA	Landscape And Seascape Character Assessment
LDAR	Leak Detection And Repair
LSE	Likely Significant Effects
MAT	Master Application Template
MCAA	Marine And Coastal Access Act
MD	Measured Depth
MDS	Maximum Design Scenario
MHWS	Mean High Water Spring
MLWS	Mean Low Water Spring
MMMP	Marine Mammal Mitigation Protocol
MMO	Marine Management Organisation
MMV	Monitoring, Measuring And Verification
MPS	Marine Policy Statement
MSV	Multi-Purpose Supporting Vessels
NDCs	Nationally Determined Contributions
NE	Natural England
NORM	Naturally Occurring Radioactive Material
NPS	National Policy Statement
NRA	Navigational Risk Assessment
NRP	Natural Resources Policy
NRW	Natural Resources Wales
NRW-MLT	Natural Resources Wales – Marine Licencing Team
NSTA	North Sea Transition Authority, Known As The Oil And Gas Authority Until March 2022.
NUI	Normally Unmanned Installation
OGA	Oil And Gas Authority, Replaced By The North Sea Transition Authority In March 2022
OP	Offshore Platform
OPRED	Offshore Petroleum Regulator For Environment and Decommissioning
P&A	Plugged And Abandoned
PAD	Protocol For Archaeological Discoveries
PDE	Project Design Envelope

Acronym/Initialisation	Description
PINS	The Planning Inspectorate
PoA	Point Of Ayr
POB	People On Board
PWA	Pipeline Works Authorisation
RBMP	River Basin Management Plan
RIAA	Report To Inform Appropriate Assessment
RTPI	Royal Town Planning Institute
SAT	Subsidiary Application Template
SMP	Shoreline Management Plan
SPA	Special Protection Area
SSC	Suspended Sediment Concentrations
T&I	Transportation And Installation
TCPA	Town And Country Planning Act
TDP	Touch Down Point
TVD	True Vertical Depth
UK	United Kingdom
UK ETS	UK Emissions Trading Scheme
UNECE	United Nations Economic Commission For Europe
UNFCCC	United Nations Framework Convention On Climate Change
UXO	Unexploded Ordnance
VSP	Vertical Seismic Profile
WAG	Welsh Assembly Government
WCA	Wildlife And Countryside Act
WFD	Water Framework Directive
WNMP	Welsh National Marine Plan
WSI	Written Scheme Of Investigation
WSW	West South West
ZOD	Zone Of Disturbance
ZOI	Zone Of Influence

Units

Unit	Description
%	Percent
“	Inch (distance; equal to 0.0254 m)
°C	Degrees Celsius (temperature)
Hz	Hertz (frequency)
km	Kilometres (distance)
km^2	Kilometres squared (area)
kV	Kilovolt (electrical potential)
kW	Kilowatt (power)
m	Metres (distance)

Unit	Description
m^2	Metres squared (area)
m^3	Metres cubed (volume)
Mt	Million tonnes (weight)
MW	Megawatt (power)
nm	Nautical Mile (distance; equal to 1.852 km)

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1 INTRODUCTION

1.1 Overview

Eni UK Limited (Eni), whose ultimate parent company is Eni SpA, is a leading partner of the Consortium delivering the HyNet North West Project, through their Eni group affiliate Liverpool Bay CCS Limited ('the Applicant'). The Applicant is developing the HyNet Carbon Dioxide Transportation and Storage Project (hereafter referred to as 'the Project'). The aim of the Project is to reduce carbon dioxide (CO_2) emissions from industry, homes, and transport and support economic growth in the North West of England and North Wales. The Project will include infrastructure to produce and distribute low carbon hydrogen. The hydrogen is produced using natural gas, with the resultant CO_2 emissions captured and stored. A schematic of the HyNet CO_2 Transportation and Storage Project (orange line), within the HyNet North West Project, is illustrated in Figure 1.1.

As part of the offshore components of the Project (hereafter referred to as the 'Proposed Development'), the existing offshore natural gas import pipeline from Point of Ayr (PoA) Gas Terminal will be repurposed to become a CO_2 export pipeline and will transport the CO_2 to the newly constructed Douglas Carbon Capture and Storage (CCS) platform. From the Douglas CCS platform, CO_2 will be transported along re-purposed natural gas pipelines to the Hamilton Main platform for injection into the Hamilton Main reservoir, to the Hamilton North platform for injection into the Hamilton North reservoir, and to the Lennox platform for injection into the Lennox reservoir. The Proposed Development will also require new electrical and fibre optic (FO) transmission infrastructure seawards of Mean High Water Spring (MHWS), connecting the PoA Terminal to the offshore infrastructure. The concept of the Proposed Development is illustrated in Figure 1.2.

This Offshore Environmental Statement (ES) supports the following permit, and licence applications being sought by the Applicant for the Proposed Development:

- a Marine Licence under the Marine and Coastal Access Act (MCAA) 2009 (administered by Natural Resources Wales Marine Licensing Team (NRW-MLT) for licensable activities in Welsh Waters (between 0 and 12 nautical miles (nm) from MHWS) (i.e. all licensable activities associated with installation of the new Douglas CCS platform, associated pipeline connections, new electrical and fibre optic cables, and related works within Territorial Waters); and
- a Storage Permit from the North Sea Transition Authority (NSTA), in accordance with the Storage of Carbon Dioxide (Licensing etc.) Regulations 2010 (SI 2010/2221) for the storage of carbon dioxide at a storage site in the licensed area (licence reference CS004). Prior to the issue of a Storage Licence the Offshore Petroleum Regulator for Environment & Decommissioning (OPRED) must approve the ES.

The Environmental Impact Assessment (EIA) Directive (2011/92/EU, as amended by Directive 2014/52/EU) has traditionally directed the assessment of effects of certain public and private projects on the environment in the United Kingdom (UK). Following the UK's departure from the European Union (EU), EU-derived legislation continues to have effect in domestic law under the European Union (Withdrawal) Act 2018. For this chapter (and throughout this offshore Environmental Statement), where legislation has been amended (for example, by EU Exit Amendment Regulations), following an initial acknowledgement of the amending legislation, the legislation is not referred to as amended.

This ES documents the EIA process and conclusions as carried out in support of applications for consent to develop the proposed HyNet Carbon Dioxide Transportation and Storage Project.

This chapter introduces the Proposed Development, summarises the consents and licences that are required for the proposed works, and outlines the content of the Offshore ES.

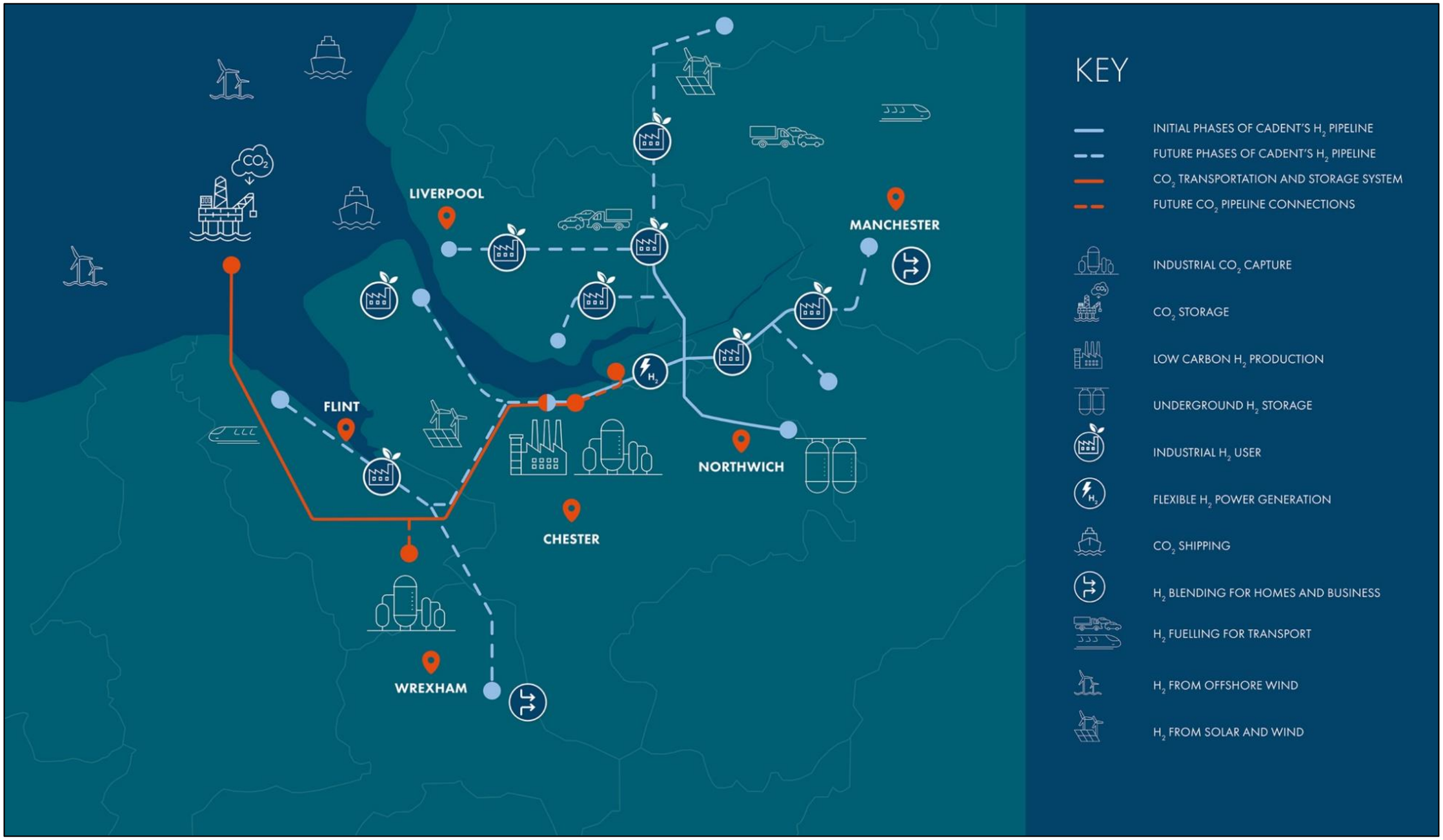


Figure 1.1: Illustrates The HyNet Carbon Dioxide Transportation And Storage Project Within The HyNet North West Project

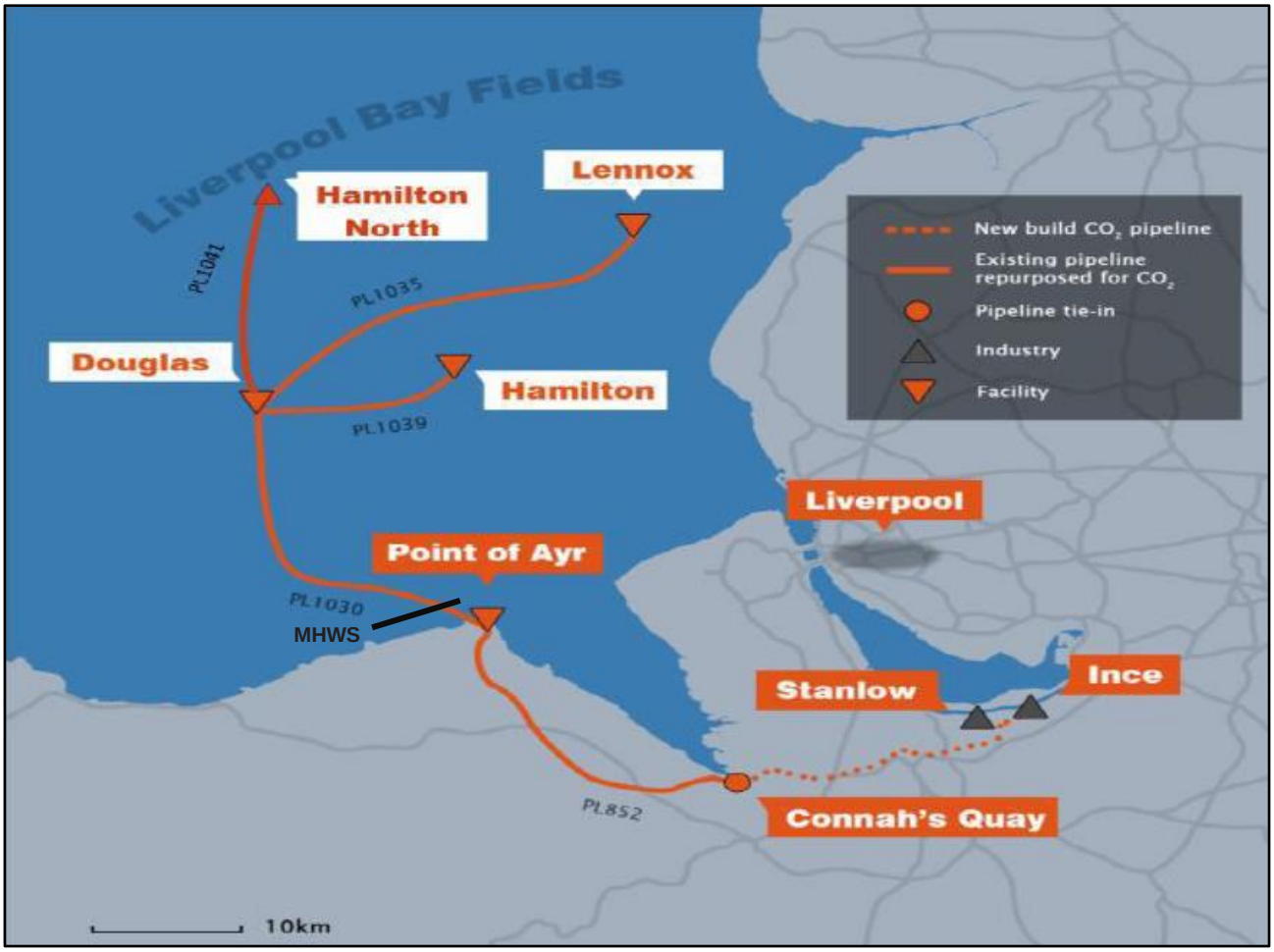


Figure 1.2: Illustrates The Concept Of The Proposed Development (Infrastructure Seawards MHWS)

1.2 The Proposed Development

An overview of the Project is outlined in the paragraphs below, the full Proposed Development description is provided in volume 1, chapter 3.

The Proposed Development is located entirely within the 12 nm limit of both Welsh and English territorial waters and will include:

- installation of a new Douglas CCS platform to replace the existing Douglas Process platform to receive CO_2 from the onshore PoA Terminal and distribute CO_2 to the Hamilton Main, Hamilton North, and Lennox wellhead platforms and when necessary, provide heating. Installation of the new Douglas CCS platform will include up to eight driven piles;
- installation of new topsides on the Hamilton Main, Hamilton North, and Lennox wellhead platforms to receive and inject CO_2 into the depleted hydrocarbon reservoirs;
- repurposing of the existing subsea natural gas pipelines for their change of use from hydrocarbon to CO_2 service;
- installation of new sections of pipeline to connect the new Douglas CCS platform to the existing subsea natural gas pipelines;
- development of the Hamilton Main, Hamilton North, and Lennox reservoirs for the injection of around 109 Mt of CO_2 over a 25-year period for permanent geological storage. The storage would be divided between the three reservoirs, as follows: Hamilton Main, 53 Mt; Hamilton North, 18 Mt; and Lennox 38 Mt.

This will be done through up to eight injection wells created by side tracking of existing production wells. This includes drilling and recompletion operations, all of which will be within the existing footprint (template) of each platform;

- implementation of a programme of Monitoring ,Measurement and Verification (MMV) activities; the Monitoring Plan. This includes the drilling of two new monitoring wells, one at Hamilton North and one at Hamilton Main. Additional monitoring wells will be created from the recompletion of existing wells within the existing footprint (template) of each platform: one monitoring well created by side-tracking an existing well in Lennox; and two sentinel wells, one in Hamilton North and one in Lennox;
- installation, including cable burial, and some dredging, of two submarine 33 kV armoured cables, with integrated FO cable connections (35 km from PoA Terminal onshore to the new Douglas CCS platform, including within the intertidal/foreshore area up to MHWS, within Welsh waters only);
- installation, including cable burial, of new power cables with integrated FO connecting the new Douglas CCS platform with the Hamilton Main (12 km; 33 kV), Hamilton North (15 km; 33 kV) and Lennox (35 km; 33 kV) platforms; and
- installation of concrete mattresses and external cable protection at crossings of existing cables, and in areas where cable burial is not deemed feasible, or as a remedial secondary protection measure if the target cable depth of lowering cannot be achieved.

A 'Project Design Envelope' (PDE) approach has been adopted that takes into account Planning Inspectorate Advice Note Nine: Rochdale Envelope, July 2018 (PINS, 2018). The provision of a PDE is intended to identify key parameters to enable the environmental assessment to be carried out whilst retaining enough flexibility to accommodate further refinement during detailed design, and installation. Further details on the use of the PDE parameters for each of the project elements described above are presented in volume 1, chapter 3.

To support the Proposed Development, several site surveys were caried out between October 2022 and May 2023, including:

- Environmental Baseline Survey (EBS) to inform the Offshore EIA;
- Geophysical and Geotechnical (G&G) survey to inform the Offshore cable routes design;
- surveys to inform the Monitoring Plan, including seismic, bathy-morphological surveys and environmental monitoring; and
- pipeline inspection and facilities integrity surveys.

The site surveys were consented with separate permits (Marine Licenses), accompanied by an Environmental Assessment Justification (EAJ) proportionate to the works within the scope of the surveys, where required.

To support the Proposed Development, the existing offshore infrastructure that will no longer be required for the transport and storage of CO_2, will be decommissioned. This will include removal of the existing Douglas offshore platforms (OPs), and the plugging and abandonment (P&A) of existing wells. These decommissioning activities will be consented with separate permits, upon submission of a Decommissioning Programme (DP), including an Environmental Appraisal (EA) proportionate to the works within the scope of the DP.

The proposed activities will be undertaken within the carbon storage license area (CS004), including within Offshore Licensed Blocks 110/13a, 110/13b, 110/14a, 110/14c and 110/15a. The location overview of the Proposed Development is provided in Figure 1.3.

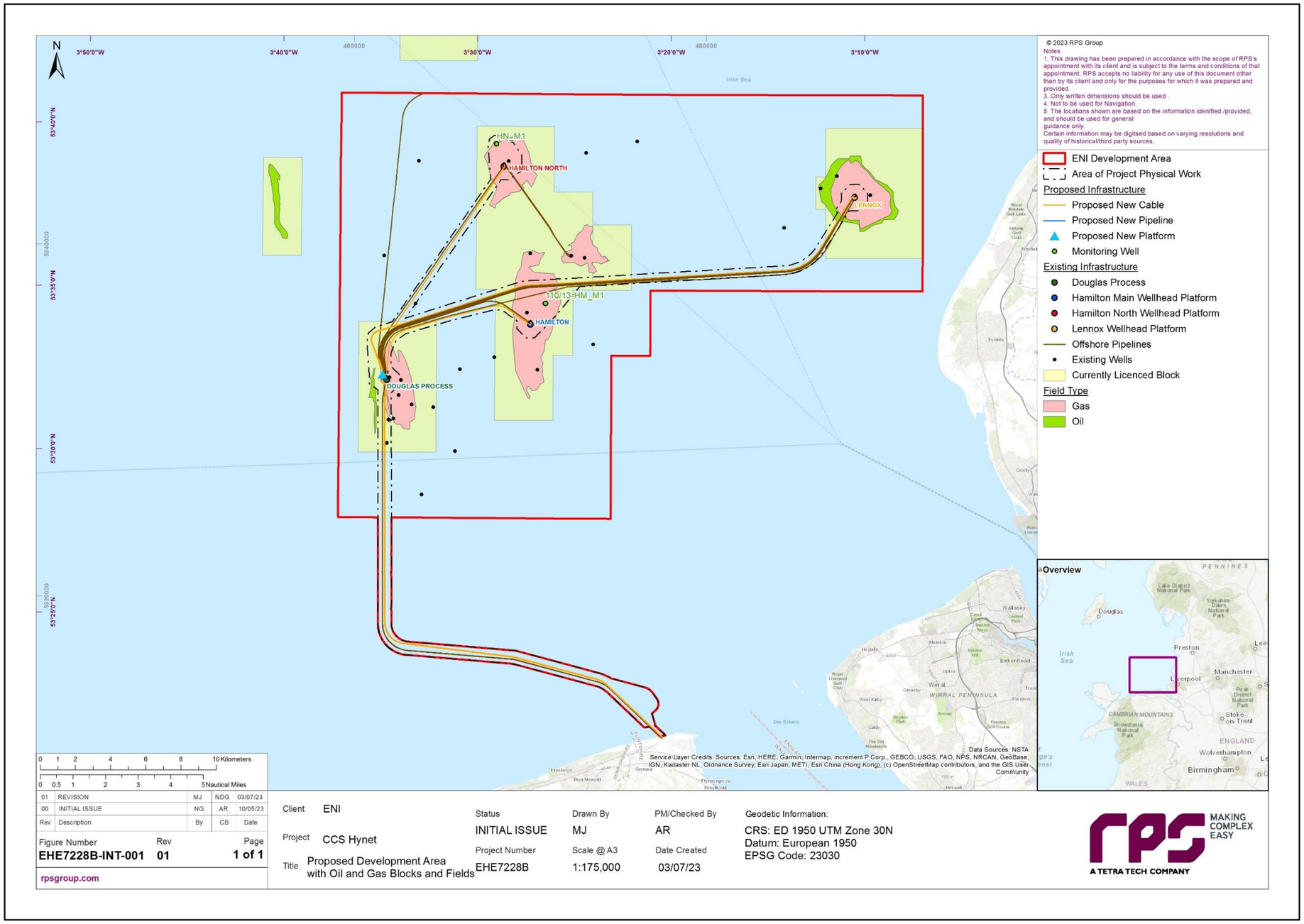


Figure 1.3: Location of the Proposed Development and Eni Development Area overview

1.3 Environmental Impact Assessment

1.3.1 Offshore and onshore EIA

The HyNet Carbon Dioxide Transportation and Storage Project has both Onshore and Offshore elements.

The Onshore elements were supported by two separate ESs:

- an ES to support the Development Consent Order (DCO) application for the HyNet Carbon Dioxide Pipeline DCO. The ES for the HyNet Carbon Dioxide Pipeline DCO application was submitted in October 2022. National Infrastructure Planning Examination of the application started on the 20 March 2023 and closed on the 20 September 2023. The decision from the relevant Secretary of State (SoS) is expected in Q1/Q2 2024; and
- an ES to support the Town and Country Planning Act (TCPA) applications for the HyNet Carbon Dioxide Pipeline TCPA, these covering the elements located in Wales only. An EIA Scoping Report for the HyNet Carbon Dioxide Pipeline TCPA applications was submitted in July 2021 and the EIA Scoping Opinion received in August 2021. Consultation on the ES closed in December 2022 and the planning applications were submitted on the 10 March 2023. The TCPA applications were approved by Flintshire County Council (FCC) on 10th January 2024.

The Onshore elements of the HyNet Carbon Dioxide Transportation and Storage Project are outside the scope of this Offshore ES, which relates to those impacts from the infrastructure seawards of MHWS. The onshore ES for the TCPA application relates to those impacts from infrastructure landwards of Mean Low Water Spring (MLWS) and therefore there is an overlap in assessment within the intertidal area (between MHWS and MLWS).

Where there is an overlap in jurisdiction in the intertidal area between MHWS and MLWS of the Offshore and Onshore consenting and regulatory regimes, both the Offshore ES and the Onshore ES present the relevant technical assessments. Within this Offshore ES, 'Offshore' generally refers to the receptors on the seaward side of MHWS and 'Onshore' refers to the receptors on the landward side of MHWS.

1.3.2 Purpose of the offshore EIA

This report is intended as a single overarching Offshore ES that serves the requirements of all consenting authorities for the Offshore elements, to support the following applications:

- **Storage Permit application**, following requirements defined in License CS004, for the use of the depleted hydrocarbon reservoirs within the Liverpool Bay area for the storage of CO_2, including the carbon dioxide pipeline/transportation and injection facilities offshore. The Storage Permit application includes a Carbon Storage Development Plan, which also contains a detailed description of each storage site and complex, and associated injection facilities.
- **Marine Licence application**, for all licensable activities associated with installation of the new Douglas CCS platform, associated pipeline spool connections, new electrical and FO cables, and related works, located in Welsh waters.

The Offshore ES provides a description of the Proposed Development and presents the environmental information that has been gathered to carry out an assessment of the likely significant environmental effects of the Proposed Development (seaward of MHWS) on the receiving environment.

The Offshore ES specifically:

- provides statutory and non-statutory consultees with technical information to facilitate understanding of the Proposed Development;
- presents the existing environmental baseline information, established from desktop studies, site-specific surveys, and/or consultation;

- describes the EIA methodology used for the assessments;
- presents the likely significant environmental effects arising from the Proposed Development, based on baseline information and data gathered, and the analysis and impact assessments completed as part of the EIA process;
- outlines any limitations encountered during the compilation of the environmental information, including where any data gaps or deficiencies exist, and the level of confidence in the information gathered;
- suggests designed in mitigation measures to avoid, prevent, reduce or, where possible, offset any identified significant adverse effects on the environment, and where appropriate, proposed monitoring arrangements to validate findings of the EIA (see also Section 3.5.1.2). Where additional mitigation measures have been identified, the residual significance of effect has also been presented; and
- provides a description of the reasonable alternatives considered for the Proposed Development, and an indication of the main reasons for site, route, and concept selection.

The Non-Technical Summary (NTS) provides an overview, in non-technical language, of the findings of the Offshore ES.

1.3.3 Scope of the assessment

On 30 September 2022, the Applicant submitted a HyNet Carbon Dioxide Transportation and Storage Project – Offshore EIA Scoping Report to OPRED to support a request for a formal Scoping Opinion from in relation to HyNet Carbon Dioxide Transportation and Storage Project – Offshore EIA Scoping Report (Liverpool Bay CCS Limited, 2022). The intention at this time was that the Douglas OP would be repurposed, but this concept has been replaced by the proposed installation of a new Douglas CCS platform. The Scoping Opinion for HyNet Carbon Dioxide Transportation and Storage Project – Offshore project was received on 27 January 2023, which helped inform the proposed scope of the current assessment for the Proposed Development and guided the Applicant in progressing with the Offshore EIA.

The Scoping Opinion for the HyNet Carbon Dioxide Transportation and Storage Project – Offshore (OPRED, 2023) set out the proposed scope of the assessment and guided the Applicant in progressing with this Offshore ES. As far as responses provided are relevant to the Proposed Development, or the Applicant has been directed to refer to them, the Applicant has relied on these responses to guide the scope of this Offshore ES. Such responses are categorised within the term ‘relevant consultation undertaken to date’.

Based on the Scoping Opinion (OPRED, 2023) received and discussions with stakeholders, as well as consideration of the proposed new Douglas CCS platform, this Offshore ES focuses on the following topic areas:

- Physical Processes;
- Marine Biodiversity (Benthic Subtidal and Intertidal Ecology; Fish and Shellfish Ecology; and Marine Mammals);
- Ornithology;
- Shipping and Navigation;
- Commercial Fisheries;
- Marine Archaeology;
- Infrastructure and Other Sea Users;
- Climate Change; and
- Inter-Related Effects.

The topics Seascape, Landscape and Visual Resources, Aviation and Radar, and Air Quality have been scoped out of the EIA due to no likely significant effect in EIA terms or no effect-receptor pathways identified.

Justification for scoping out these topics is provided in volume 3, appendix C. Major accidents and disasters have also been scoped out of the assessment because the Proposed Development is not seen as vulnerable to, or introducing, risks of major accidents and/or disasters. Furthermore, all possible major accidents and/or disasters are covered by design measures and compliance with legislation and best practice.

1.4 Need for the Proposed Development

Climate change is a global issue, resulting from greenhouse gas (GHG) emissions released into the atmosphere, largely due to human activity. Evidence of the effects of climate change include widespread and rapid changes in the atmosphere, ocean, cryosphere, and biosphere (IPCC, 2021).

The United Kingdom (UK) Parliament announced a climate change emergency in May 2019, publicly declaring concern over the findings around climate change and its consequences. The Climate Change Act 2008 (2050 Target Amendment) Order 2019 introduced a legally binding commitment that the net UK carbon account for the year 2050 must be at least 100% lower than the 1990 baseline i.e. 'net zero'. The Committee on Climate Change (CCC10) concluded that net zero is (CCC, 2019):

- **necessary** to respond to the overwhelming evidence of the role of GHGs in driving global climate change;
- **feasible** as the technologies and approaches to deliver net zero are understood and can be implemented with strong government leadership; and
- **cost-effective** given the falls in the costs of key technologies that permit net zero.

To achieve the UK Net Zero target, it is thought that industrial emissions in the UK will need to reduce by at least two thirds by 2035, and at least 90% by 2050, and to achieve this, the deployment of carbon capture and storage (CCS) is essential (CCC, 2019). CCS refers to a set of processes that capture CO_2 from waste gases produced at industrial or power generation facilities and permanently store it in offshore geological storage sites. CCS is proven technology and is already in use around the world (Global CCS Institute, 2021).

Forecasts of the UK's future energy scenarios require CCS to be utilised with industrial processes where there are limited available alternatives to fossil fuels e.g. producing steel, concrete, and chemicals (BEIS, 2022a; IEA, 2020). Power plants with CCS provide reliable lower carbon generation capacity and are intended to reduce emissions compared to unabated plants by 90% or more. Power plants equipped with post-combustion CCS could provide flexible generation that is able to ramp up or down to meet demand and balance variable generation from renewable electricity sources (National Grid, 2020).

In November 2020, the UK Government published the Ten Point Plan for a Green Industrial Revolution, to decarbonise the economy with commitments focused on driving innovation, boosting export opportunities, and generating green jobs and growth across the country to level up regions of the UK. Included in the Plan was the first UK commitment to deploy CCS in two industrial clusters by the mid-2020s, and a further two clusters by 2030 with an ambition to capture 10 million tonnes per annum (MtPA) CO_2 by 2030 (UK Government, 2020). The UK Government is committed to investing up to £1 billion to support the establishment of CCS in four industrial clusters in areas such as the North West, Wales, the Humber, North East, and Scotland (UK Government, 2021). CCS infrastructure is needed to decarbonise the industrial areas of the North West proposed by HyNet.

As part of encouraging CCS cluster development, the Government established a cluster sequencing process in February 2021, which seeks to provide industry with the certainty to deploy the technology at pace and at scale (BEIS, 2021a). In October 2021, the UK Government published the UK Net Zero Strategy, which set out to at least double the commitments from the UK Government's Ten Point Plan by aiming to capture between 20 and 30 MtPA of CO_2. In the same month, the Department for Business, Energy and Industrial Strategy (BEIS) (now the Department for Energy Security and Net Zero (DESNZ)) confirmed two Track-1 clusters, i.e. clusters expected to be operational by mid-2020s and having the first opportunity to receive support from the government's CCS Programme.

HyNet is one of the two selected Track-1 clusters and includes the Proposed Development (Section 1.2). The Proposed Development aims to transport and store around 4.5 MtPA CO_2, and 109 Mt by the end of the 25-year life of the Proposed Development. Achieving these aims bolsters the UK's leadership in the energy transition and the emerging global low-carbon and hydrogen market and plays a major role in the desire to level up across the country. The Development is critical to delivery of the wider HyNet Project by providing the onshore and offshore infrastructure for transporting CO_2 from the industrial emitters in the North West of England to the Liverpool Bay storage sites.

1.5 Statutory Consents and Permissions

The Project is located within the jurisdictions of England and Wales; therefore, the Offshore ES will be submitted to two regulators: NRW-MLT for the Marine Licence Application in Wales; and OPRED, who will approve the ES for the Storage Permit Application to the NSTA covering England and Wales.

Further details of the other consents that will be required, consenting process, and legislation that the Project will comply with is provided in volume 1, chapter 2.

1.6 The Applicant

The Applicant is an integrated energy company committed to developing a fully decarbonised portfolio of products and services by 2050, creating value for their stakeholders and contributing to a socially just energy transition (Eni, 2021). As a global energy company, Eni is active at every stage of the value chain, from natural gas and oil to co-generated electricity and renewables.

1.7 The EIA Team

Eni UK Limited (Eni) has engaged the services of RPS ('the Environmental Consultants'), who are competent and experienced experts in the field of offshore EIA, to carry out an EIA in respect of the Proposed Scheme and to prepare this ES. In accordance with the Regulation 12(2)(f), (g) of The Marine Works (EIA (England and Wales) Regulations 2007 (as amended) (the '2007 EIA Regulations'), Eni confirms that to the best of their knowledge and belief, the Environmental Consultants are competent experts within the meaning of the 2007 EIA Regulations. This belief is based on the Environmental Consultants' relevant expertise, qualifications, and level of experience in preparing environmental statements. The evidence of the Environmental Consultants' competence is demonstrated in Table 1.1.

Table 1.1: Qualifications And Experience Of The Offshore EIA Competent Experts Responsible For The Preparation Of The ES

Role	Qualifications
EIA Project Director	• RPS Associate Director with 20+ years' experience in the environmental sector. • BSc Joint Hons (2:1) Botany and Marine Biology, University of Wales, Bangor, MSc Marine Resource Management, Heriot-Watt University, Graduate Certificate, Environmental Studies, Strathclyde University. • Full Member, The Institution of Environmental Sciences (IES), Associate Member, Association for Project Management (APM), Affiliate Member, Institute of Environmental Management and Assessment (IEMA), Affiliate Member, Royal Town Planning Institute (RTPI).
EIA Project Manager	• RPS Principal Consultant with 20+ years' experience in the environmental sector. • M.Sc. Marine Resource Development and Protection, B.Sc. (Hons). Geology. • Full membership of IEMA, Chartered Environmentalist (Cenv).
EIA Assistant Project Manager	• RPS Senior Consultant with 11+ years' experience in the energy sector.

Role	Qualifications
	• MSc (Distinction) Environmental Partnership Management, University of Aberdeen, MSc Petroleum Engineering, Delft University of Technology, BSc Applied Earth Sciences, Delft University of Technology.
Physical Processes	• RPS Senior Engineer - Water Environment and Flood Risk Management. • PhD Computational Fluid Dynamics, Queen's University of Belfast, MSc Engineering Computation, Queen's University of Belfast, PGCHET Queen's University of Belfast, BEng (2:1 Hons.) Civil Engineering, University of Brighton. • Graduate member Institution of Civil Engineers, Registered Practitioner for Higher Education Academy (ILTHE).
Marine Biodiversity	• RPS Principal Consultant with 12+ years' experience in the environmental sector. • BSc (Hons) Marine Biology and Oceanography.
Ornithology	• RPS Senior Consultant with 4+ years' experience in the environmental sector. • BSc (Hons) in Zoology with Industrial Experience, University of Manchester, MPhil (Cantab) in Biological Science, University of Cambridge. • Associate Member of IMarEST.
Shipping and Navigation	• Anatec Ltd Principal Risk Analyst with 20+ years' experience. • BEng (Hons) in Chemical Engineering and an MSc in Information Technology Systems from the University of Strathclyde.
Commercial Fisheries	• Poseidon Aquatic Resources Management Ltd Director with 13+ years' experience. • B.Sc. Marine Biology (First Class Hons), University of Newcastle upon Tyne, B.Eng. Chemical Engineering (2:1 Hons), Edinburgh University.
Marine Archaeology	• MSDS Marine Ltd Director with 12+ years' experience in the maritime archaeology sector. • BSc (Hons) Marine Archaeology, Bournemouth University.
Infrastructure and Other Sea Users	• RPS Principal Consultant with 18+ years' experience. • MSc Environmental Science, BSc Ocean Sciences, Society for the Environment Cenv, Science Council Chartered Scientist (CSci), Energy Institute Member, IEMA Affiliate Member.
Climate Change	• RPS Associate Director – EIA and Sustainability. • BSc (Hons) Geography and Environmental Sciences, MSc Sustainable Cities, BREEAM UK NC Assessor. • Practitioner Member of IEMA.
Air Quality	• RPS Principal Air Quality Consultant. • BSc (Hons) Environmental Science, MSc Environmental Pollution Control. • Member of the Institute of Air Quality Management (IAQM) and Associate Member of the Institute of Environmental Sciences.
Aviation and Radar	• Anatec Ltd Principal Risk Analyst with 20+ years' experience. • BEng (Hons) in Chemical Engineering and an MSc in Information Technology Systems from the University of Strathclyde.
Seascape, Landscape and Visual Resources	• RPS Director - Planning and Environment with 30+ years' experience in urban and rural design, and planning. • BSc (Hons) Environmental Science, University of Ulster, Master of Landscape Architecture, University of Edinburgh. • Chartered Member of the Landscape Institute, Member of the Irish Landscape Institute, Practitioner Member of IEMA.
Underwater Noise	• Seiche Specialist Acoustic Consultant with 24+ years' experience. • BSc (Hons) Physics University of Bristol. • Chartered Engineer (CEng) Institute of Acoustics (IOA), Member of IOA, Associate of the Acoustical Society of America.

1.8 Structure of the Offshore ES

The Offshore ES relates to those impacts and receptors associated with the offshore environment (seaward of MHWS), including potential impacts of offshore infrastructure on onshore and offshore receptors (i.e. impacts from infrastructure seaward of MHWS).

The Offshore ES is divided into four volumes:

- volume 1 – Introductory Chapters;
- volume 2 – Offshore ES Main Report; and
- volume 3 – Offshore ES Technical Reports; and

Table 1.2 provides a breakdown of the contents of each of the Offshore ES Report volumes and the organisations that have contributed to them. Topics are discussed in full within each chapter in a consistent and sequential manner (i.e. each environmental receptor chapter describes the baseline, impact assessment, mitigation measures, and conclusions for the receptor).

Table 1.2: Structure Of The Offshore ES

Chapter Number	Chapter Title	Lead Author
Non-Technical Summary		
-	Non-Technical Summary	RPS and The Applicant
Volume 1 – Introductory Chapters		
-	Glossary	RPS
-	Acronyms and Initialisations	RPS
-	Units	RPS
1	Introduction	RPS
2	Policy and Legislative Context	RPS
3	Proposed Development Description	RPS and The Applicant
4	Site Selection and Consideration of Alternatives	RPS and The Applicant
5	Environmental Impact Assessment Methodology	RPS
Volume 2 – Offshore ES Main Report		
6	Physical Processes	RPS
7	Marine Biodiversity	RPS
8	Ornithology	RPS
9	Shipping and Navigation	Anatec Ltd.
10	Commercial Fisheries	Poseidon Aquatic Resource Management Ltd.
11	Marine Archaeology	MSDS Marine Ltd.
12	Infrastructure and Other Sea Users	RPS
13	Climate Change	RPS
14	Inter-Related Effects	RPS
Volume 3 – Appendices and Technical reports		
Appendix A	Scoping Report	RPS
Appendix B	Scoping Opinion	RPS
Appendix C	Topics scoped out of assessment	RPS
Appendix D	Marine Plan policies	RPS

Chapter Number	Chapter Title	Lead Author
Appendix E	Enhancement, Mitigation and Monitoring Commitments	RPS and The Applicant
Appendix F	Cumulative Effects Appendix	RPS
Appendix G	Transboundary Impacts Screening	RPS
Appendix H	Physical Processes Technical Report	RPS
Appendix I	Marine Biodiversity Technical Reports	RPS
Appendix J	Underwater Noise Technical Report	Seiche Ltd.
Appendix K	Ornithology Technical Reports	RPS
Appendix L	Navigational Risk Assessment (NRA) Report	Anatec Ltd.
Appendix M	Commercial Fisheries Technical Report	Poseidon Aquatic Resource Management Ltd.
Appendix N	Marine Archaeology Technical Report	MSDS Marine Ltd
Appendix O	Greenhouse Gas Assessment	RPS
Appendix P	Report to Inform Appropriate Assessment (RIAA)	RPS
Appendix Q	Water Framework Directive (WFD) Report	RPS
Volume 4 – Outline Management Plans		
Appendix R	Appendix O Environmental Management Plan (EMP)	RPS
Appendix S	Marine Mammal Mitigation Protocol (MMMP)	RPS
Appendix T	Invasive Non-Native Species (INNS) Plan	RPS
Appendix U	Written Scheme of Investigation (WSI) and Protocol for Archaeological Discoveries (PAD)	MSDS Marine Ltd

1.9 Availability of the Offshore ES

The documents described in Table 1.2, and above, have been made publicly available online, giving all interested parties an opportunity to engage with the Proposed Development. The Offshore ES, including the non-technical summary, is available in English language in digital format at:

- **website:** https://hynethub.co.uk/.

1.9 References

Eni (2021) *Eni for 2021 – Carbon neutrality by 2050*. Available at: https://www.eni.com/assets/documents/eng/just-transition/2021/eni-for-2021-carbon-neutrality-2050-eng.pdf Accessed on September 2023.

Liverpool Bay CCS Limited (2022) *HyNet Carbon Dioxide Transportation and Storage Project - Offshore EIA Scoping Report*.

Liverpool Bay CCS Limited (2023) *HyNet Carbon Dioxide Pipeline TCPA - Onshore Environmental Statement*.

Offshore Petroleum Regulator for Environment and Decommissioning (OPRED) (2023). *Scoping Opinion for HyNet Carbon Dioxide Transportation and Storage Project - Offshore*.

The Planning Inspectorate (PINS) (2018) *Advice Note Nine: Rochdale Envelope.*

2 POLICY AND LEGISLATIVE CONTEXT

2.1 Introduction

This chapter of the Offshore Environmental Statement (ES) provides a summary of the policy and legislative context for the Proposed Development, specifically in relation to:

- international obligations and policy, including those derived from European legislation, relating to climate change, reducing Greenhouse Gas (GHG) emissions and the role of Hydrogen, and Carbon Capture and Storage (CCS);
- United Kingdom (UK) and Welsh climate change and energy policy and legislation;
- planning consents and environmental legislation, including the consent applications required for the construction, operation and maintenance, and decommissioning of the Proposed Development; and
- other legislation that may be relevant to the Proposed Development.

Policy and legislation relating to specific topics, particularly in respect to the impact assessment, is discussed in the relevant topic chapters of this Offshore ES.

The consents required are dictated by the location, nature and scale of the Proposed Development and the consenting requirements are explained with reference to different legislative requirements within inshore/offshore waters. Section 2.4 describes the consents and legislation relevant to the Proposed Development.

Throughout this Offshore ES, where legislation has been amended (for example, by European Union (EU) Exit Amendment Regulations), following an initial acknowledgement of the amending legislation, the legislation is referred to 'as amended'.

2.2 Climate change and energy policy and legislation

This section provides a summary of policy, legislation, and strategy in relation to the climate crisis and the role of CCS and low carbon hydrogen.

2.2.1 International commitments

Climate change and energy policy in the UK is underpinned by international commitments, which are summarised below.

2.2.1.1 United Nations Framework Convention on Climate Change

The United Nations Framework Convention on Climate Change (UNFCCC) came into force on 21 March 1994. Its objective was to achieve:

'*Stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system*' (United Nations, 1992).

To date, the UNFCCC has been ratified by 197 signatories, including the UK.

2.2.1.2 Kyoto Protocol

The UK is a signatory to the Kyoto Protocol, an international agreement for the implementation of the UNFCCC. The Kyoto Protocol commits industrialised countries and economies to limit and reduce GHG emissions in accordance with agreed individual targets. The protocol came into effect in 2005 and its commitments are transposed into UK law by the Climate Change Act 2008 (as amended).

The protocol initially placed a duty on the UK to ensure that the net UK carbon account for the year 2050 was 80% lower than the 1990 baseline. Due to increasing awareness of the need for more urgent action, this was

revised to a '*net zero target*' of GHG emissions for the year 2050 to be 100% lower than the 1990 levels by the Climate Change Act 2008 (2050 Target Amendment) Order 2019.

2.2.1.3 The United Nations adoption of the Paris Agreement COP21

In December 2015, 195 countries adopted the first ever universal, legally binding global climate deal at the Paris climate conference (21st Conference of the Parties (COP)). The Paris Agreement (United Nations, 2015) seeks to reduce global GHG emissions and to limit the global temperature increase in this century to 2°C, while pursuing the means to limit this further to 1.5°C. This was ratified by the UK Government in November 2016 and now forms part of UK Government Policy.

2.2.1.4 The Glasgow Pact COP26

At the COP26 summit in November 2021, nearly 200 parties voted to adopt the Glasgow Climate Pact (UNFCCC, 2021). This included commitments to phase down the use of coal and supports a common timeframe and methodology for national commitments on emissions reductions. Countries were tasked to return in 2022 with more ambitious 2030 emissions reductions targets.

2.2.2 European legislation

2.2.2.1 EU exit

On 31 January 2020, the UK formally left the EU after triggering article 50 of the Lisbon Treaty (EU Exit). After leaving the EU, the UK Government has committed, as a minimum, to implement international environmental obligations in accordance with the EU (Withdrawal) Act 2018 and to maintain environmental commitments made and legislation enacted following the departure of the UK from the EU (HM Government, 2018).

On this basis, the existing EU Climate Change Act 2008 will remain applicable. However, new EU legislation or updates to existing directives will not be required to be transposed into UK law.

Where specific EU Exit legislation has been implemented to ensure legislative instruments continue to operate in a similar way after EU Exit Day, these are discussed in this chapter.

2.2.3 UK climate change and energy policy and legislation

The UK has several policies relating to climate change and energy, a summary of which is provided below.

2.2.3.1 The Climate Change Act 2008 (as amended)

Under the Climate Change Act 2008, the UK committed to a net reduction in GHG emissions of 80% by 2050 against the 1990 baseline in line with the commitments of the Kyoto Protocol. In June 2019, secondary legislation (the Climate Change Act 2008 (2050 Target Amendment) Order 2019) was passed that extended that target to at least 100% against 1990 baseline by 2050, with Scotland committing to a net zero by 2045.

The Climate Change Act 2008 also established the Climate Change Committee (CCC), which advises the UK and devolved governments on emissions targets and reports to Parliament on progress made in reducing GHG emissions and preparing for and adapting to the impacts of climate change.

The CCC has produced six four yearly carbon budgets, covering 2008-2037. The UK has so far outperformed on its carbon budget targets, but progress is slowing, and the UK is not on track to meet its future budgets or the overall reduction target, according to the most recent Progress Report to Parliament by the Committee on Climate Change (CCC, 2021). Low carbon and hydrogen energy proposed developments, such as the HyNet North West Project, are an important part in aiding the whole of the UK to meet its future environmental budgets.

2.2.3.2 Carbon capture and storage

The CCC have stated that CCS is a necessity, not an option (CCC, 2021). CCS is fundamental to the decarbonisation of energy intensive industries, such as chemical and cement plants and refineries, and will enable domestic production of low carbon hydrogen from natural gas.

Through updates to National Policy Statement (NPS) EN-1 (DESNZ, 2023), the UK Government recognises that new CCS infrastructure will be essential to ensuring the transition to a net zero economy and that any realistic alternatives to new CCS infrastructure for delivering net zero by 2050 are limited.

To meet the UK's sixth carbon budget, the Government has outlined an ambition to capture 20-30 $MtCO_2$ per year by 2030 and the CCC have recommended that the first cluster should be operational by 2025, with at least one cluster involving low-carbon hydrogen. A cluster is a collection of businesses and applications working in unison to create a new hydrogen network.

The HyNet North West Project is an innovative low carbon and hydrogen energy project that will provide infrastructure to unlock a low carbon economy for the North West of England and North Wales and put the region at the forefront of the UK's drive to Net-Zero. The importance of the Project has been recognised in the Government's choice in taking forward the Project in Track 1 of its Cluster Sequencing process, which provides support to begin decarbonising industry from 2025.

The Proposed Development, being part of the HyNet North West Project, will contribute to the reduction of CO_2 in the atmosphere and make a significant contribution to the international, national, and local effort against the climate emergency. The HyNet North West Project overall will capture 10 $MtCO_2$ per year by 2030, the equivalent of taking four million cars off the road or the equivalent of heating 5 million households with natural gas boilers for a year. The transportation and offshore storage of CO_2 via the Proposed Development, in combination with the onshore elements of the CCS infrastructure, means that industry in the region will be able to reduce their emissions and new low-carbon hydrogen plant can be built with the CO_2 captured.

2.2.3.3 The Energy Act 2008

The Energy Act 2008 provides for a licensing regime that governs the offshore storage of carbon dioxide. It forms part of the transposition into UK law of EU Directive 2009/31/EC on the geological storage of carbon dioxide. In 2011, the Storage of Carbon Dioxide (Amendment of the Energy Act 2008 etc.) Regulations 2011 extended the licensing regime to onshore and the adjacent internal waters in the United Kingdom. Carrying out regulated CCUS operations without a license is prohibited. The Storage of Carbon Dioxide (Licensing etc.) Regulations 2010 (SI 2010/2221), which transpose many other requirements of the Directive, came into force in 1 October 2010.

The regime applies to storage in the offshore area comprising both UK territorial sea and beyond designated as a Gas Importation and Storage Zone (GISZ) under Section 1(5) of the Act. The North Sea Transition Authority (NSTA), formerly known as the Oil and Gas Authority, is the licensing authority for offshore storage within the territorial sea adjacent to England and Wales. In addition to applying for a license, developers must obtain a grant of the appropriate rights from the Crown Estate.

2.2.3.4 The Clean Growth Strategy 2017

In October 2017, the government announced its new approach to Carbon Capture, Usage and Storage (CCUS) in the Clean Growth Strategy (HM Government, 2017). The approach is designed to enable the UK to become a global technology leader for CCUS and ensure that government has the option of deploying CCUS at scale during the 2030s, subject to costs coming down sufficiently. To progress this ambition, the government has set out action under three themes:

- reaffirming our commitment to deploying CCUS in the UK subject to cost reduction;
- international collaboration on CCUS; and
- CCUS innovation.

Additionally, in 2018, the UK Government published "*The UK Carbon Capture Usage and Storage Deployment Pathway: An Action Plan*" (HM Government, 2018). This document further illustrated and details the commitment to CCS as part of the UK's Energy Strategy. Furthermore, the Action Plan identifies the East Irish Sea Basin as a key location to develop CCS projects.

2.2.3.5 The Ten Point Plan for a Green Industrial Revolution 2020

The UK's Ten Point Plan (HM Government, 2020a) intends to set the foundations for a Green Industrial Revolution, creating jobs through harnessing British science and technology to create and use clean energy. Point 1 of the Ten Point Plan is '*Driving the Growth of Low Carbon Hydrogen*' and Point 8 is '*Investing in Carbon Capture, Usage and Storage*'.

The Plan notes that producing low carbon hydrogen at scale will be made possible by carbon capture and storage and that developing CCS infrastructure will contribute to the economic transformation of the UK's industrial regions, enhancing the long-term competitiveness of UK industry in a global net zero economy.

It confirms the ambition to capture and store 10 Mt of CO_2 per year by 2030 and sets out a proposed £1 billion CCUS Infrastructure Fund to invest in the new carbon capture industry at pace and scale.

2.2.3.6 The HM Government Energy White Paper - Powering our Net Zero Future 2020

Following the Prime Minister's ten-point plan for a green revolution (HM Government, 2020a), the White Paper (HM Government, 2020b) marked a significant milestone in the UK's net-zero transition, setting a net-zero target by 2050 and outlining how this may be achieved. It relates to the generation, supply and use of energy with the drive towards net zero by 2050 at its core, along with energy-efficient buildings and lower household bills. It signalled a decisive move away from fossil fuel generation and highlights how planned Government investment has the potential to leverage billions of pounds more in private sector funding and support for over 250,000 jobs in the green economy by 2030.

In particular, the White Paper set out a commitment to invest £1 billion up to 2025 to facilitate the deployment of CCUS in two industrial clusters (HyNet and East Coast Clusters) by the mid-2020s, and a further two clusters by 2030, supporting the aim to capture 10 $MtCO_2$ per year by the end of the decade.

2.2.3.7 UK Net Zero Strategy 2021

Building on the Ten Point Plan, the Energy White Paper, the requirements of the Climate Change Act 2008 (2050 Target Amendment) Order 2019 and the commitments made at COP26, the Government published its Net Zero Strategy in 2021 (HM Government, 2021). This sets out the long-term plan to end the UK's contribution to man-made climate change by 2050. The key policies in the net zero strategy include:

- by 2035 the UK will fully decarbonise the power system; and
- deliver six $MtCO_2$ per year of industrial CCUS by 2030, and nine $MtCO_2$ per year by 2035.

The Strategy proposed that the UK lead the way in meeting the commitments made at COP26.

2.2.4 Welsh policy and legislation

2.2.4.1 Climate policy Wales

The Welsh Government declared a climate emergency in April 2019 (Welsh Government, 2019a). Following this, Wales has set interim carbon targets for 2030 and 2040, and a series of carbon budgets. The second carbon budget for 2021 to 2025 sets out the plan for Net Zero Wales (Welsh Government, 2021a).

Further details of the approach to achieving net zero are set out in the Working Together to Reach Net Zero document (Welsh Government, 2022) and in Prosperity for All: A Low Carbon Wales (Welsh Government, 2019b).

2.2.4.2 The Well-being of Future Generations (Wales) Act 2015

The Well-being of Future Generations (Wales) Act 2015 places the duty on public bodies to place the principles of sustainability and sustainable development at the heart of its decision-making processes. The Act is centred in improving the social, economic, environmental, and cultural well-being of Wales. The relevant objectives of the Well-being of Future Generations (Wales) Act 2015 include:

- A Resilient Wales – contributing to the protection and improvement of the environment, to improve the quality of life and protect local and global ecosystems;
- A Healthier Wales – contribute to the protection and, where possible, the improvement of people's health and well-being as a core component of achieving the well-being goals and responding to climate change; and
- A Globally Responsive Wales – support the need to tackle the causes of climate change by moving towards a low carbon economy.

2.2.4.3 The Environment (Wales) Act 2016

The Environment (Wales) Act 2016 puts in place the legislation needed to plan and manage Wales's natural resources in a more proactive, sustainable and collective way. A key part of the Environment (Wales) Act 2016 focuses on climate change with the aim to reduce emissions by at least 80% by 2050 and sets a clear path for decarbonisation in the future.

The Environment (Wales) Act 2016 is supported by the Natural Resources Policy (NRP) which focuses on the sustainable management of Wales's natural resources to maximise their contribution to achieving goals within the Well-being of Future Generations (Wales) Act. The NRP sets out three National Priorities including '*increasing renewable energy and resource efficiency*'.

The act will provide an iterative framework that ensures sustainable management of natural resources, provide Natural Resources Wales (NRW) with tools to manage natural resources more sustainably, and include a biodiversity duty to help in reversing decline and securing the long-term resilience of biodiversity in Wales.

2.2.4.4 Future Wales: The National Plan 2040

Future Wales (Welsh Government, 2021b) is the national development framework, setting the direction for development in Wales to 2040. It addresses key national priorities, including sustaining and developing a vibrant economy, achieving decarbonisation and climate-resilience, developing strong ecosystems and improving the health and well-being of communities.

In terms of climate change, Future Wales recognises that changes to climate and weather patterns will have a significant impact on well-being for both current and future generations. Therefore, climate change is identified as an equality issue as it will disproportionately affect the most vulnerable communities in Wales and throughout the world.

Furthermore, the plan realises that it is vital that emissions are reduced to protect well-being and to demonstrate global responsibility. Future Wales together with Planning Policy Wales will ensure the planning system focuses on delivering a decarbonised and resilient Wales. Future Wales identifies that Wales can become a world leader in renewable energy technologies. Wales's support for both large and community scaled projects and commitment to ensuring the planning system provides a strong lead for renewable energy development means it is well placed to support the renewable sector, attract new investment and reduce carbon emissions.

2.3 Marine policy

2.3.1 UK Marine Policy Statement

Published in 2011, the UK Marine Policy Statement (MPS), under Section 44 of the Marine and Coastal Access Act (MCAA) 2009, provides the framework for marine spatial planning, specifically for the preparation of Marine Plans and to ensure marine resources are utilised in a sustainable way (Defra, 2011). The MPS was jointly adopted by the Secretary of State, Welsh Minister, Scottish Ministers, and the Department of the Environment in Northern Ireland to promote successful collaboration opportunities.

The MPS states that Marine Plans should consider and identify the specific areas of potential related to the deployment of various renewable energy technologies, to help improve the UK's energy security. Additionally, the MCAA 2009 requires that all public authorities taking authorisation and/or enforcement decisions that affect or have the potential to affect the UK marine area, to do so in accordance with the MPS and relevant Marine Plans.

2.3.2 North West Marine Plan

Part of the Eni development area overlaps with English offshore waters, and is covered by the North West Inshore and North West Offshore Marine Plan (Figure 2.1). The North West Inshore and North West Offshore Marine Plan was published in June 2021 (HM Government, 2021) and introduces a strategic approach to marine planning within the marine plan area. It is intended to inform decision-making by marine users and regulators on where, when or how activities may take place within the marine plan area.

The North West Inshore and North West Offshore Marine Plan sets out the following four objectives in relation to achieving a sustainable marine economy:

- infrastructure is in place to support and promote safe, profitable, and efficient marine businesses;
- the marine environment and its resources are used to maximise sustainable activity, prosperity and opportunities for all, now and in the future;
- marine businesses are taking long-term strategic decisions and managing risks effectively. They are competitive and operating efficiently; and
- marine businesses are acting in a way which respects environmental limits and is socially responsible. This is rewarded in the market place.

The policy provisions within the North West Inshore and North West Offshore Marine Plan relevant to each physical, biological and human environment topic of the Environmental Impact Assessment (EIA) will be presented and addressed in the individual technical topic chapters of the ES.

When assessing applications in England (see section 2.4) the Regulator, in this case, the NSTA, must determine whether the activities of the proposed project are compatible with the objectives of the relevant marine plan. The key policies relevant to the Proposed Development and how the policy objectives have been addressed are presented in volume 3, appendix D.

2.3.3 Welsh National Marine Plan

The Welsh National Marine Plan (WNMP) was published in November 2019 (Welsh Government, 2019c), introducing a framework to support sustainable decision making within the marine environment. Policies within the WNMP are specific to the renewable energy sector.

The WNMP represents the planning process to shape Wales's seas to support economic, social, environmental, and cultural objectives. The purpose of the WNMP is to guide the sustainable development of Wales's marine area by setting out how proposals will be considered to decision makers. Pertaining to the Welsh inshore region (out to 12 nautical miles (nm)) and the offshore region (12 nm to 200 nm), the WNMP sets out four key objectives in achieving an increasingly sustainable marine economy, including:

- contribute to a thriving Welsh economy by encouraging economically productive activities and profitable and sustainable businesses that create long-term employment at all skill levels;
- support the opportunity to sustainably develop marine renewable energy resources with the right development in the right place, helping to achieve the UK's energy security and carbon reduction objectives, whilst fully considering other's interests, and ecosystem resilience;
- provide space to support existing and future sustainable economic activity through managing multiple uses, encouraging the coexistence of compatible activities, the mitigation of conflicts between users and, where possible, by reducing the displacement of existing activities; and
- recognise the significant value of coastal tourism and recreation to the Welsh economy and well-being and ensure such activity and potential for future growth are appropriately safeguarded.

When assessing Marine Licence applications in Wales (see section 2.4) the Regulator, NRW, must determine whether the activities of the proposed project are compatible with the objectives of the relevant marine plan. The key policies relevant to the Proposed Development and how the policy objectives have been addressed are presented in volume 3, appendix D.

2.3.4 North West Shoreline Management Plan

The Shoreline Management Plan (SMP) is a non-statutory policy document for coastal defence management planning that was formally adopted in August 2016. It takes account of other existing planning initiatives and legislative requirements and is intended to inform wider strategic planning. The SMP identifies the most sustainable management policies over three main timescales – the present day (0 years to 20 years), the medium-term (20 years to 50 years) and the long-term (50 years to 100 years). There are four policy options: Hold the Line, Advance the Line, Managed Realignment, No Active Intervention. SMPs form an important part of the Department for Environment, Food and Rural Affairs (Defra) and Welsh Assembly Government (WAG) strategy for managing risks due to flooding and coastal erosion. The North West SMP extends between Great Orme's Head in North Wales and the Scottish Border. This area is also known as Cell 11.

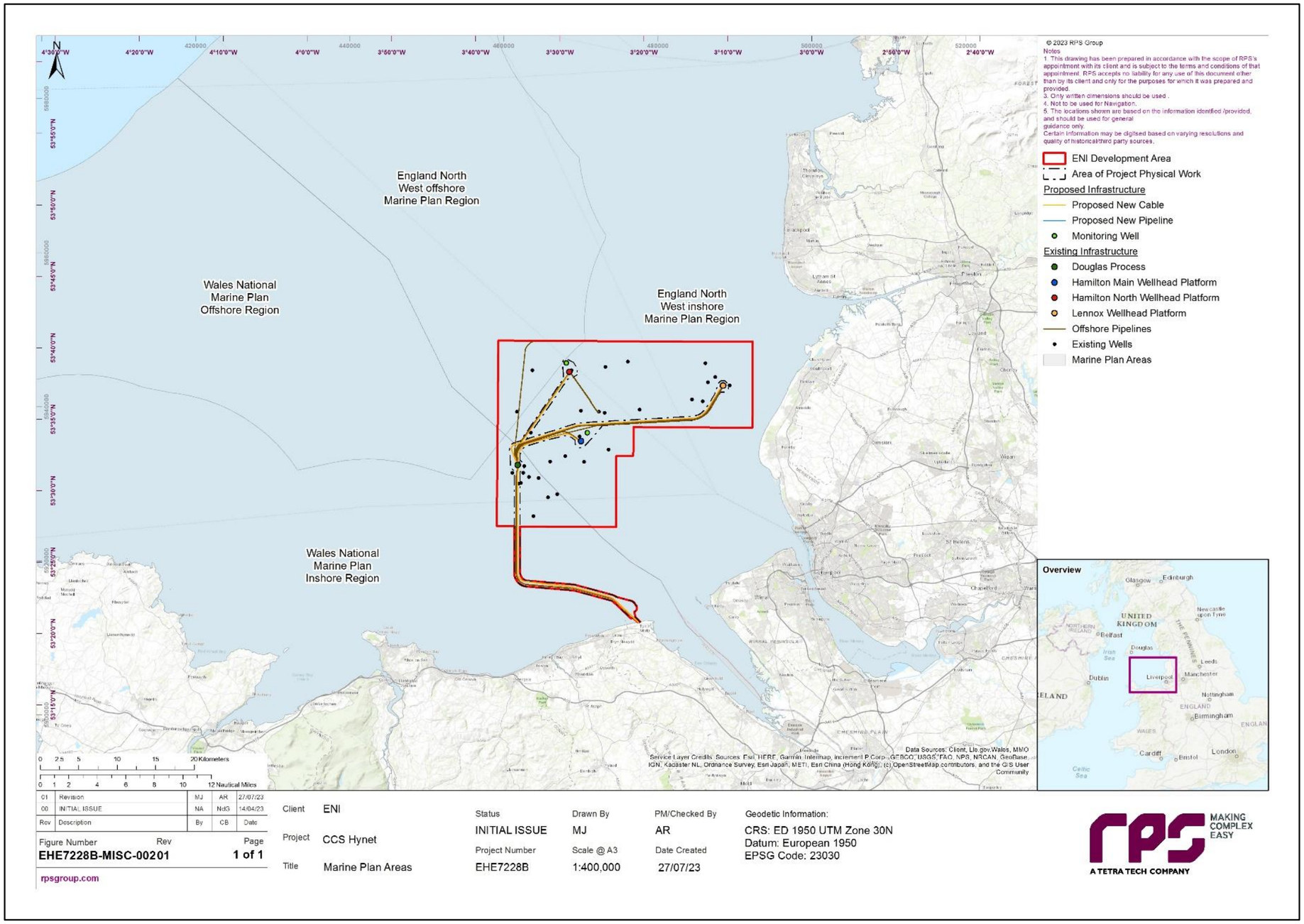


Figure 2.1: Eni Development Area in relation to the Marine Plan Regions (*The 12 nm limit represents the boundary of the inshore and offshore Marine Plan Regions. The boundary between the England and Wales Marine Plan Regions is represented by the territorial boundary of the two nations*).

2.4 Consenting regime

2.4.1 Introduction

This section provides a summary of the consenting process and associated legislative requirements being followed for the Proposed Development.

Table 2.1 sets out the permits and licences pertinent to the Proposed Development and to which the following legislation applies. The applications are supported by this ES, as well as a Water Framework Directive (WFD) assessment, and a Report to Inform Appropriate Assessment (RIAA).

Should additional pre-construction licences be required, these will be discussed and agreed with the relevant consent authority during the pre-construction phase of the Proposed Development.

Table 2.1: Proposed Development Planning And Consenting Requirements

Activity	Permit/Licence/Requirement	Key Legislation
Benthic ecology baseline surveys: • intertidal benthic survey; and • subtidal benthic survey.	• Marine Licence (Band 1) from **NRW-MLT** (MMO exemption). • **OPRED** Survey Notification. • **Crown Estate** seabed survey licence.	• Marine and Coastal Access Act (MCAA) 2009.
Pipeline repurposing/Installation of new pipeline spools to new platform	• Pipeline Works Authorisation (PWA) updates/renewals for the repurposed pipeline from **NSTA**. • Marine Licence Band 3 from **NRW-MLT**.	• The Petroleum Act 1988. • The Pipeline Safety Regulations 1996. • The Offshore Chemicals Regulations 2002 (as amended). • MCAA 2009.
New platform installation	• Marine Licence Band 3 from **NRW-MLT**. • Consent to Locate (CtL) for fixed installation from **OPRED**.	• MCAA 2009. • Energy Act 2008.
Drilling	• Master Application Templates (MATs) and Subsidiary Application Templates (SATs) from **OPRED** for new wells, side-track drilling and well intervention.	• Offshore Oil and Gas Exploration, Production, Unloading and Storage (Environmental Impact Assessment) Regulations 2020. • The Offshore Chemicals Regulations 2002 (as amended). • Part 4A of The Energy Act 2008 (as amended). • The Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005 (as amended). • Consent for a Marine Geological Survey or Investigation under The Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 (as amended).
Environmental Impact Assessment and Environmental Statement	• Scoping. • ES production. • HRA screening and appropriate assessment. • WFD assessment. • Submission and Public Notice. • ES approval for Storage Permit – **OPRED**	• The Offshore Oil and Gas Exploration, Production, Unloading and Storage (Environmental Impact Assessment) Regulations 2020. • The Offshore Environmental Impact Assessment (The Marine Works (Environmental Impact Assessment) Regulations 2007 (as amended).

Activity	Permit/Licence/Requirement	Key Legislation
	• ES approval for Marine Licence – **NRW-MLT**	• HRA (Conservation of Habitats and Species Regulations 2017 (as amended); Conservation of Offshore Marine Habitats and Species Regulations 2017 (as amended)). • Water Framework Directive. • The Habitats and Birds Directive.
Carbon Storage	• Carbon Dioxide Appraisal and Storage Licence already awarded by **NSTA**. Licence No. CS004. • **Crown Estate** Lease. • Carbon Storage Permit from **NSTA**.	• Energy Act 2008. • The Storage of Carbon Dioxide (Licensing etc.) Regulations 2010.
Cable laying and associated activities	• Marine Licence Band 3 (Welsh waters.) from **NRW-MLT**. • PWA (English waters) from **NSTA**.	• MCAA 2009 Marine Licence. • The Petroleum Act 1988.

2.4.2 The Carbon Appraisal and Storage Licensing

In October 2020, the UK Oil and Gas Authority (OGA), currently NSTA, awarded Eni UK Limited a Carbon Dioxide Appraisal and Storage Licence (CS004) under the Energy Act 2008, Section 18.

The CS004 license includes terms and conditions for the application of a Storage Permit, in accordance with the Storage of Carbon Dioxide (Licensing etc.) Regulations 2010 (SI 2010/2221), in respect of a storage site situated in the licensed area. In addition, the CS004 license includes the general conditions applicable to a storage site authorised under a Storage Permit, addressing the closure of storage site, the post-closure plan and post-closure obligations.

A draft Storage Permit application has been made to the NSTA, which comprises a suite of prescribed documents, supported by this ES. The application documents draw upon a number of those previously developed during the Assess and Define Phases of the CS Permit application process. These documents provide a summary of the essential features of the proposed storage site and storage complex; the containment risk analysis undertaken; and the planned operational strategy associated with the proposed undersea carbon storage facility located within Liverpool Bay and described by Carbon Dioxide Appraisal and Storage Licence CS004. Once the process set out in the "Guidance on Applications for a Carbon Storage Permit " is complete and the Applicant has formally taken FID and OPRED 'approved' the ES, the NSTA will notify the Applicant to submit the finalised Storage Permit Application. The Storage Permit will authorise the use of a place as a storage site for CO_2. This will grant authorisation for the Applicant to proceed with both the construction of facilities and other infrastructure, and the injection of CO_2 into the storage sites.A Monitoring Plan, Corrective Measures Plan, Provisional closure and post-closure Plan, and proposals for Financial Security are also included with the Storage Permit application.

To inform the Storage Permit application and its accompanying plans, the EIA has been undertaken, and ES prepared, with reference to the following guidelines:

- OSPAR. Guidelines for Risk Assessment and Management of Storage of CO_2 Streams in Geological Formations (Reference Number: 2007-12);
- London Protocol. Risk Assessment and Management Framework for CO_2 Sequestration in Sub-Seabed Geological Structures (CS-SSGS), LC/SG-CO2 1/7, Annex 3. 2006; and
- London Protocol. Specific Guidelines for the Assessment of Carbon Dioxide for Disposal into Sub-seabed Geological Formations.LP.7. LC 34/15, Annex 8. 2012.

2.4.3 Marine and Coastal Access Act (MCAA) Marine Licence

Within the UK offshore waters (between 12 nm and up to 200 nm offshore), the MCAA 2009 applies. Under the MCAA 2009 (as amended) there is the requirement for a marine licence to be obtained prior to the construction, alteration or improvement of any works or deposit any object in or over the sea, or on or under the seabed. Similarly, under the Marine MCAA 2009 which applies to both Welsh and English Territorial Waters (between 0 nm and 12 nm seaward from Mean High Water Springs (MHWS)), there is also the requirement for a marine licence prior to the construction, alteration or improvement of any works or deposit any object in or over the sea, or on or under the seabed. Marine Licensable areas in Welsh waters are defined in the MCAA 2009 (Section 42), while those in English waters are assessed by the MMO in Part 4 of the MCAA 2009.

The MCAA 2009 (administered by NRW-MLT and MMO), make it a licensable activity to:

- deposit any substance or object in the sea or on or under the seabed from:
  - any vehicle, vessel, aircraft or marine structure;
  - any container floating in the sea; and
  - any structure on land constructed for depositing solids in the sea;
- construct, alter or improve any works either in or over the sea or under the seabed;
- use a vehicle, vessel, aircraft or marine structure to remove any substance or object from the seabed; and
- carry out any form of dredging, whether or not involving the removal of any material from the sea or seabed.

As proposed, the Applicant's activities include the potential to remove substrate from the seabed and to deposit infrastructure in the sea or on or under the seabed, Marine Licences may be required for certain activities.

Section 77 of the Act specifically excludes offshore energy activities relating to oil and gas exploration and production, gas unloading and storage, and carbon dioxide storage from the marine licensing provisions, where the activities fall into the following categories:

- anything done in the course of carrying on an activity for which a licence under Section 3 of the Petroleum Act 1998 (c. 17) or Section 2 of the Petroleum (Production) Act 1934 (c. 36) (licences to search for and get petroleum) is required;
- anything done for the purpose of constructing or maintaining a pipeline as respects any part of which an authorisation (within the meaning of Part 3 of the Petroleum Act 1998) is in force;
- anything done for the purpose of establishing or maintaining an offshore installation (within the meaning of Part 4 of the Petroleum Act 1998 (c. 17)); and
- anything done in the course of carrying on an activity for which a licence under Section 4 or 18 of the Energy Act 2008 (c. 32) is required (gas unloading, storage and recovery, and carbon dioxide storage), with the exception of activities where there is devolved competence.

Additional exemptions from the marine licensing provisions are contained in the Marine Licensing (Exempted Activities) Order 2011 (as amended).

As a consequence of the exclusions and exemptions, most offshore energy activities that are the responsibility of OPRED are not subject to the MCAA marine licensing regime. However, the exclusions do not apply to activities that do not fall into the categories detailed above, and the most significant activities that are not excluded are any licensable activities relating to decommissioning operations and the use of explosives for either ordnance clearance or decommissioning.

Where there is a licensing requirement, OPRED is the licensing authority for reserved offshore energy activities, acting on behalf of the Secretary of State.

2.4.4 Marine licensing in England

In England, depositing any object in the sea, on, or under the seabed, may require a marine licence. The MMO licences most activities in English inshore and offshore waters. However, for the Proposed Development, the activities in English waters are associated with a CCS project and are therefore understood to be exempt from Marine Licencing under Section 77 of the MCAA. A Pipeline Works Authorisation (PWA) will instead be required from the NSTA for such activities. A marine wildlife licence or a European Protected Species (EPS) licence may also be required if deployment of an Acoustic Deterrent Device (ADD) may cause an offence in relation to seals (UK protected species) or cetaceans (EPS species).

The English and Welsh guidance *"The protection of marine European Protected Species from injury and disturbance: Guidance for the marine area in England and Wales and the UK offshore marine area"*, can be referred to for further information.

The location of planned infrastructure is shown in Figure 2.1.

2.4.5 Marine licensing in Wales

NRW licences activities in Welsh inshore and offshore waters. In Wales, depositing any object in the sea or on or under the seabed may require a marine licence. A Marine Licence application has therefore been made for the marine licensable activities in Welsh waters, which is supported by this ES.

A marine wildlife licence or an EPS licence may also be required if deployment of an ADD may cause an offence in relation to seals (UK protected species) or cetaceans (EPS species). From 31 March 2017 species licensing becomes the responsibility of Welsh Ministers and licences will be issued by NRW.

The English and Welsh guidance *"The protection of marine European Protected Species from injury and disturbance: Guidance for the marine area in England and Wales and the UK offshore marine area"*, can be referred to for further information.

The location of planned infrastructure is shown in Figure 2.1.

2.4.6 Environmental Impact Assessment Regulations

EIA is the process of identifying and assessing the significant effects likely to arise from a project. This requires consideration of the likely changes to the environment, where these arise because of a project, through comparison with the existing and projected future baseline conditions.

In compliance with the EU Directive on the assessment of the effects of certain public and private projects on the environment (EIA Directive) (2011/92/EU, as amended by Directive 2014/52/EU), when applying for a marine licence or carbon dioxide storage permit, an ES is required to be prepared and submitted to support these applications if they are likely to have a significant effect on the environment due to factors such as their size nature or location. The Proposed Development is classified as a band 3 project under NRW's Marine Licensing bands, defined as having a complex application process that has estimated costs pertaining to marine works exceeding £1 million and/or requiring an EIA and/or undertaking activities involving construction works.

The Proposed Development falls within the descriptions of projects that fall within Schedule 1 of The Offshore Oil and Gas Exploration, Production, Unloading and Storage (Environmental Impact Assessment) Regulations 2020 (The '2020 EIA Regulations'), and for which EIA is mandatory:

"*3. Activities captured by section 17(2)(a) or (b) of the Energy Act 2008 (activities related to the geological storage of carbon dioxide).*"

The Proposed Development also falls within the descriptions of projects that fall within Schedule A1 of The Marine Works (Environmental Impact Assessment) (Amendment) Regulations 2017 (The '2017 EIA Regulations'), and for which EIA is mandatory:

"*29. Storage sites pursuant to Directive 2009/31/EC(a) of the European Parliament and of the Council on the geological storage of carbon dioxide.*"

The Proposed Development also includes marine licensable activities as defined in Section 66 of the Marine and Coastal Access Act 2009. As per Schedule A2 of the 2017 EIA Regulations, it is considered that these activities are likely to have significant effects on the environment due to factors such as their "*size, nature or location*", as follows:

- any deposit or removal of material or substance, using a vehicle or vessel;
- construction, alteration or improvement works (including works hanging/suspended over the marine licensable area and works beneath the seabed);
- dredging; and
- deposit and use of explosives.

The EIA for the Proposed Development will therefore be undertaken in accordance with the 2020 EIA Regulations, and the 2017 EIA Regulations.

Schedule 6 of the 2020 EIA Regulations, and Schedule 3 of the 2017 EIA Regulations, specify the requirements of the information for inclusion in an environmental statement.

In addition to this, the Offshore ES must consider the following factors during the assessment:

- population and human health;
- biodiversity, in particular species and habitats protected under the Habitats Directive;
- land, soil, water, air and climate; and
- material assets, cultural heritage and the landscape.

The main stages of the EIA process include the following:

- decision to undertake an EIA (screening);
- scoping to determine the subject matter of the EIA and to identify potentially significant effects;
- data review involving compiling and reviewing available baseline data and/or undertaking of baseline surveys to generate site-specific data;
- assessment and design iterations, whereby the potential impacts of the development during the construction, operation and maintenance, and decommissioning stages of its life are assessed. Feedback is provided to the design and engineering team(s) to modify the design of the development where possible in order to avoid, prevent, reduce and/or offset any significant adverse effects on the environment;
- identifying any further mitigation or compensation requirements;
- identifying residual effects;
- preparing the Offshore ES (i.e. reporting on the EIA process and continuing with design iteration and consultation);
- consultation with the consultation bodies, stakeholders, and the community, in accordance with all relevant requirements (the MCAA 2009, EIA Regulations and the associated regulations and guidance);
- consideration of the Offshore ES by NRW, and OPRED; and
- controlling and where necessary monitoring the effects of the project during construction, operation and maintenance, and decommissioning in accordance with the mitigation measures identified in the Offshore ES and/or the requirements identified in the relevant licences which have been drawn from the findings of the EIA.

2.5 Additional consents and legislation

2.5.1 Drilling operations

MAT and SAT permits will be required from OPRED to undertake drilling operations.

- Drilling Operations (DR) MAT: this will cover the proposed monitoring wells, sentinel wells, and side-track drilling operations. SATs falling under the DR MAT will include:
  - EIA Screening Direction SAT (Offshore Oil and Gas Exploration, Production, Unloading and Storage (Environmental Impact Assessment) Regulations 2020);
  - Chemical Permit (CP) SAT (The Offshore Chemicals Regulations 2002 (as amended);
  - Consent to Locate (CtL) (Part 4A of The Energy Act 2008 (as amended) SAT; and
  - Marine Licensing, OPEP/TOOPEP.

2.5.2 New offshore pipeline

Pipeline Works Authorisation from NSTA, which includes application for Consent to Locate and application for Consent to Deposit Materials for any material deposits required for pipeline stabilisation, will be required for pipeline repurposing and the installation of new pipeline.

Should any chemicals be used and discharged during pipeline commissioning, a CP application will be required.

2.5.3 The WFD Regulations

In the UK, coastal waters are protected under the WFD which requires that "*the project or activity does not cause or contribute to deterioration in water body status or jeopardise the water body achieving good status*" (UK Government, 2014).

The Welsh Ministers, in exercise of the powers conferred by Article 11 of the Natural Resources Body for Wales (Establishment) Order 2012(a) and having consulted the Secretary of State to the extent that there is any effect in those parts of England that are within the catchment areas of the rivers Dee, Wye and Severn, and having also consulted the Natural Resources Body for Wales, give the following Directions to the Natural Resources Body for Wales.

The Directions are given for the implementation of:

- Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for community action in the field of water policy;
- Directive 2008/105/EC of the European Parliament and of the Council on environmental quality standards in the field of water policy; and
- Directive 2013/39/EU of the European Parliament and of the Council amending Directives 2000/60/EC and 2008/105/EC as regards priority substances in the field of water policy.

The WFD guidance is for compliance assessment of activities in the marine environment up to one nautical mile out to sea for ecological status, and 12 nm for chemical status. A WFD assessment must be provided as part of the application to the public body tasked with regulating and granting permission for the Proposed Development activity. Additionally, a WFD assessment helps all parties understand:

- the impact the proposed activity may have on the immediate water body and any linked water bodies; and
- whether the proposed activity complies with the River Basin Management Plan (RBMP).

For the Proposed Development, one WFD assessment has been carried out to cover all activities (described in section 3).

2.5.4 The Habitats and Birds Directive

The Council Directive 92/43/EEC (the Habitats Directive) was adopted in 1992, providing a means for the EU to meet its obligations under the Bern Convention. The aim of the Directive is to maintain or restore natural habitats and wild species listed on the Annexes at a favourable conservation status. This protection is granted through the designation of European Sites and EPS. The European Directive (2009/147/EC) on the conservation of wild birds (The Birds Directive) provides a framework for the conservation and management of wild birds within Europe. The Directive affords rare and vulnerable species listed under Annex I of the Directive, and regularly occurring migratory species, protection through the identification and designation of Special Protection Areas (SPAs).

The Habitat Regulations require that where a plan or project that is not directly connected with, or necessary to the management of a Natura 2000 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. NRW-MLT, and OPRED must therefore consider whether the Proposed Development is likely to have significant effects on the conservation objectives of the sites considered in the HRA, and, where Likely Significant Effects (LSE) cannot be excluded at the screening stage, and in the absence of mitigation measures, an 'Appropriate Assessment' of the implication of the plan or project must be undertaken by the competent authority before consent may be given for the proposed project.

The HRA process is a multi-stage process aligned with European Commission (EC) guidance documents '*Assessment of plans and projects significantly affecting Natura 2000 sites*' (EC, 2001) and 'Managing Natura 2000 sites: The Provisions of Article 6 of the '*Habitats*' Directive 92/43/EEC' (EC, 2019). In accordance with this guidance from the Commission, the obligations arising under Article 6 establish a stepwise procedure, as set out below:

1. The first part of this procedure consists of a preliminary '*screening*' stage to determine whether, firstly, the plan or project is directly connected with or necessary to the management of the site, and secondly, whether it is likely to have a significant effect on the site; it is governed by the first sentence of Article 6(3).
2. The second part of the procedure, governed by the second sentence of Article 6(3), relates to the appropriate assessment and the decision of the competent national authorities.
3. A third part of the procedure (governed by Article 6(4)) comes into play if, despite a negative assessment, it is proposed not to reject a plan or project but to give it further consideration. In this case Article 6(4) allows for derogations from Article 6(3) under certain conditions.

The stepwise procedure has the aim of determining LSEs and, where necessary, assesses the implications of the Proposed Development for their potential to adversely affect the integrity of a European site or sites in accordance with Article 6(3) of the Habitats Directive. If a determination of adverse effect on site integrity is made despite the application of mitigation measures intended to avoid or reduce the harmful effects of the project(s) on the sites concerned, the stepwise procedure then provides for a derogation procedure under Article 6(4). Such a derogation is available to the competent authorities concerned following three tests to be met in sequential order:

1. There are no feasible alternative solutions to the project which are less damaging.
2. There are "imperative reasons of overriding public interest" (IROPI) for the project to proceed.
3. Compensatory measures are secured to ensure that the overall coherence of the network of European sites is maintained.

Some of the existing and Proposed Development infrastructure lies within the Liverpool Bay/Bae Lerpwl SPA (UK designated site and Natura 2000 site), namely, the existing pipeline and proposed cables route between

PoA and Douglas platforms, the existing Douglas, Hamilton North, Hamilton Main, and Lennox platforms, and the existing pipelines and proposed cables between Douglas and Hamilton North, Hamilton Main, and Lennox platforms. The location of planned infrastructure is described in volume 1, chapter 3, and shown in Figure 3.1.

The aim of the Directive 2009/147/EC of 30 November 2009 on the conservation of wild birds (The Birds Directive) (Ref 2.5) is to protect, manage and control all species of naturally occurring wild birds in the Member States. Member States are required to take the requisite measures to maintain the population of the species at a level which corresponds to ecological, scientific, and cultural requirements, while taking account of economic and recreational requirements, or to adapt the population of these species to that level. The Birds Directive is implemented in England and Wales through the Wildlife & Countryside Act 1981 (as amended) and the Habitats Regulations.

For the Proposed Development, a Report to Inform Appropriate Assessment (RIAA) has been prepared by the Applicant to cover all activities described in section 3.

2.5.5 EPS licensing

The Conservation of Habitats and Species Regulations 2017, known as the '*Habitats Regulations*' transposes requirements of the European Habitats Directive (92/43/EEC) on the conservation of natural habitats and of wild flora and fauna into UK law. This includes animals whose natural range includes any area of the UK, and animals which are included in Annex IV of the Directive, and which are species of European Community interest and in need of strict protection (EPS). Within Welsh and English waters, the following EPS are known to occur:

- Cetaceans (whales, dolphins, and porpoises);
- marine turtles;
- otter; and
- common sturgeon.

Of the cetacean species occurring within UK waters, the following species are known to occur in Welsh waters:

- Harbour porpoise *Phocoena phocoena*;
- Bottlenose dolphin *Tursiops truncates*;
- Short-beaked common dolphin *Delphinus delphis*;
- Risso's dolphin *Grampus griseus*; and
- Minke whale *Balaenoptera acutorostrata*.

Under the Conservation of Habitats and Species Regulations 2017, it is an offence to deliberately or recklessly capture, injure or kill an EPS, or deliberately disturb wild animals of EPS. As of 1 April 2018, the responsibility for the administration of EPS licence applications has transferred to NRW-MLT, who act on behalf of the Welsh Ministers. NRW-MLT issues licences under Regulation 55 of the Conservation of Habitats and Species Regulations 2017 and the Conservation of Offshore Marine Habitats and Species Regulations 2017, to allow activities that would otherwise constitute an offence under the Conservation of Habitats and Species Regulations 2017, to be carried out.

Underwater noise associated with the Proposed Development activities (e.g. seismic activity) has the potential to cause an offence under the Regulations, therefore there may be a requirement to obtain a licence to disturb marine EPS from the Department for Energy Security and Net Zero (DESNZ), formerly the Department for Business, Energy, and Industrial Strategy (BEIS). EPS licences are obtained from Natural England (NE) and NRW, depending on the reason for the licence application. Although the grant of EPS licences is separate to the Section 36 and marine licence application process, it can be considered in parallel by NE and NRW to constrict timelines.

Should an EPS licence be required, DESNZ aims to process applications within 6 to 8 weeks from receipt of a completed application, with all associated supporting information provided.

Should additional pre-construction licences be required, these will be discussed and agreed with the relevant consenting authority during the pre-construction phase of the Proposed Development.

2.5.6 Basking shark licence

Basking sharks are protected under Schedule 5 of the Wildlife and Countryside Act (WCA) 1981 (as amended). Under this Act it is an offence to intentionally kill, injure or take; damage or destroy a place of shelter or protection, or disturb them whilst occupying such a place; or obstruct access to such a place. In addition, it is an offence to disturb a basking shark intentionally or recklessly.

NRW can issue a licence under Section 16(3) of the WCA (if required) to allow an activity to be carried out that would otherwise constitute an offence. NRW aim to process applications with 30 working days from receipt of a completed application, with all associated supporting information provided.

2.5.7 UK Emissions Trading Scheme

The UK Emissions Trading Scheme (UK ETS) was established on 1 January 2021 by the UK ETS Authority (UK Government, Scottish Government, Welsh Government and the Department of Agriculture, Environment and Rural Affairs of Northern Ireland (DAERA)), replacing the UK's participation in the EU ETS.

The UK ETS is established through The Greenhouse Gas Emissions Trading Scheme Order 2020. This guidance includes CO_2 capture, transport by pipelines and geological storage of CO_2 in its scope of activities (Schedule 2). This means that the installations that are covered by the UK ETS wouldn't need to surrender credits for the CO_2 they have captured for subsequent transportation by pipelines and geological storage.

At the time of writing, proceedings for the development of the UK ETS are ongoing, including proposals on aligning the scheme's cap with UK Net Zero Target. It is expected the new legislation will come to force in due course, ahead of the 2024 scheme year.

2.6 References

Climate Change Committee (2019) Net Zero: The UK's contribution to stopping global warming. Available at: https://www.theccc.org.uk/wp-content/uploads/2019/05/Net-Zero-The-UKs-contribution-to-stopping-global-warming.pdf Accessed April 2023.

Climate Change Committee (2021) 2021 Progress Report to Parliament. Available at: https://www.theccc.org.uk/publication/2021-progress-report-to-parliament/ Accessed April 2023.

Department for Environment, Food and Rural Affairs (Defra) (2011) Marine Policy Statement. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69322/pb3654-marine-policy-statement-110316.pdf Accessed April 2023.

Department for Energy Security & Net Zero (DESNZ) (2023) Overarching National Policy Statement for Energy (EN-1). Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1147380/NPS_EN-1.pdf Accessed May 2023.

Eni (2021) Eni for 2021 – Carbon neutrality by 2050. Available at: https://www.eni.com/assets/documents/eng/just-transition/2021/eni-for-2021-carbon-neutrality-2050-eng.pdf Accessed April 2023.

HM Government (2017) The Clean Growth Strategy – Leading the way to a low carbon future. Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/700496/clean-growth-strategy-correction-april-2018.pdf Accessed April 2023.

HM Government (2018) Clean Growth - The UK Carbon Capture Usage and Storage Deployment Pathway: An Action Plan. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/759637/beis-ccus-action-plan.pdf Accessed April 2023

HM Government (2020a) The Ten Point Plan for a Green Industrial Revolution. Building back better, supporting green jobs, and accelerating our path to net zero. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/936567/10_POINT_PLAN_BOOKLET.pdf Accessed April 2023.

HM Government (2020b) Energy White Paper: Powering out net zero future. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/945899/201216_BEIS_EWP_Command_Paper_Accessible.pdf Accessed April 2023.

HM Government (2021a) Net Zero Strategy: Build Back Greener. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1033990/net-zero-strategy-beis.pdf Accessed April 2023.

HM Government (2021b) North West Inshore and North West Offshore Marine Plan. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1004490/FINAL_North_West_Marine_Plan__1_.pdf Accessed April 2023.

United Nations (1992) United Nations Framework Convention on Climate Change. Available at: https://unfccc.int/sites/default/files/convention_text_with_annexes_english_for_posting.pdf Accessed April 2023.

United Nations (2015) Paris Agreement. Available at: https://unfccc.int/sites/default/files/english_paris_agreement.pdf Accessed April 2023.

United Nations Framework Convention on Climate Change (2021) Glasgow Climate Pact. Available: https://unfccc.int/sites/default/files/resource/cop26_auv_2f_cover_decision.pdf Accessed April 2023.

United Nations Framework Convention on Climate Change (2022) Report of the Conference of the Parties on its Twenty-Sixth Session, held in Glasgow from 31 October to 14 November 2021. Available: https://unfccc.int/sites/default/files/resource/cp2021_12_add1E.pdf Accessed April 2023.

Welsh Government (2019a) Welsh Government makes climate emergency decision. Available at: https://www.gov.wales/welsh-government-makes-climate-emergency-declaration Accessed April 2023.

Welsh Government (2019b) Prosperity for All: A Low Carbon Wales. Available at: https://www.gov.wales/sites/default/files/publications/2019-06/low-carbon-delivery-plan_1.pdf Accessed April 2023.

Welsh Government (2019c) Welsh National Marine Plan. Available at: https://www.gov.wales/sites/default/files/publications/2019-11/welsh-national-marine-plan-document_0.pdf. Accessed April 2023.

Welsh Government (2021a) Net Zero Wales Carbon Budget 2 (2021-25). Available at: https://www.gov.wales/sites/default/files/publications/2021-10/net-zero-wales-carbon-budget-2-2021-25.pdf Accessed April 2023.

Welsh Government (2021b) Future Wales The National Plan 2040. Available at: https://www.gov.wales/sites/default/files/publications/2021-02/future-wales-the-national-plan-2040.pdf Accessed April 2023.

Welsh Government (2022) All Wales Plan 2021-25 Working Together to Reach Net Zero. Available at: https://www.gov.wales/sites/default/files/publications/2022-04/working-together-to-reach-net-zero-all-wales-plan-april-22-update.pdf Accessed April 2023.

3 PROPOSED DEVELOPMENT DESCRIPTION

3.1 Introduction

The HyNet Carbon Dioxide Transportation and Storage Project - Offshore (hereafter the "Proposed Development") is being developed in parallel with and as a key part of the HyNet North West full-chain hydrogen and Carbon Capture and Storage (CCS) industrial decarbonisation project (the HyNet Project), which is designed to transform a region of the UK into the world's first low carbon industrial cluster by 2030.

This chapter provides an outline description of the Proposed Development and describes the activities likely to be associated with the construction, operation, and maintenance, and decommissioning of the Proposed Development. It summarises the design and components of the Proposed Development infrastructure. These are based on evolving design information and refinement of the Proposed Development parameters following receipt of the Offshore EIA Scoping Opinion (OPRED, 2023), and understanding of the environment from site specific surveys and desk-top analysis.

The Project Design Envelope (PDE) approach (also known as the Rochdale Envelope approach) has been adopted for the assessment of the Proposed Development, in accordance with current good practice (National Infrastructure Planning, 2018) and the 'Rochdale Envelope Principle'. The PDE concept allows for some flexibility in project design options, for example, cable installation and protection, where the full details of the project are not known at application submission but will be confirmed in detail once the installation contractor is appointed.

3.2 Proposed development location

The Proposed Development is in the CS004 CO_2 Appraisal and Storage Licence area (NSTA, 2020), approximately 12 km to the north of the Welsh coastline and 2 km west of the English coastline (Figure 3.1). The licence area covers approximately 576.82 km^2 and encompasses the depleted hydrocarbon reservoirs of the Hamilton, Hamilton North, and Lennox fields. The Proposed Development infrastructure will be located within the 'Eni development area' defined by both the Licence area (CS004), and the pipeline and cable corridor connecting the Point of Ayr (PoA) Terminal to Douglas Offshore Platform (OP) (up to Mean High Water Springs (MHWS)), as shown by the red line in Figure 3.1. The corridor shore approach is located to the north of Talacre in Flintshire, Wales, near the mouth of the Dee Estuary. Within the Eni Development Area, Figure 3.1 also shows a black, dotted, and dashed line, which identifies the 'area of project physical works'. It is within this area that the works required for the Proposed Development will be carried out.

The Eni development area is in water depths that range from 0.72 m below Lowest Astronomical Tide (LAT) to 35 m LAT, with average water depths across the Eni development area approximately 20 m LAT. The Lennox OP is in 7.2 m depth of water, while the Douglas OP complex is in 29.2 m depth of water.

The Eni development area encompasses the existing OPs, depleted oil and gas reservoirs, and connecting submarine pipelines and cables (Figure 3.1). These OPs are:

- The Douglas OP Complex comprises three-bridge linked platforms comprising a wellhead platform, a central process platform and an accommodation platform. These will be decommissioned, subject to the approval by Offshore Petroleum Regulator for Environment & Decommissioning (OPRED) of a separate decommissioning plan and environmental appraisal;
- Lennox OP is an unmanned oil and gas Wellhead platform to be repurposed for CO_2 service;
- Hamilton Main OP is an unmanned oil and gas Wellhead platform to be repurposed for CO_2 service; and
- Hamilton North OP is an unmanned Wellhead gas platform to be repurposed for CO_2 service.

Eni's offshore infrastructure is just one element of many other existing and proposed offshore activities and infrastructure elements situated within Liverpool Bay. These are discussed further in volume 2, chapter 12 and include:

- Burbo Bank, Burbo Bank Extension, North Hoyle, Gwynt y Môr, and Rhyl Flats wind farms;
- electrical export cables and landfalls associated with offshore wind developments;
- proposed wind farms and electrical export cables and landfalls, including Awel y Môr (in planning), OWL's Project 5 (in pre-planning) and a proposed 1,500 MW project by an EnBW/BP consortium;
- active aggregate dredging areas south of Douglas and northwest of Hamilton;
- active dredge spoil dumping areas to the west of Douglas, to the northeast of Hamilton, to the southwest of Lennox and north of Lennox; and
- shipping lanes to the south, and through the development area.

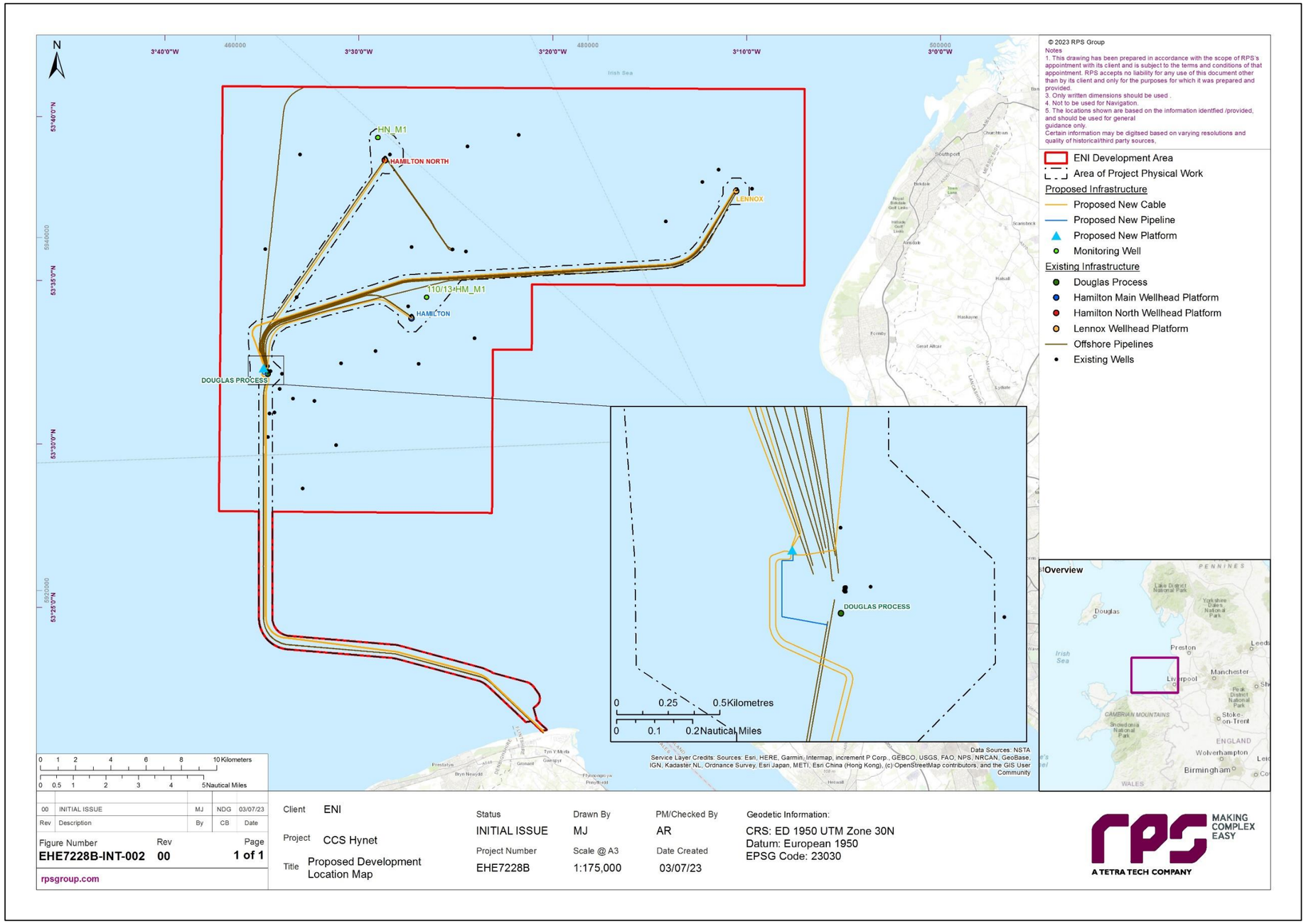


Figure 3.1: Location overview of Proposed Development

3.3 Offshore infrastructure

3.3.1 Overview

The key offshore infrastructure of the Proposed Development will include both new and re-purposed existing infrastructure.

The elements of offshore infrastructure that comprise the Proposed Development will include:

- Utilisation of the existing Hamilton Main, Hamilton North, and Lennox reservoirs for the injection of 109 Mt of CO_2 over a 25-year period for permanent geological storage. The storage would be divided between the three reservoirs, as follows: Hamilton Main, 53 Mt; Hamilton North, 18 Mt; and Lennox 38 Mt.
- Drilling and re-completion of injection wells by side-tracking existing production wells. This includes drilling and recompletion operations, all of which will be within the existing footprint (template) of each platform.
- Installation of a new Douglas CCS platform to replace the existing Douglas Process platform to receive CO_2 from the onshore PoA Terminal and distribute CO_2 to the Hamilton Main, Hamilton North, and Lennox wellhead platforms and when necessary, provide heating to the CO_2 stream. Installation of the new Douglas CCS platform will include up to eight driven piles.
- Installation of new sections of pipeline, concrete mattresses, and external rock protection to connect the new Douglas CCS platform and the existing subsea natural gas pipelines.
- Installation of new topsides on the Hamilton Main, Hamilton North, and Lennox wellhead platforms to receive and inject CO_2 into the depleted hydrocarbon reservoirs.
- Repurposing of the existing subsea natural gas pipelines for their change of use from hydrocarbon to CO_2 service.
- Implementation of a Monitoring Plan. This includes the drilling of two new monitoring wells, one at Hamilton North and one at Hamilton Main. Additional monitoring wells will be created from the recompletion of existing wells within the existing footprint (template) of each platform: one monitoring well created by side-tracking an existing well in Lennox; and two sentinel wells, one in Hamilton North and one in Lennox.
- Installation of two submarine 33 kilovolt (kV) power cables, with integrated fibre-optic cable connections (35 km from PoA Terminal onshore to the modified Douglas platform, including within the intertidal/foreshore area up to MHWS, within Welsh waters only).
- Installation of new submarine 33 kV power cables with integrated fibre-optic connecting the modified Douglas platform with the Hamilton Main (12 km; 33 kV), Hamilton North (15 km; 33 kV) and Lennox (35 km; 33 kV) platforms.
- Installation of concrete mattresses and external cable protection, at crossings of existing cables, and in areas where cable burial is not deemed feasible, or as a remedial secondary protection measure if the target cable depth of lowering cannot be achieved.

All the above infrastructure will be confined within the Eni Development Area shown in Figure 3.1, and is also described in detail in each of the Carbon Storage Development Plans, submitted with the Storage Permit applications.

3.3.2 Partial decommissioning programme

3.3.2.1 Programme overview

Prior to the commencement of the Proposed Development there will be a partial decommissioning programme (PDP) that will make ready the Liverpool Bay assets that will be repurposed for CO_2 transportation and storage. The partial decommissioning will comprise the following:

- Removal of the satellite platform topsides at Lennox, Hamilton, and Hamilton Main;
- Plugging and abandonment (P&A) of wells at Douglas, Hamilton, Hamilton North, and Lennox; and
- Removal of expansion spools, umbilicals, and exposed stabilisation features (mattresses and grout bags) in the near platform area (at Douglas, Hamilton, Hamilton North, and Lennox), which do not meet the 0.6m depth of burial criterion and therefore cannot be left in-situ.

The draft PDP and supporting Environmental Appraisal (EA) have been submitted to OPRED for review. The PDP will be finalised for approval once review comments have been addressed to OPRED's satisfaction.

Further separate Decommissioning Programmes (and respective EAs, environmental permits and consents, as required) that are out of scope of the PDP, will cover the following remaining facilities as part of Liverpool Bay Asset: Offshore Storage Installation (OSI) (unless alternative re-use options are found to be viable and more appropriate); Conwy platform (jacket, topsides, wells, and pipelines); Douglas production platform; Douglas accommodation platform; Douglas wellhead platform; Hamilton East subsea field (subsea well and integral protection structure); offshore pipelines; subsea umbilicals; subsea flexible lines; and subsea valves and components.

3.3.2.2 Well 110/15-6z abandonment at Lennox

The proposed P&A programme included in the PDP requires an immediate abandonment activity at well 110/15-6z in the Lennox field (Figure 3.2). This is an exploration well that was previously subject to temporary P&A works that do not meet current Eni and OEUK permanent P&A standards. The well is in the Lennox field in Liverpool Bay, approximately 900 metres east of the Lennox platform and 6 km west of Southport.

The P&A work is being carried out to safely cap 110/15-6z and prevent further gas release. The required intervention programme for the P&A of this well has been subject to substantial planning. This is because the P&A works will secure the Lennox reservoir in preparation for the permanent geological storage of CO_2. Additionally, the works have commenced because the suspension consent granted by the NSTA requires the P&A works to have commenced by 31 March 2024.

The 2024 plan is to now re-enter -/6z and drill and mill out the existing cement plugs. P&A of Well -/6z can then be carried out to AB2 status to current OEUK P&A guidelines, with two rock-to-rock cement barriers, tagged and pressure tested as a permanent decommissioning of the well 110-15/6z, and for which the following consents have been granted:

- Due to the operational risks of re-entering the original 110/15-6 well, Eni has opted to design and plan a standalone intersection drilling well that is covered under the DRA/1042 MAT on the NSTA portal. To ensure that there is even footing of the spudcans when engaging with the seabed, Eni has the contingent placement of rock stabilisation material permitted under the Consent to Locate (CL/1413).
- The Environmental Assessment Justification (EAJ) that refers to and covers the Consent to Locate (CTL-OPRED reference CL/1413 under WIA/1587 MAT).
- The use of the Bismuth as an environmental plugging material for cement plugging under Chemical Permit (CP-OPRED reference CP/3224 under WIA/1587 MAT); and
- The Marine Licence Application (ML-OPRED reference ML/1053 under WIA/1587 MAT).

Upon P&A to AB2, Well -/6z will be monitored by the rig based remotely operated vehicle (ROV) for gas bubbles during the 24-hour cement plug #2 Wait on Cement (WOC) period. After the successful completion of

the 24-hour bubble watch while WOC with no bubbles seen, Well -/6z will be judged as satisfactorily sealed and the rig will be moved to its next location.

Meanwhile, a Vessel of Opportunity (VO) will conduct periodic video surveys of Well -/6z to observe its continued integrity. If gas bubbles are still flowing from the -/6z location during and after the 24-hour Plug #2 WOC period, the rig will be moved from its 110/15-6z location to the 110/15-8 intersection well location, 100m from Well-/6z, and operations will start to drill the -/8 well to intersect, and kill, Well 110/15-6.

If bubbles are seen to re-start after the rig has departed the-/6z location by the periodic ROV survey, the rig will suspend its P&A activities at a natural break in the programme. It will then move to the 110/15-8 location to drill the intersection well and kill Well 110/15-6 and isolate the gas source with a permanent rock-to-rock barrier. Well 110/15-6 will be confirmed to be sealed during 110/15-8 operations when gas bubbles are no longer seen at the 110/15-6 location.

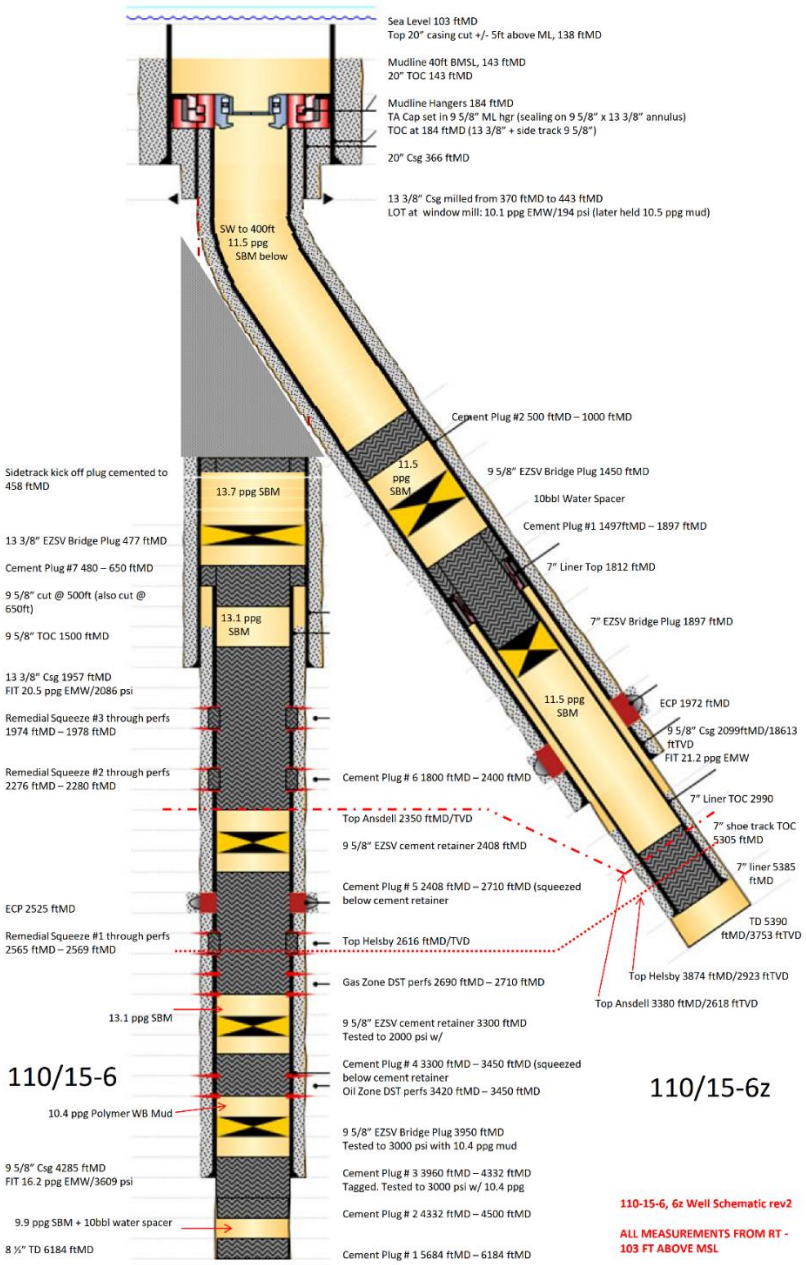


Figure 3.2: Cross section of Well 110/15-6, and 110/15-6z.

P&A activities at Well 110/15-8 will be completed to AB2 status, which will enable its location to be periodically video surveyed for gas bubbles by an ROV deployed from a VO. At 110/15-8 AB2, the rig will be moved off location to resume P&A operations across LBA.

The VO ROV will continue to run periodic video surveys of Well110/15-/8 and 110/15-6 and -/6z to observe their continued integrity.

P&A of Well 110/15-6z and 110/15-8, if drilled, will be to AB3 status (conductor and casings cut and recovered from 10 ft BML) by a VO after their successful long term monitoring is satisfactorily completed.

Eni UK-OpS - Asset Decommissioning - 110-15-6z abandonment procedure contains all the well abandonment details. In this document, Eni outlines the procedures for milling out the current barriers and installing new ones that will fully comply with OEUK Well Decommissioning Guidelines Issue 7, and OEUK Well Decommissioning CO_2 Storage Guidelines Issue 1. Eni anticipates that the present gas leak will be completely fixed by this process, and the integrity of the Lennox reservoir for long-term geological storage of CO_2 can be confirmed.

3.3.3 CO_2 storage sites

3.3.3.1 Geological characterisation

The three proposed storage sites (Hamilton Main, Hamilton North, and Lennox) are depleted oil and gas reservoirs managed by the Applicant that have been in production since 1996. Throughout this time, the assets have performed as expected without any exceptional event. The experience acquired has allowed the Applicant to develop a comprehensive understanding of the CO_2 storage sites.

The Hamilton Main and Hamilton North storage sites are shown as red areas on Figure 3.3, and the Lennox storage site in green, which are described as follows:

- **Hamilton Main** - The Hamilton Main field is a horst block structure located in the East Irish Sea Basin (EISB), Block 110/13, approximately 23 km from the Lancashire coast. The Hamilton Main field was discovered in 1990 by well 110/13-1 and has been appraised with a further two wells at the Hamilton platform. The discovery well encountered 155 m of gas-bearing from the Triassic Sherwood Sandstone Group with apparent gas water contact at about 887 m true vertical depth subsea (TVDSS). The field consists of a north-south trending horst block forming a structural trap fault-bounded on all sides with some dip closure, about 10 km long and 3 km wide. The reservoir comprises the Triassic Sherwood Sandstone Group, characterised by excellent permeability sand deposited by fluvial and aeolian processes. The Sherwood Sandstone Group extends over most of the EISB. The original (pre-natural gas extraction) pressure of the Hamilton reservoir was 97 bar and production began in 1997. As of October 2023, the reservoir recovery factor (RF) was 97% and the pressure was 4 bar.
- **Hamilton North** - The Hamilton North field is a structural trap consisting of several fault blocks that dip close to the south-east and are closed elsewhere, about 3 km long and 2 km wide. The fault blocks lie at the northern end of a horst feature running through Block 110/13. The field was discovered in 1991 (well 110/13-5), at the Hamilton North platform, which encountered about 144 m of the gas-bearing reservoir from the Triassic Sherwood Sandstone Group. The well found an apparent gas water contact of 965 m TVDSS and tested at 70 and 80 MMCFD from two intervals. The North Hamilton Field reservoir rock is represented by the Triassic Sherwood Group sandstones sealed by the overlying shales and evaporites of the Triassic Mercia Mudstone Group. The Sherwood Sandstone in the field comprises two formations, the St Bees Sandstone overlain by the Ormskirk Sandstone. The original (pre-natural gas extraction) pressure of the Hamilton North reservoir was 106 bar and production began in 1996. As of October 2023, the reservoir recovery factor (RF) was 94% and the pressure was 6 bar.
- **Lennox** - The Lennox field is in the EISB, approximately 5 km off the west coast of Lancashire and in shallow water (5-10 m depending on tidal excursions). The field is principally located within Block 110/15a, although it extends into the neighbouring Block 110/14c on its western flank. The field

was discovered in 1992 by exploration well 110/15-6, at the Lennox platform. The well targeted a four-way dip closed structure identified on 2D seismic lines shot between 1981 and 1990. Well 110/15-6 was drilled on the crest of the structure and encountered about 227 m gas column overlying a 44 m oil column. The reservoir interval is the still Triassic-aged Ormskirk Sandstone Formation, exhibiting high-quality reservoir sandstones throughout. Lennox is a mature saturated oil reservoir developed in time through two phases; oil rim development (phase I) and final gas cap blow down since 2012 (phase II, ongoing). The original (pre-natural gas extraction) pressure of the Lennox reservoir was 112 bar and production began in 1996. As of October 2023, the reservoir gas recovery factor (RF) was 91% and the pressure was 7 bar.

The Triassic-aged Ormskirk Sandstone Formation belonging to the Sherwood Sandstone Group represents the reservoir for all three fields. It consists of fluvial and aeolian sandstones of variable grain size. The quality of the Ormskirk Sandstone reservoir is extremely high with average porosities of between 14% and 19%.

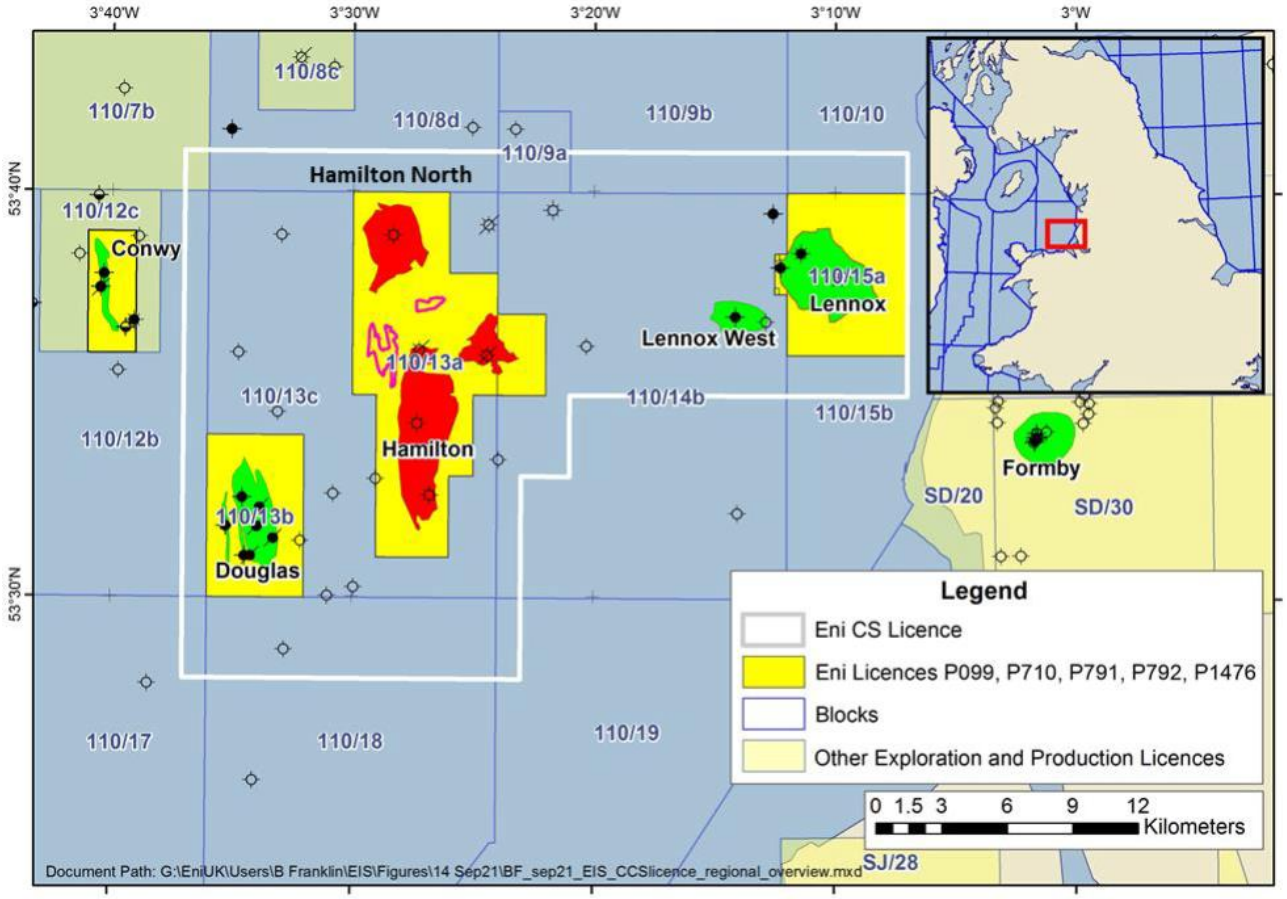


Figure 3.3: Location of the storage sites in relation to the Eni licence blocks

3.3.3.2 Seal description

The Mercia Mudstone Group (MMG) provides the top seal, which consists of a cyclic sequence of sandy mudstones and halites. The Rossall and Mythop halites are less than 15 m thick each while the Preesall Halite has a thickness between 150 m and 223 m.

The geological formations shown in Figure 3.4 identify the main barriers (primary, and secondary seals) preventing the upwards migration of CO_2, their relationship to the Storage Site, and Storage Unit, and their place within the overall Storage Complex. The Primary and Secondary Seals comprise the following geological formations:

- **Primary seal:** Blackpool Mudstone, Rossall Halite; and Ansdell Mudstone.

- **Secondary seal:** Dowbridge Mudstone, Preesall Halite, Cleveleys Mudstone; and Mythop Halite.

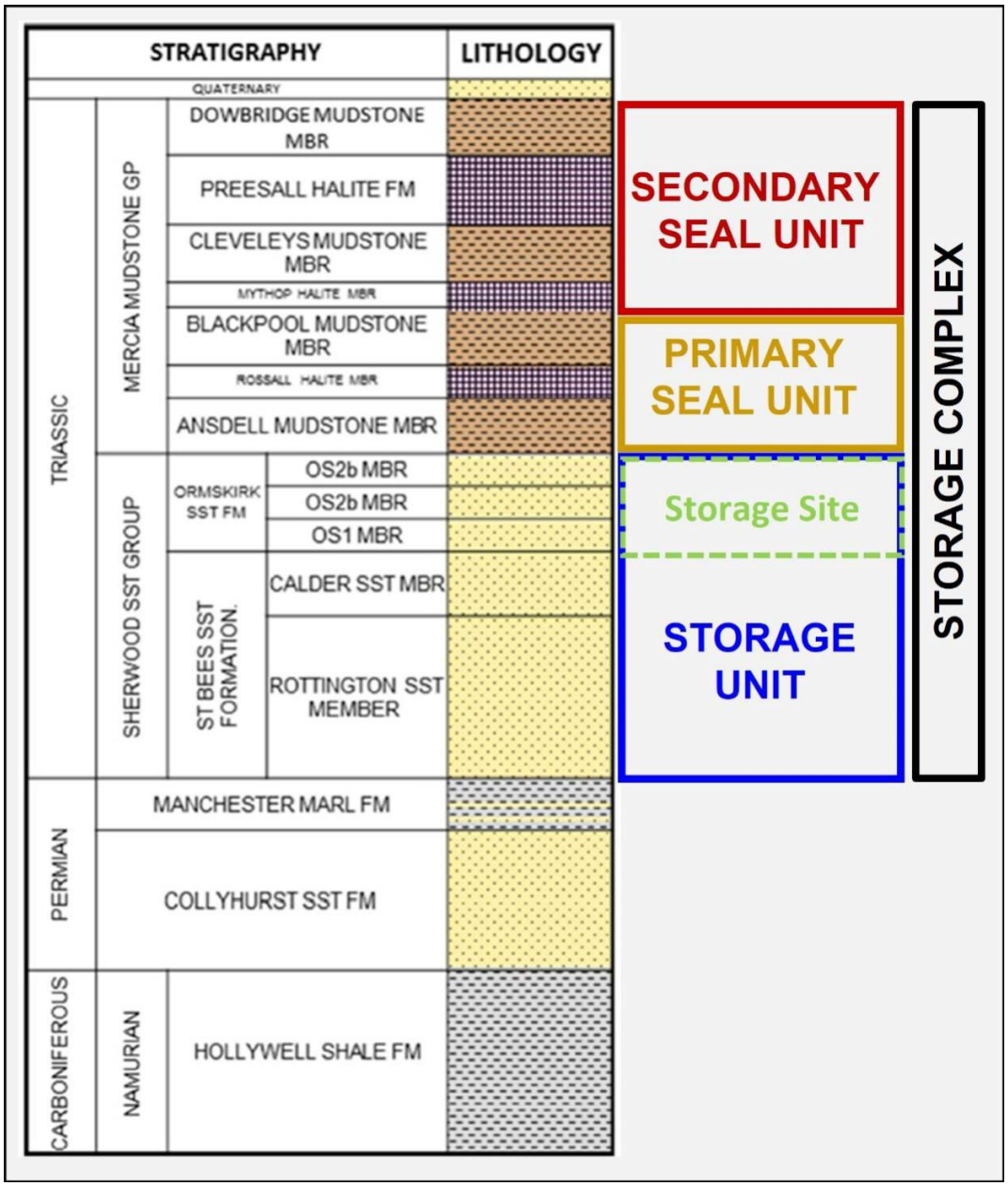


Figure 3.4: Relationship of storage unit and storage complex to the cap rocks

The project base case scenario foresees the injection of 109 Mt of CO_2 in 25 years, with a constant rate of 4.5 MTPA after an initial ramp up phase. The identified injection strategy will ensure that the three fields experience a comparable re-pressurisation trend during the whole injection period.

3.3.4 Wells

3.3.4.1 Preparation of CO_2 injection wells

The development of the Hamilton Main, Hamilton North, and Lennox hydrocarbon depleted reservoirs for CO_2 storage requires the drilling and re-completion of wells for CO_2 injection, by side-tracking existing production wells.

In addition to the CO_2 injector wells, monitoring, and sentinel wells are planned for CO_2 conformance and containment monitoring, and to inform the Monitoring Plan, during the pre-injection, operation, and post closure phases.

Their locations have been selected to accommodate the Monitoring Plan needs and target sensitive areas that require tailored monitoring.

The current base case for the Proposed Development includes a total of 13 wells, of which:

- eight will be CO_2 injector wells (four at Hamilton Main, two at Hamilton North, and two at Lennox). These will be drilled as side-tracks from existing producer wells, within the existing footprint (template) of each platform, to install CO_2 resistant tubulars and cement;
- two will be new monitoring wells (one at Hamilton Main, and one at Hamilton North). These will target areas on the flanks of the reservoirs not previously drilled hence why new wells will be needed;
- one will be an additional monitoring well, side-track from an existing producer well within the existing footprint (template) of the platform. This will be drilled at the Lennox field; and
- two will be sentinel wells (one at Hamilton North, and one at Lennox). These wells will be existing wells within the existing footprint (template) of each platform that will be recompleted for additional reservoir monitoring. They will not have CO_2 resistant cement or tubulars. As such, they will be Plugged and Abandoned (P&A) once the CO_2 front in the reservoir reaches them.

All CO_2 injection and monitoring wells will be drilled from the existing platform well slots (either as side-track or as new ones), while the sentinel wells will be only recompleted and therefore not require any drilling activity.

3.3.5 Offshore platforms

3.3.5.1 Douglas CCS platform

Overview

A new Douglass CCS platform will be installed to the northwest to the exiting Douglas complex, just beyond the blow-out/H_2S dispersion radius of the existing facilities at approximate coordinates E461607 N5932596. The new Douglas CCS platform will be a Normally Unmanned Installation (NUI), acting as a hub for the CCS operations. It will provide overnight emergency shelter in a purpose-built module for six persons. The location of the new Douglas platform in relation to the existing Douglas complex is shown in Figure 3.5.

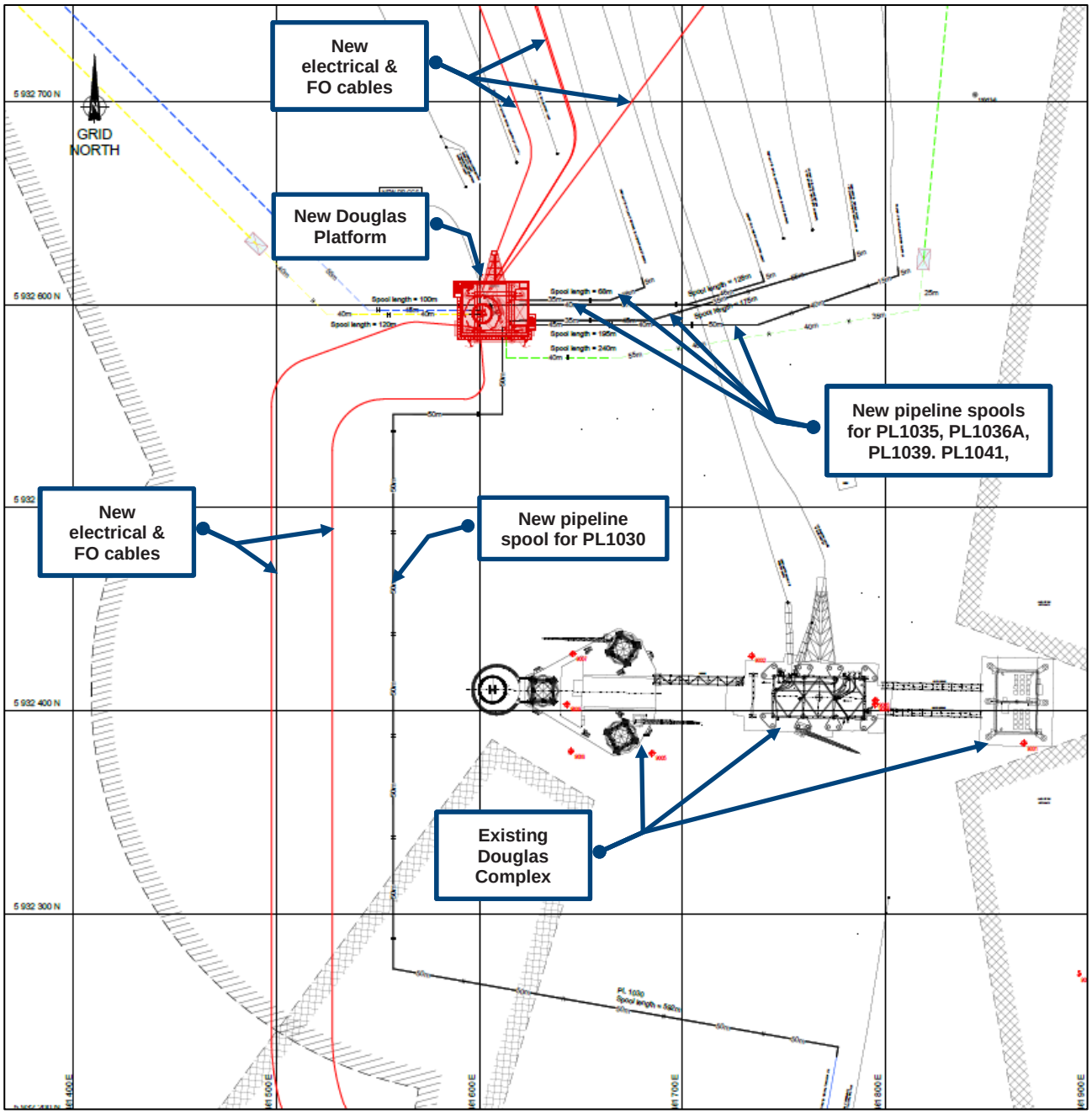


Figure 3.5: Location of New Douglas CCS platform and existing Douglas complex, and existing gas pipelines connections to New Douglas

Access to the platform will be by helicopter. A boat landing will also be provided onto the platform. The helideck is designed for helicopter approach from the West South West (WSW) including the required obstacle free zone and marking according to CAP 437 (standards for offshore helicopter landing areas) requirements.

Douglas CCS platform topsides

The topsides, shown in Figure 3.6, will comprise cellar, mezzanine, and weather decks, and have overall dimensions of approximately 33 m in length, 30 m in width, and 35.5 m in height to the weather deck/helideck.

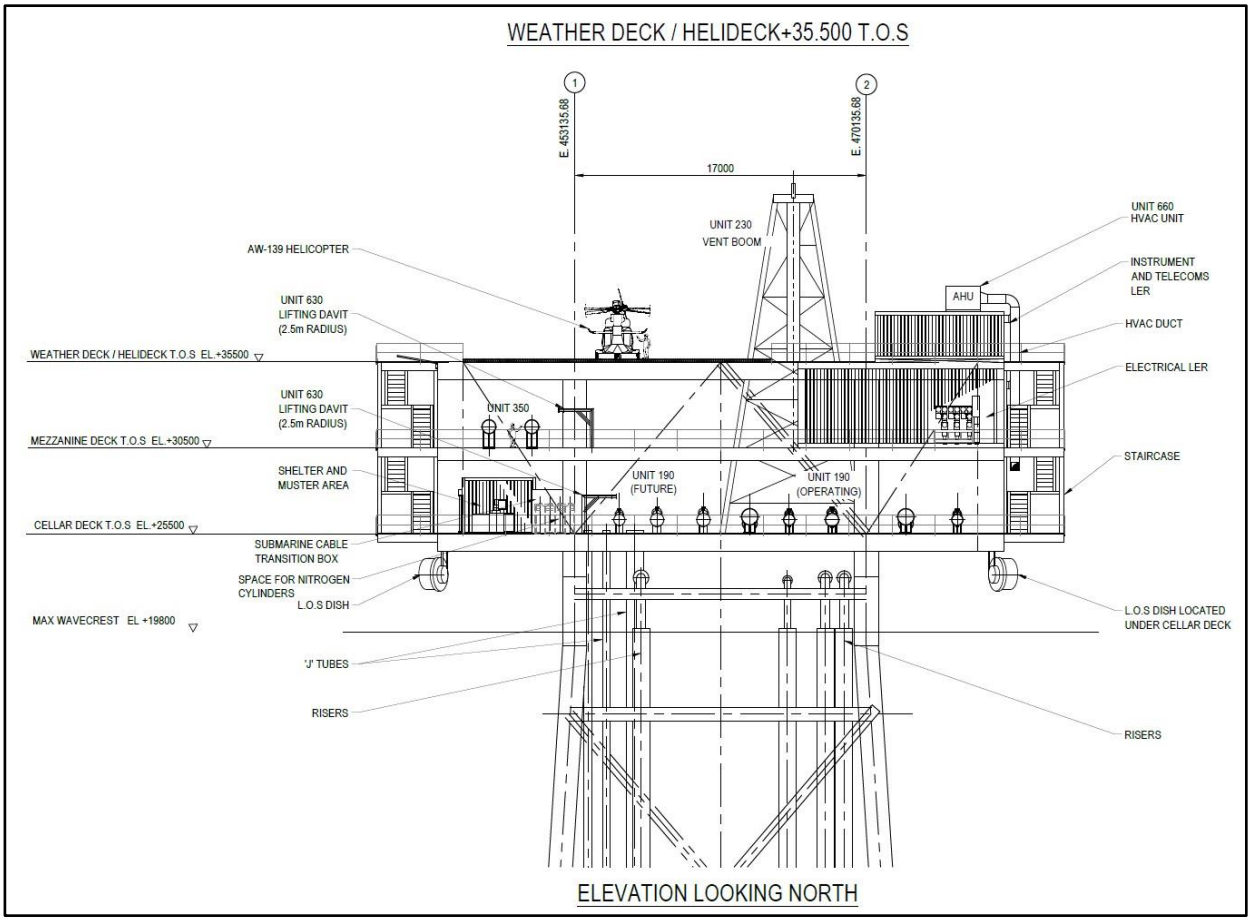


Figure 3.6: New Douglas CCS Platform Topsides

The main equipment located on the cellar deck, and mezzanine deck are set out in Table 3.1. The weather deck will comprise the helideck, four temporary lifting pad-eyes and a modularised instrument/telecoms room.

Table 3.1: Equipment located on cellar deck, and mezzanine deck

Cellar Deck	Mezzanine Deck
• pig launchers and pig receivers. • Emergency Shutdown (ESD) valving and riser pipework. • emergency overnight shelter. • survival craft. • davit crane(s). • submarine cable transition box. • J-tube head.	• electrical local equipment room. • battery room. • piping manifold area. • CO_2 gas heaters. • deck stair access to either cellar or weather decks. • helideck fire/foam fighting skid. • Heating, Ventilation, and Air Conditioning (HVAC) unit for instrumentation and electrical equipment room.

Douglas CCS jacket structure

The Douglas CCS jacket shown in Figure 3.7 will be a four-legged steel structure measuring approximately 20 m x 20 m at the lower level and 17.5 m x 17.5 m at the upper level. The jacket will support several equipment items listed below:

- 8 risers, of which 3 are provision for future dense phase gas;
- 5 J-tubes, of which one is provision for a possible future cable from PoA;
- 4 caissons for riser support;

- caisson for J-tubes support;
- cathodic protection monitoring J-tube; and
- Zodiac landing platform.

The jacket will be piled into the seabed. The piles will be vertically driven through the pile sleeves which are in turn are attached to the jacket legs via the use of shear plates, yoke plate, and stiffeners. The jacket is primarily designed to support both the lateral loads attributed to the environmental loads (wind, waves, etc.) as well as the vertical loads from the topsides. The foundation piles will transfer both the jacket weight and topsides loads directly to the soil. Each pile will be approximately 1.5 m in diameter and 40.25 m in length, with a penetration depth of around 22 m.

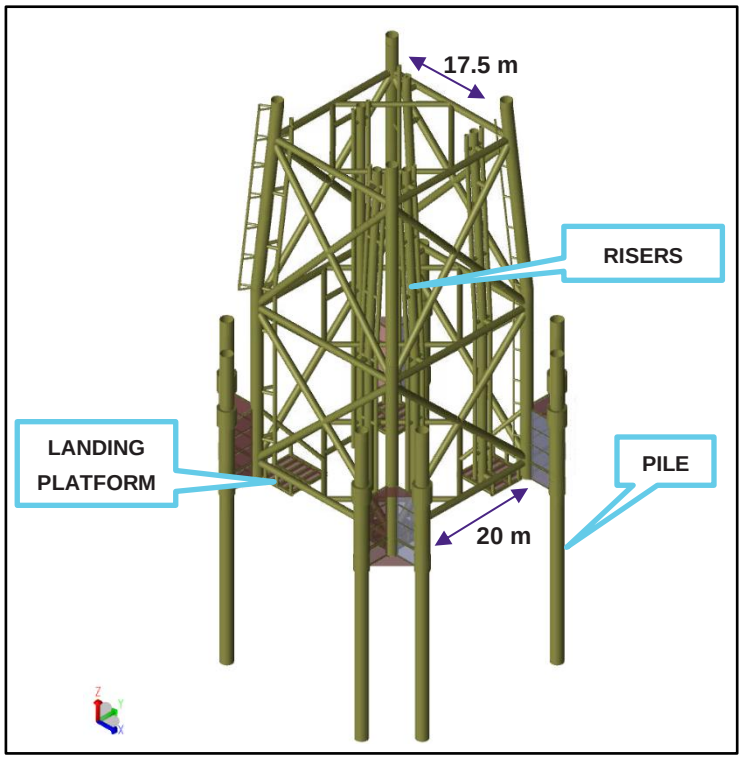


Figure 3.7: New Douglas CCS Platform Jacket Structure

3.3.5.2 Satellite platforms

The new Douglas CCS platform will receive and distribute CO_2 to the Hamilton Main, Hamilton North, and Lennox OPs. When necessary, the Douglas platform will additionally provide pressure control and heating prior to distribution of the CO_2 to the three fields. The existing Hamilton Main, Hamilton North, and Lennox OPs will be redeveloped in an incremental manner for CO_2 service, as dictated by the availability of CO_2 from the emitters.

The outcome of the Front-End Engineering Design (FEED) studies has demonstrated that a modular approach (consisting of the installation of a new module including the facilities necessary for CO_2 treatment and injection) for the modification of the satellite wellhead OPs (Hamilton Main, Hamilton North, and Lennox) is not viable. These substructures do not possess the reserve strength required to support the additional topsides weight without removal of the existing topside structures. It has, therefore, been determined that the only feasible approach is the removal of the existing topsides and the installation of new purpose-built topsides, with the installation of new risers and J-Tubes within the perimeter framework of the existing jacket to avoid additional protection frames and their additional loads on the substructures.

A new deck will be installed on each of the satellite platforms (Hamilton Main, Hamilton North, and Lennox) after removal of the existing topsides. The components will be delivered to the OPs completely fabricated and ready for integration onto their respective jackets. The main fabricated components are detailed in Table 3.2.

Table 3.2: Modules For Satellite Platforms

Platform deck	Estimated Dimensions	Estimated Dry Weight	Equipment Accommodated
Hamilton Main Integrated Deck	L: 23 m X W: 26 m X H: 12 m	~1,100 tonnes	Helideck Electrical heaters and controls Battery room UPS system Instrument room (telecoms)
Hamilton North Integrated Deck	L: 23 m X W: 26 m X H: 12 m	~950 tonnes	Helideck Electrical heaters and controls Battery room UPS system Instrument room (telecoms)
Lennox Integrated Deck	L: 24 m X W: 30.5 m X H: 12 m	~1,400 tonnes	Helideck Electrical heaters and controls Battery room UPS system Instrument room (telecoms)

3.3.5.3 Offshore accommodation flotel

It is expected that the offshore construction workforce will be accommodated in a flotel adjacent to the New Douglas CCS platform, utilising a 'walk-to-work' system suitable for year-round working. The flotel would come on station after the departure of the main offshore Heavy Lift Vessel (HLV) (see section 3.4.2). It is assumed that the Flotel will also be present during the Commissioning and Start-Up activities.

3.3.6 Pipelines

3.3.6.1 Repurposing of existing pipelines

Figure 3.8 shows a schematic diagram of the different pipelines currently in use transferring hydrocarbons from satellite wellhead platforms to the Douglas complex, and onward export from Douglas to Storage and the Point of Ayr Terminal. Most of this network will be repurposed for CO_2 transportation.

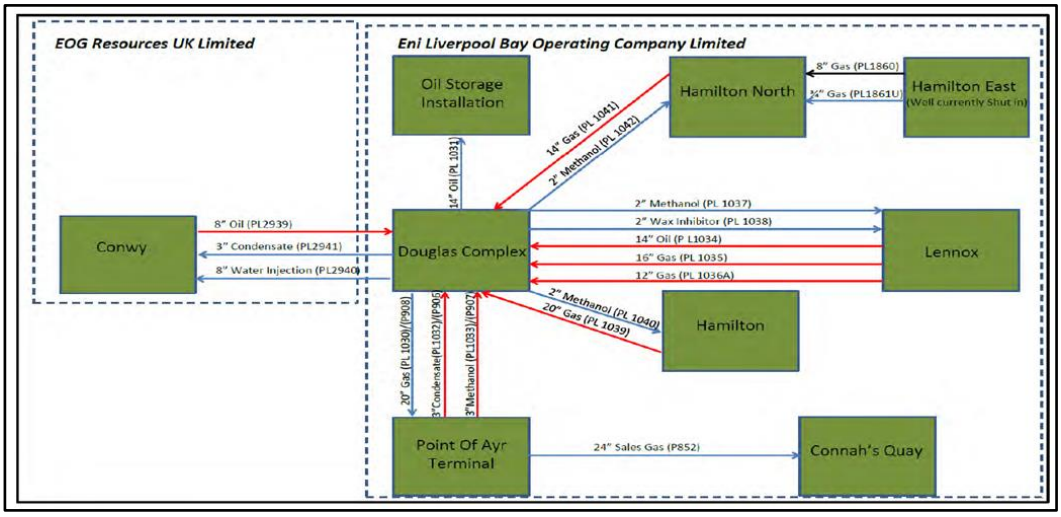


Figure 3.8: Liverpool Bay Area Existing Pipeline Schematic

New connections to existing gas pipelines

CO_2 will be transported from PoA to Douglas via the existing 20" pipeline, approximately 600 m of which will be rerouted to the new Douglas CCS platform. Four pipelines will then convey CO_2 from the new Douglas CCS Platform to the satellites. Whilst much of the existing pipeline infrastructure will be repurposed to transport CO_2, the end sections of each pipeline at Douglas would be rerouted to the new Douglas CCS platform. The following lengths of new pipeline will be required to connect to the new Douglas CCS platform, as shown in Figure 3.5:

- PL1030, existing 20" gas to Point of Ayr (approximately 592 m);
- PL1039, existing 20" gas export from Hamilton Main (approximately 175 m);
- PL 1041, existing 14" gas export from Hamilton North (approximately 68 m);
- PL1035, existing 16" gas export from Lennox (approximately 128 m); and
- PL1036A, existing 12" gas injection to Lennox (approximately 195 m).

The existing PL1034, 14" Douglas to Lennox pipeline will not be re-used for CCS and will be left in situ.

In addition to laying these pipeline lengths on the seabed, PL1030 may also require some external protection in the form of concrete mattresses over approximately 400 m of its length. The 200 m of this pipeline closest to the new Douglas CCS platform will not be provided with any external protection. No external protection will be provided for the other pipeline connections, as these lengths are all within 200 m of the new Douglas CCS platform. Material quantities for the protection of pipeline connections are given in Table 3.3.

Table 3.3: Design Envelope: material quantities for mattress protection of pipeline connections

Pipeline ID	Steel pipe (m)	No. concrete mattresses	Dimensions of each concrete mattress (m)	Weight of each mattress (kg)	Total weight of concrete mattresses (kg)
PL1030 20"	608	110	6 x 3 x 0.3	9,800	1,078,000
PL1039 20"	309	70	6 x 3 x 0.3	9,800	686,000
PL1041 14"	205	50	6 x 3 x 0.3	9,800	490,000
PL1035 16"	263	60	6 x 3 x 0.3	9,800	588,000
PL1036a 12"	329	70	6 x 3 x 0.3	9,800	686,000

In addition to the concrete mattresses used for stabilisation of the pipeline spools, concrete sleepers (rubber coated) will be required for the crossings on approach to the new Douglas platform comprising:

- 2 sleepers (6m x 2m x 1.1m) for 14" Spool PL1041 and 14" PL1031
- 2 sleepers (6m x 2m x 1.1m) for 20" Spool PL1039 and 12" PL1036A

Grout bags will be used to support spool pieces and provide protection for infield umbilicals. The footprint of the grout bags is unlikely to lie outside of that calculated for concrete mattresses. The material quantities for grout bags are given in Table 3.4.

Table 3.4: Design Envelope: material quantities for grout bags at pipeline connections

Pipeline ID	Grout bag type	No. grout bags	Dimensions of each grout bag	Weight of each grout bag (kg)	Total weight of grout bags (kg)
PL1030 20"	Pyramid	1	3 m x 3 m x 2.8 m	-	-
	Regular	100	500 mm x 300 mm x 75 mm	20	2,000
PL1039 20"	Pyramid	1	3 m x 3 m x 2.8 m	-	-
	Regular	100	500 mm x 300 mm x 75 mm	20	2,000

Pipeline ID	Grout bag type	No. grout bags	Dimensions of each grout bag	Weight of each grout bag (kg)	Total weight of grout bags (kg)
PL1041 14”	Pyramid	1	3 m x 3 m x 2.8 m	-	-
	Regular	100	500 mm x 300 mm x 75 mm	20	2,000
PL1035 16”	Pyramid	1	3 m x 3 m x 2.8 m	-	-
	Regular	100	500 mm x 300 mm x 75 mm	20	2,000
PL1036a 12”	Pyramid	1	3 m x 3 m x 2.8 m	-	-
	Regular	100	500 mm x 300 mm x 75 mm	20	2,000

The existing pipelines to be re-utilized for gas phase have been assessed to suit the CO_2 injection. There are no additional modifications needed for the purpose of transporting CO_2 other than rerouting the short pipeline sections to tie-in to the new Douglas CCS platform.

From assessments conducted to date, it has been concluded that no existing process or utility systems are suitable for reuse due to their age and condition.

3.3.6.2 Pipeline contents temperature increase

Natural gas currently flows into the PoA terminal from offshore production. As the natural gas reaches the foreshore pipeline, having travelled from the Douglas Process OP through the marine environment, it is at or near equilibrium with the sea temperature. With the Proposed Development, CO_2 will flow from the PoA terminal out through the foreshore pipeline to the Douglas Process OP. Compression at the PoA terminal will increase the temperature of the gas. There is the potential for this to increase the temperature of the surrounding environment of the foreshore and offshore pipeline. Studies (Wood, 2023) have been undertaken to understand the effect of heat from the Proposed Development. The findings of these studies are presented in the relevant topic chapters of this ES.

3.3.7 Offshore electrical and fibre optic cables

Douglas Process OP currently supplies 13.8 kV, 60 Hz power through the existing gas-fuelled turbine installed on the platform to Hamilton Main and Hamilton North OPs via a subsea cable. The Lennox OP is provided with power, in series, from Hamilton Main OP.

None of the existing inter-platforms subsea power cables have been deemed suitable for re-use for CO_2 service, consequently new inter-platform power cables would be installed as part of the Proposed Development. The Proposed Development will therefore require the electrification of Douglas OP from the Onshore PoA Terminal, as the existing gas-fuelled turbine on Douglas OP will no long have a fuel supply at the end of gas production from the Liverpool Bay assets.

It is expected that the main power to Douglas OP would be extended from PoA Terminal with two new 33 kV, 50 Hz subsea cables integrated with fibre optic (FO) connection. Power will then be distributed from Douglas OP to Hamilton Main, Hamilton North and Lennox Ops through a new single 33 kV, 50 Hz subsea cable integrated with FO, connecting Douglas OP to each of the three wellhead platforms Figure 3.1. The Offshore power and FO cables will, as a general principle, follow the alignment of the existing pipelines at an offset of around 100 m, and there may be a need to micro-route the cables around identified obstructions such as heritage assets, and unexploded ordnance (UXO).

There is planned to be 35,000 m (35 km) of Offshore power and FO cables (35 km each, for the two parallel Offshore power and FO cables) which would lead from PoA Terminal to Douglas OP. There is an additional requirement of 72,000 m (72 km) of inter-platform cabling. Approximately 15,000 m (15 km) of this subsea cabling would be present from Douglas OP to Hamilton North OP, while 12,000 m (12 km) would be present

from Douglas OP to Hamilton Main OP and 35,000 m (35 km) of inter-platform cabling would be present from Douglas OP to Lennox OP (Figure 3.1 and Table 3.5). Each of the cables will have to cross several existing pipelines and cables. The number of crossings by each cable, and the typical composition of the external cable protection at these locations is presented in Table 3.5 and Table 3.7.

Table 3.5: Design Envelope: Cables

Parameter	Number of crossings	Cable Length
Cables from PoA Terminal to Douglas OP	10	35,000 m
Inter-platform cable from Douglas OP to Hamilton North OP	8	15,000 m
Inter-platform cable from Douglas OP to Hamilton Main OP	8	12,000 m
Inter-platform cable from Douglas OP to Lennox OP	6	35,000 m

The crossings for the three inter-platform cables are over existing Eni owned gas and oil pipelines. The cables from PoA Terminal to Douglas OP will cross third-party electrical cables, as described in Table 3.6.

Table 3.6: Design Envelope: Third Part Cable Crossings

Crossing ID	Third-party owner	UTM Easting (m)	UTM Northing (m)	Water depth (m)	Water above berm (m)	Berm height (m)
PoAX-1	Ørsted Burbo Bank wind farm	470974.84	5916002.39	5	4.2	0.8
PoAX-2	Greencoat UK Wind North Hoyle wind farm	468795.03	5916535.10	7	6.2	0.8
PoAX-3		468776.17	5916536.68	7	6.2	0.8
PoAX-4	Gwynt y Môr OFTO, Gwynt y Môr wind farm	461904.20	5917763.30	12	11.2	0.8
PoAX-5		461875.07	5917817.57	12	11.2	0.8
PoAX-6		461713.35	5924702.50	20	19.2	0.8
PoAX-7	National Grid/Scottish Power, Western Link HVDC cable	461713.35	5930787.10	30	29.2	0.8
PoAX-8		461713.35	5930818.38	30	29.2	0.8

Where the new Offshore power and FO cables cross existing pipelines and cable, they will require external cable protection consisting of freshly quarried rock, sand-filled geotextile bags, and concrete mattresses. There are likely to be four different crossing types that will each have their own external protection arrangements. However, the arrangements for buried pipelines and cables will be similar, as will those for seabed pipelines and cables. These are described in Table 3.7, and illustrated in Figure 3.9, and Figure 3.10.

Table 3.7: Design Envelope: Cable Crossings External Protection

Crossed infrastructure	Materials	Dimensions
Buried cable	Concrete mattresses, sandbags, and freshly quarried rock	200 m length x 7 m width x 0.8 m height
Seabed cable	Concrete mattresses and sandbags	200 m length of 18 No. 6 m x 3 m concrete mattresses
Buried pipeline	Concrete mattresses, sandbags, and freshly quarried rock	200 m length x 7 m width x 0.8 m height
Seabed pipeline	Concrete mattresses and sandbags	200 m length of 22 No. 6 m x 3 m concrete mattresses

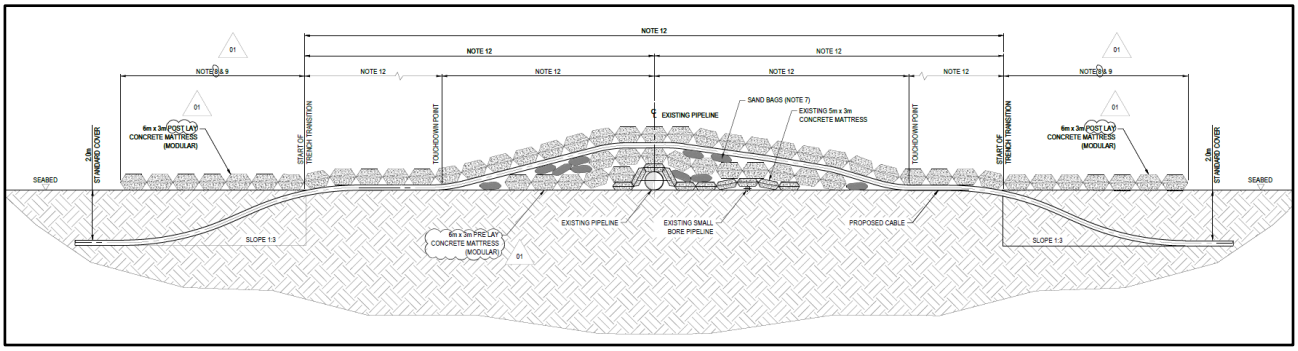


Figure 3.9: Cross Section Of Typical Arrangement For Crossing Of Existing Seabed Pipeline (arrangement for crossing existing seabed cable will be similar)

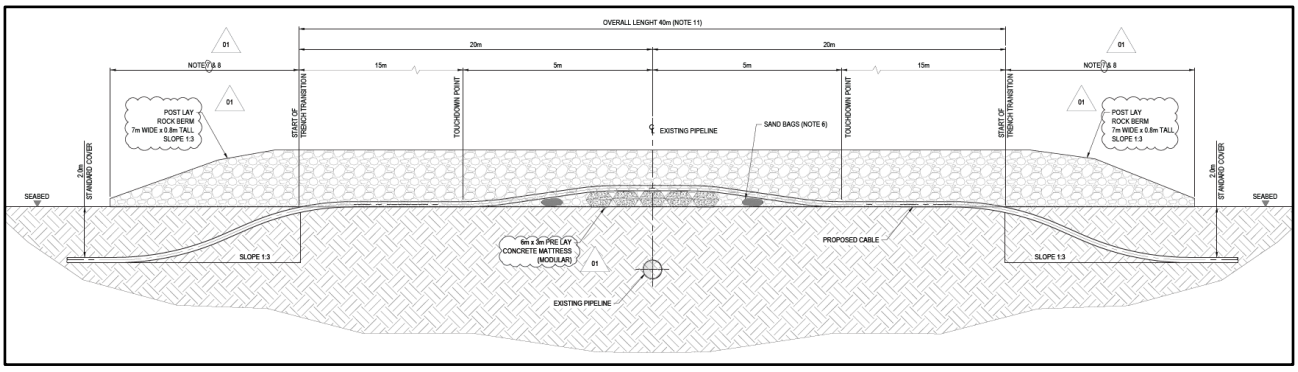


Figure 3.10: Cross Section Of Typical Arrangement For Crossing Of Existing Buried Pipeline (arrangement for crossing existing seabed cable will be similar)

Each of the offshore cables will comprise a 3-core 33 kV armoured electrical cable with bundled fibre-optic cable and an external diameter of 153 mm. The single armoured submarine cables comprise a copper conductor, XLPE (Cross Linked Polyethylene), copper wires, and copper foil bonded to the polyethylene sheath. External protection will be required on each of the electrical cables on their final approaches to the new Douglas platform and at the crossings of existing pipelines and cables. The material quantities for the cable protection are given in Table 3.8.

Table 3.8: Design Envelope: material quantities for protection of electrical cables

Cable/crossing ID	Protection type	Number	Dimensions (m)	Weight (kg)	Total weight (kg)
PoA to new Douglas Cable 1	Concrete mattress	35	6 x 3 x 0.3	9,800	343,000
PoA to new Douglas Cable 1	Concrete mattress	35	6 x 3 x 0.3	9,800	343,000
New Douglas to Hamilton North	Concrete mattress	50	6 x 3 x 0.3	9,800	490,000
	Rock	-	1,000	12,000 – 16,000 per linear metre	12,000,000 – 16,000,000
New Douglas to Hamilton Main	Concrete mattress	100	6 x 3 x 0.3	9,800	980,000
New Douglas to Lennox	Concrete mattress	60	6 x 3 x 0.3	9,800	588,000
	Rock	-	-	12,000 – 16,000 per linear metre	12,000,000 – 16,000,000
	Concrete mattress	64	6 x 3 x 0.3	9,800	686,000

Cable/crossing ID	Protection type	Number	Dimensions (m)	Weight (kg)	Total weight (kg)
PoA to new Douglas Cable 1, 10x crossings	Rock	-	1,000	12,000 – 16,000 per linear metre	12,000,000 – 16,000,000
PoA to new Douglas Cable 2, 10x crossings	Concrete mattress	64	6 x 3 x 0.3	9,800	686,000
	Rock	-	1,000	12,000 – 16,000 per linear metre	12,000,000 – 16,000,000

3.4 Offshore construction

3.4.1 Introduction

This section summarises the key Offshore construction activities of the Proposed Development. In addition, it provides details on the temporary infrastructure required for the installation of the offshore cables and associated permanent infrastructure.

Construction of the Proposed Development is anticipated to start in 2024, to enable operation to commence during 2026 and 2027.

3.4.2 Drilling

3.4.2.1 Wells overview

Table 3.9 presents an overview of the thirteen proposed CCS wells including their surface location coordinates, estimated Measured Depth (MD) and estimated True Vertical Depth (TVD).

Table 3.9: Overview Of Wells

Purpose	Well type	Field	Well name	Easting	Northing	Proposed kick-off point m MD	Measured Depth (MD) m	True Vertical Depth (TVD) m
Injector	Sidetrack	Hamilton	H1ST1	469685	5936706.2	863	1498	932
			H2ST1	470200.5	5937333.5	1686	2380	932
			H3ST1	470200.5	5935501.56	893	1366	932
			H4ST1	470200.5	5934462.3	1579	2219	933
		Hamilton North	N1ST	468323	5945412.5	783	1403	971
			N3ST	468323	5944406.4	713	1043	1010
		Lennox	L13ST2	489487.6	5942334.3	678	1668	865
			L5ST1	489487.6	5942938.2	625	1947	1124
Monitor	New well	Hamilton	HM_M2_1	470848.6	5936608.7	N/A	1894	960
		Hamilton North	HN_M2_1	468084.6	5945670.8	N/A	1781	1043
	Sidetrack	Lennox	LX_M3_2	490155.3	5941955.3	625	2466	1114
Sentinel	Recompletion	Hamilton North	HN_M3	469272	5944899	N/A	N/A	N/A
		Lennox	LX-M2_1	487637	5941932	N/A	N/A	N/A

3.4.2.2 CO_2 injection wells

Hamilton Main

At Hamilton Main, CO_2 four injection wells are required, which means that all four current production wells will be side-tracked. Each side-tracked wellbore will be carried out from a jack-up vessel and take approximately 35 days to complete. This will comprise around 15 days for drilling, and 20 days for completion. Waste streams from the vessels would be shipped onshore for onshore processing and disposal.

Hamilton North

At Hamilton North, two injection wells are required, which means that two of the current production wells will be sidetracked. The proposed drilling targets provided are very close to the existing wellbores. Where the sidetrack occurs at more than 60 degrees inclination, the target has been optimised on the right-hand side to assist building away from the wellbore.

Lennox

Two injection wells are planned for Lennox. However, three suitable target locations have been identified, two eastern and one western. Priority was placed on hitting at least one of the eastern targets. As mentioned above, the directional challenges are significantly greater at Lennox due to a change in depth of the reservoir target compared to the original production wells. As such, very few of the existing wells are deemed suitable for sidetracking. Only L05, L13 and L01z have been identified as candidates. L01 would require a difficult slot recovery to complete the sidetrack. L05 and L13 will also require casing recovery to sidetrack at the 13 3/8" shoe.

3.4.2.3 Monitoring wells

Two new dedicated monitoring wells, one each at Hamilton North, and Lennox, will be drilled. These are required to enable the calibration of 4D seismic data, to monitor the structural spill point, and to calibrate the 3D reservoir models. Overall, their objective is to monitor both CO_2 conformance and containment, which will be carried out through the acquisition of pressure and temperature data (via permanent bottom-hole gauges), as well as fluid sampling and 3D Vertical Seismic Profile (VSP).

The two monitoring wells will be drilled to a maximum depth of between 914 m to 975 m TVD. The target depth for Hamilton North, and Hamilton Main would be 782 m TVD, and 838 m TVD respectively. Drilling will be carried out from a jack-up vessel and take approximately 50 days to complete. This will comprise around 30 days for drilling, and 20 days for completion. As there is no riser back to the rig, drill cuttings would be left on the seabed, with the estimated quantity being around 140 m^3 per well. Waste streams from the vessels would be shipped onshore for onshore processing and disposal.

The Lennox monitoring well would be side-tracked from an existing production well, with a target depth of 831 m TVD, and maximum depth of 1067 m TVD. Drilling will be carried out from a jack-up vessel and take approximately 45 days to complete. This will comprise around 25 days for drilling, and 20 days for completion.

3.4.2.4 Sentinel wells

A decision is still pending on whether the two sentinel wells would require the installation of fibre optics. If fibre optics are not required, it is conceivable that these wells would not require a workover and would only require a slickline intervention. The data acquisition requirements for the sentinel wells would be via cased hole logging on an annual basis for three years, and downhole pressure measurement. If wireless gauges can be used for the downhole measurements, a workover of the wells could be avoided.

3.4.2.5 Programme for wells installation

The drilling and side-tracking of CO_2 injection wells will be carried out at each of the Hamilton Main, Hamilton North, and Lennox platforms. Figure 3.11 shows that the works at Hamilton North will take approximately five months commencing in September 2024. The drilling works are comprised of three main activities: plugging and abandonment of the existing wells (via separate Decommissioning Plan); side-tracking; and completion of wells to be used for CO_2 injection. Perforation of the wells is then scheduled later during November/December 2027. The works at Hamilton Main involve the same main activities and are scheduled to commence in February 2025 and take approximately seven months. Perforation of the wells is then scheduled later during August/September 2027. The last works in the sequence at the Lennox platform are planned to take around 12 months commencing in October 2025. Perforation of the wells is then scheduled later during April/May 2028.

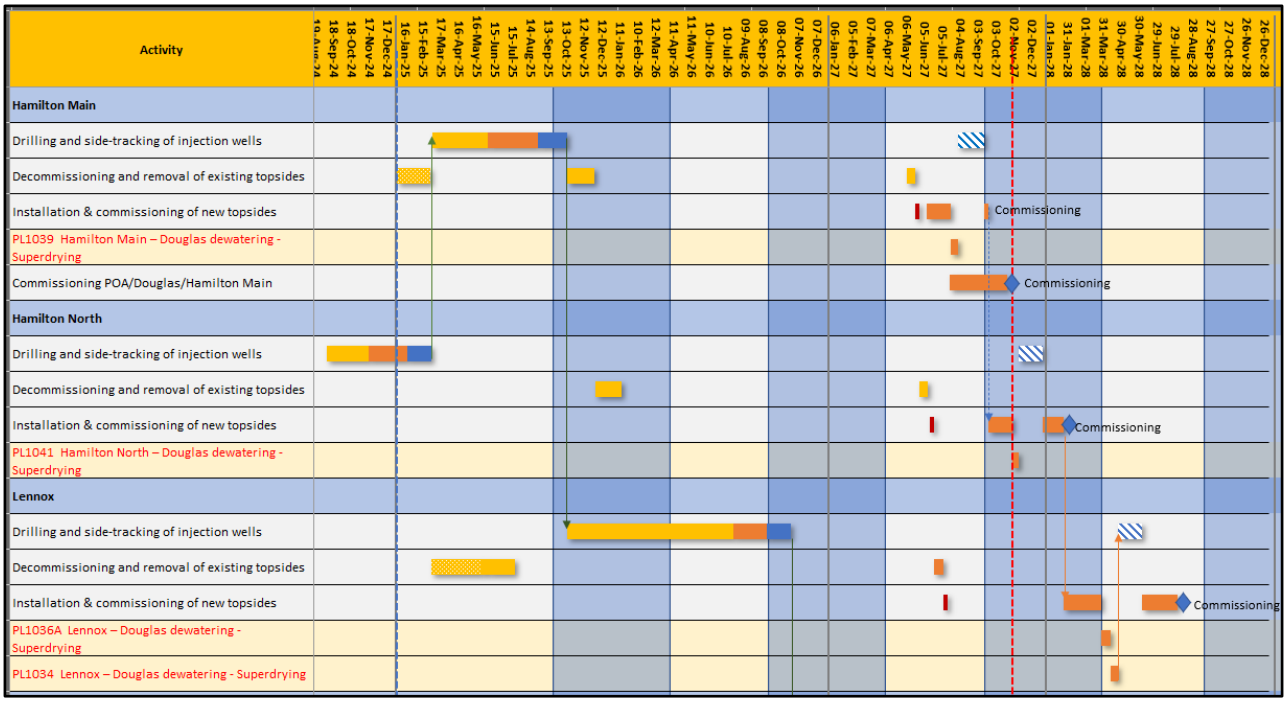


Figure 3.11: Summary Programme for Installation and Commissioning CO_2 Injection Wells and Satellite Platforms

3.4.3 Offshore platforms

The Proposed Development will re-utilise the existing jackets of Hamilton Main, Hamilton North, and Lennox Oil and Gas Platforms. Structural assessments have been performed that have identified that they are suitable to support the modifications required for CO_2 service.

The new Douglas CCS platform jacket will be designed to allow the structure to be installed offshore as a direct lift from the transportation barge to its field position. Installation of topsides would utilise a HLV or a Floating Shear Legs (FSL) crane. A standard 300' barge (91 m x 27.5 m) will be utilised for transporting the topsides.

The new topsides for the satellite platforms will be installed as single units using a HLV or Crane Barge. Figure 3.11 shows that the jackets of Hamilton Main, Hamilton North, and Lennox will be installed sequentially during May-July 2027. The potential vessels required for installation of the fabricated modules and equipment packages is shown in Table 3.10.

Table 3.10: Illustrates The Offshore Installation Methodology

Platform	Water Depth (LAT)	Module/Equipment		Installation Equipment
		Item	Est. Lift Weight (Gross, rounded)	
Douglas CCS	29.2 m	Jacket	2,940 tonnes	Transportation barge, direct lift.
		Topsides	2,290 tonnes	Transportation barge and HLV or FLS
Hamilton Main OP	25.8 m	Deck replacement	1,100 tonnes	HLV 2,500t class
Hamilton North OP	22.1 m	Deck replacement	900 tonnes	HLV 2,500t class
Lennox OP	7.2 m	Deck replacement	1,300 tonnes	HLV 2,500t class

The present structural design for the new Douglas CCS platform allows for eight jacket foundation piles: two at each leg. The foundation piles will be prefabricated at an onshore facility and delivered offshore by means of a transportation barge. The piles will be vertically driven through the pile sleeves into the seabed to reach a target penetration depth (see Figure 3.7).

3.4.4 Intra-field pipelines

The existing pipeline from the PoA Terminal to the Douglas OP, and a selection of the existing pipelines connecting Douglas OP to Hamilton North, Hamilton Main, and Lennox OPs will be repurposed to transport CO_2, and no physical changes to the current pipelines are expected.

While no new intra-field pipelines are required, a short length (595 m) of the existing Douglas to PoA (PL 1030) pipeline will need to be re-routed to the new Douglas CCS platform, along with tie-ins from Douglas CCS to the intra- platform lines. These pipeline connections will be laid on the seabed, and not buried. Section 3.3.6.1 presents the approximate pipeline connection lengths.

Sandwave ridges are present to the south of the proposed new Douglas CCS location. It will therefore be necessary to carry out some pre-lay seabed preparation through these features to create the corridor for the pipeline connection. This would be created probably using either a mass flow excavator, or a jet sled. The sand waves are approximately 2 m to 3 m in height, and a corridor approximately 10 m in width would be created through them. It would take approximately 3 to 5 days to create the corridor.

3.4.4.1 Programme for platforms and intra-field pipelines

Installation of the new Douglas CCS platform will be carried out over approximately two months commencing with the new jacket, piles, and topsides during Spring 2027. To make way for the new Douglas jacket, during late summer to autumn 2025, there will be some subsea decommissioning works to remove redundant pipework and cabling from the seabed. These removals will also include disconnecting the gas export pipework from the existing Douglas complex and making it ready for later connection to the new Douglas CCS platform. Figure 3.12 presents a summary programme for installation and commissioning of new Douglas CCS platform.

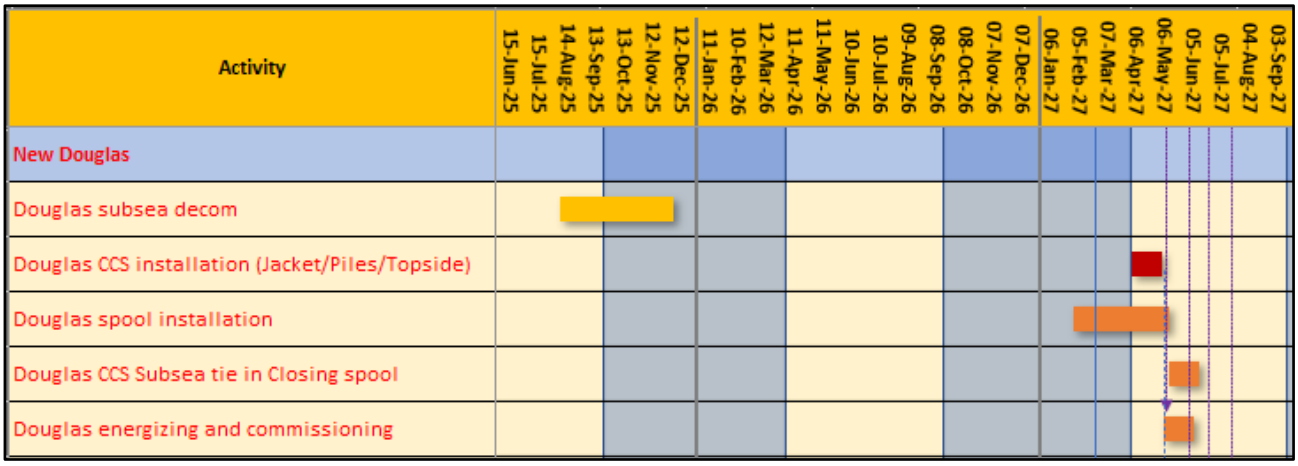


Figure 3.12: Summary Programme For Installation And Commissioning Of New Douglas Platform

A summary programme for installation and commissioning of satellite platforms is shown in Figure 3.11. This shows a sequential campaign for drilling and side-tracking injection wells that will commence at Hamilton North will commence in Q3/Q4 2024 for approximately six months. The drilling rig will then move to Hamilton Main in Q1 2025 to carry out an up to seven months campaign until Q3/Q4 2025. Lastly, injection well drilling will be carried out at Lennox for up to 12 months from Q4 2025 until Q4 2026.

The removal of the existing topsides at the satellite platforms is scheduled to start at Hamilton Main in May 2027, then move to Hamilton North, and finish at Lennox in June 2027, as shown in Figure 3.11. The removal campaign at each platform will take around four to five weeks. The sequence for the installation and commissioning of the topsides at each satellite platform will be the same as for the removal works and will commence in June or July 2027. The commissioning works at each platform will also include the flushing and drying of the existing gas export lines from each platform to make ready for CO_2 transport. Figure 3.11 shows that these works will take approximately six to nine months at each platform and pipeline, with the final works in the sequence scheduled for completion at Lennox in July 2028.

3.4.5 Offshore power and fibre optic cables

3.4.5.1 Cable installation

Cable laying

The cable route from PoA Terminal to Douglas OP, in its initial Onshore segment, heads out of PoA Terminal and will pass under the Talacre dune system to the MHWS point, via two parallel conduits that will be installed using a Horizontal Directional Drilling (HDD) trenchless method. Planning permission from Flintshire County Council (FCC) for the Onshore segment was granted on 10 January 2024 (application reference FUL/000246/23). The entry/exit pit for the Talacre dune system HDD on the intertidal side will be placed between 2-3m below ground level into the sand with pumps and storage tanks sited close to the pit to contain any fluid. As the pit will be at the same depth as the proposed cable depth, and given the Applicant's experience with similar installations, it is not expected that any external cable protection will be required. Access to the beach will be from the Talacre Beach car park. Temporary matting will be placed to facilitate vehicle access within the Foreshore Area over the soft sand as necessary (**T-PD-016** of the **REAC**). Figure 3.13 presents some illustrative cross-sections of how the electrical cable will be installed across Talacre beach and under the dunes.

At the end of the HDD works required to prepare the conduits, the first cables will be brought into the area via a cable-laying vessel and pulled ashore. The cable-laying vessel will be beached as far up the intertidal stretch of beach as possible. The cables will then be guided by excavators and brought down on to rollers, pre-installed on the beach, pegged at approximately 2m intervals. It will then be attached to the HDD pulling equipment,

including a winch, pulled to the entry/exit pit, and drawn under the Talacre dunes to the Submarine Cable Junction Boxes. Once the pull is complete, the cables will be buried on the beach using an intertidal trenching machine, plough, dredgers, and supported by excavators. With the foreshore work completed, the vessel will then lay the cables from the MLWS at the Foreshore (and on to the Offshore Douglas Complex). The process will then be repeated for the second cable. An example cable lay vessel is shown in Figure 3.14.

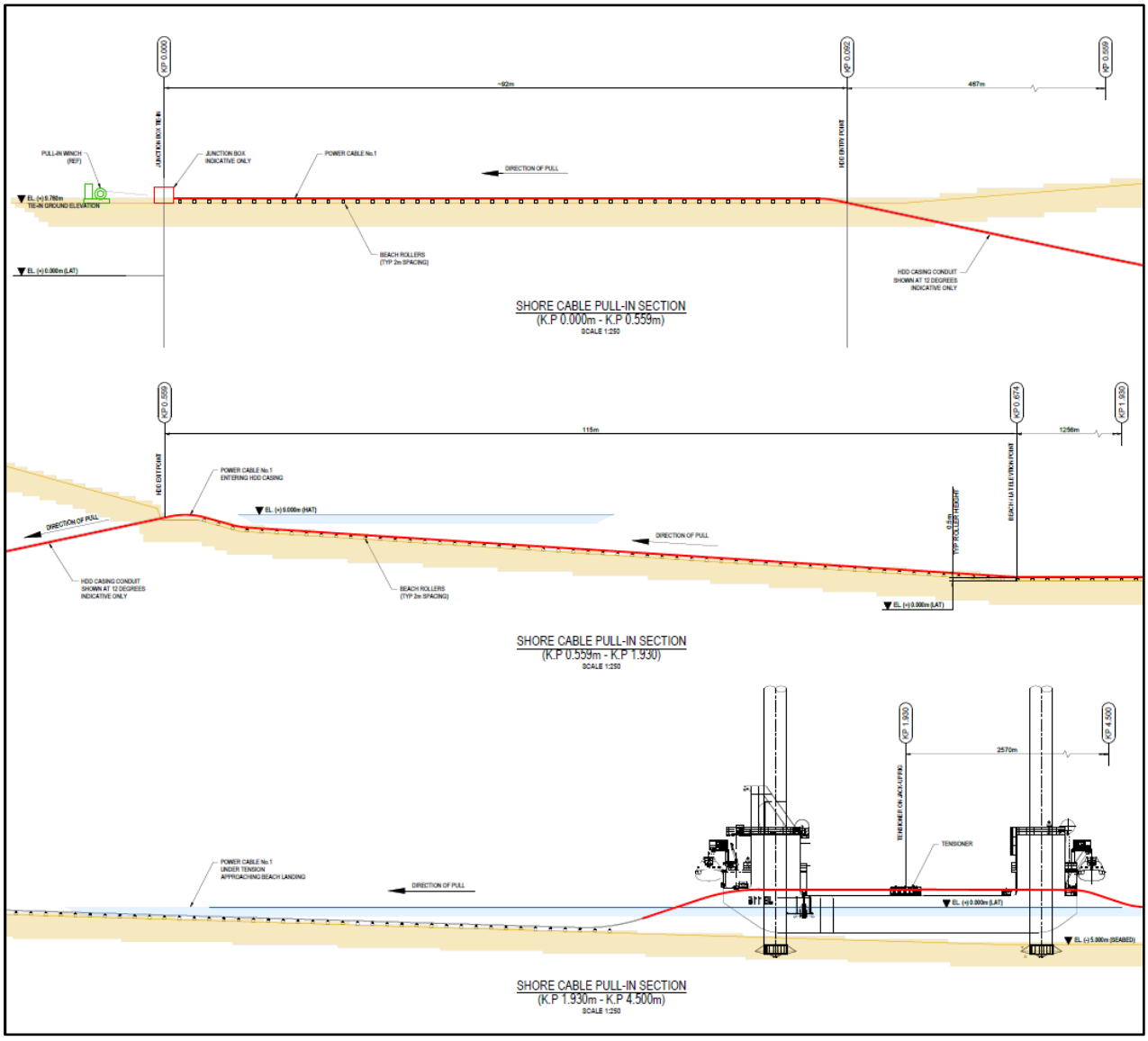


Figure 3.13: Cross Sections Of Cable Installation Through Dunes And Across Talacre Beach

Because of the presence of the Welsh Channel (shipping channel for the Port of Mostyn) and the West Hoyle Spit (a series of sand banks exposed at low tides) directly offshore, it is possible that a suitable vessel will not be able to approach near the shore. In this case, the vessel will remain on the offshore side of the spit, and smaller boats and barges will be required to control the movement of the cables on to the beach, with a jacking barge likely to be set up in the intertidal area. The cable will be floated using buoyancy units, installed from the cable-laying vessel. Once ashore, the buoyancy units will be removed, and the cables will be placed on intermediate rollers as per the previous method described.

Seawards of the shore approach, the cables routes of the Proposed Development would broadly follow the alignment of the existing pipelines connecting PoA Terminal to Douglas OP and Douglas OP to Hamilton Main, Hamilton North, and Lennox OPs (Figure 3.1 and Figure 3.16).

To take the cable directly across the West Hoyle Bank, will require dredging a channel (most likely with a barge operated backhoe dredger) approximately 1,000 m in length, 60 m in width, and 7 m in depth (approximately 3 m to take bank down to LAT, then approximately 3 m depth for cable burial). The excavated material would be side cast along the length of the trench, and then backfilled after cable installation. It would take approximately two to three weeks to excavate the trench. The route of the Proposed Development across the West Hoyle Bank is shown in Figure 3.16.

Figure 3.14: Example Of A Typical Cable Installation Vessel Showing The Cable Carousel On The Deck

Figure 3.15: HDD Exit Pit And Cable Approach (Typical For Liverpool Bay Area) Showing Jack-Up Vessel At MLWS Mark, And Cable Rollers Set Out On The Beach – The Exit Pit For The Proposed Development Would Be Further Up The Beach Just Below The MHWS Mark

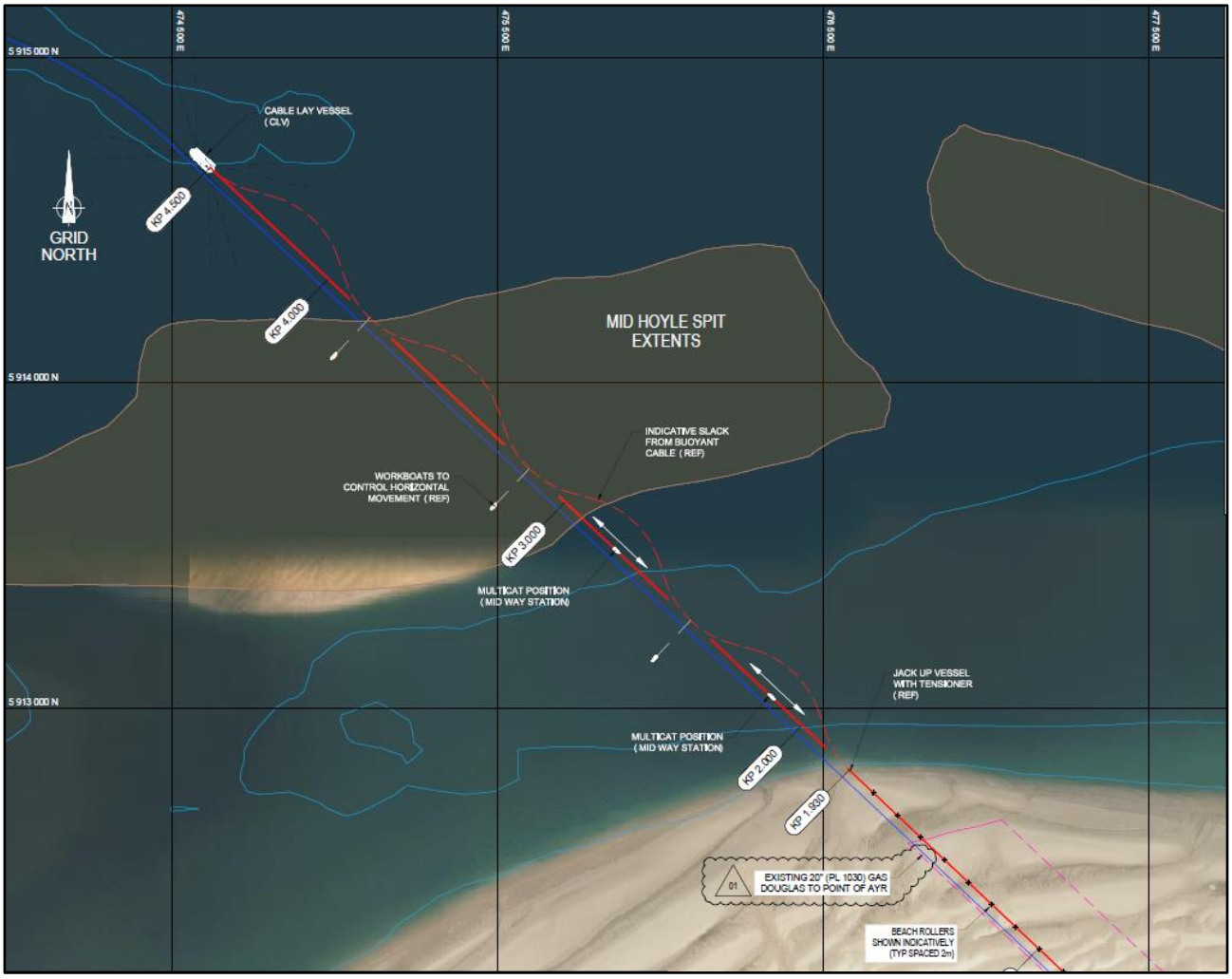


Figure 3.16: Cable Route Option (Red Line) To Cross West Hoyle Bank Following Parallel Alignment To Existing PoA To Douglas Natural Gas Pipeline (Blue Line)

The section of beach required for the intertidal works is envisaged to be closed to the public for a maximum of 8 weeks when the cable installation work will be undertaken. This is expected to be separated into two different periods: one for the Talacre dunes HDD crossing works (estimated at 6 weeks), and another for the cable pulls (estimated at 8 weeks), during which certain locations will be closed off entirely to the public. Temporary diversions will be arranged across the dunes during this period for pedestrian use.

As part of the construction works, a temporary fence will be erected to safeguard both the public and workforce and provide security of the works. This temporary fencing will be removed upon completion of the works.

Seawards of Mean Low Water Springs (MLWS), at the shore approach, the cables route corridor of the Proposed Development shown in Figure 3.1 is taking allowance for possible alternative options currently under assessment, considering the presence of the West Hoyle Spit sandbank and other constraints, such as availability of cable lay vessel.

An alternative under consideration is to route the cable further to the east, via a tidal channel through the spit, as shown in Figure 3.17. The water depth that remains in this location is less than the amplitude of a spring tide and therefore some pre-lay dredging would still be required to allow for a self-beaching Cable Lay Vessel (CLV) to ground itself at low tide on a 'flat' area of sandbank. The area to be dredged and flattened as required

to allow beaching of vessel on seabed, in this scenario would be approximately 180 m length, 60 m wide and 1 m to 2 m below LAT. It would take approximately four to seven days to excavate the area depending on dredging technique applied.

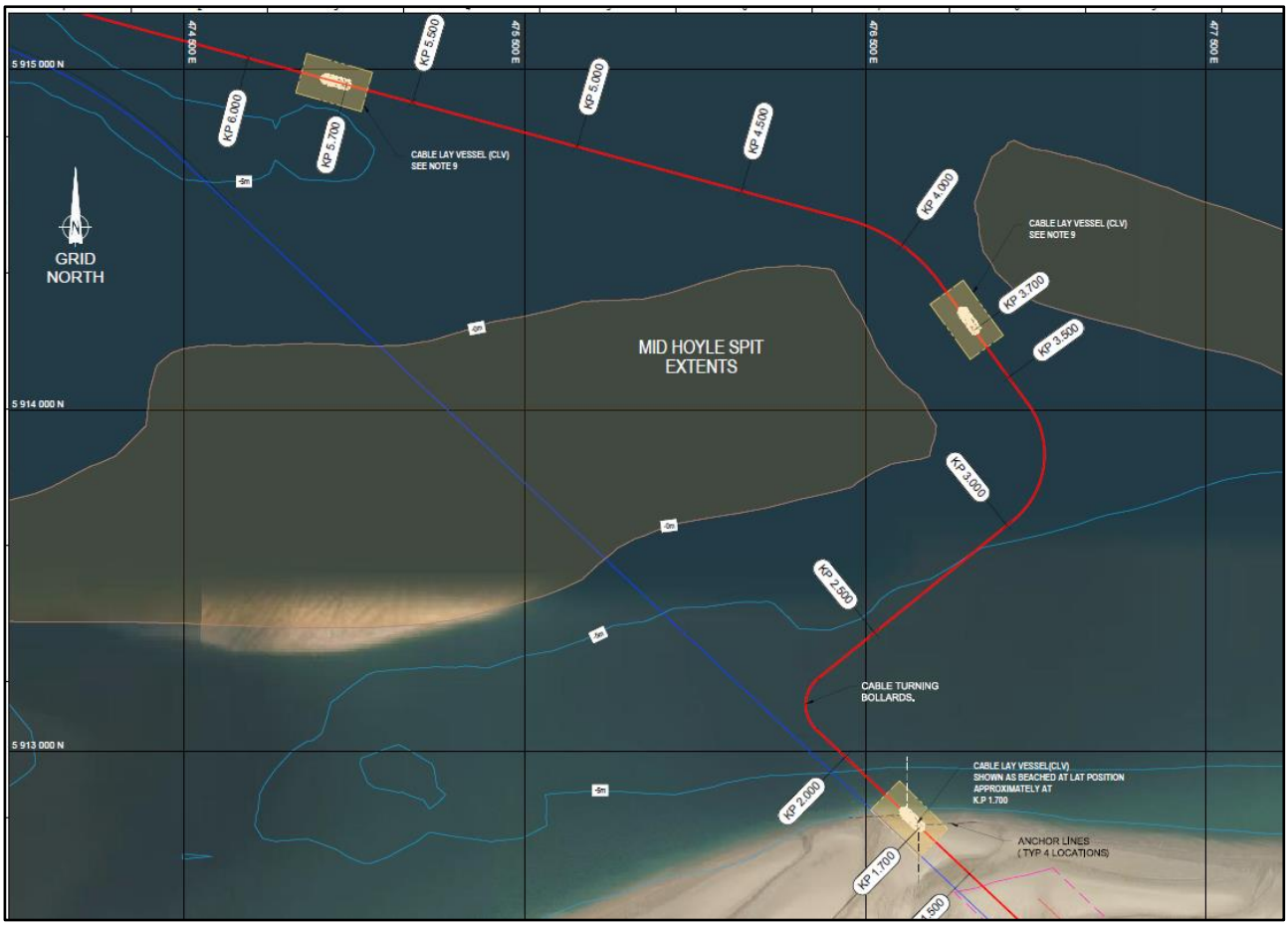


Figure 3.17: Cable Route Option To East Of West Hoyle Bank

Cable burial

It is anticipated that the offshore cables will be installed via either ploughing, or cable trenching, or a combination of both these techniques, depending on ground conditions along the specific cable route.

The zone of disturbance for the cable burial using a plough is expected to be around 15 m total width for each cable, as this accounts for the overall width of the plough as it traverses the seabed on its skis. However, the skis are designed to minimise the disturbance on the seabed. The plough 'slices' a trench approximately 1 m to 1.5 m in width, while simultaneously burying the cable to the desired burial depth of 2 m to 3 m. This area of disturbance is localised between the plough skis. On this basis, the potential Zone of Disturbance (ZoD) under the cable burial equipment through the intertidal area would be approximately 18,000 m^2, with around 1,800 m^2 (10%) of this area disturbed by either the plough or cutter blades.

A typical cable plough is illustrated in Figure 3.18 showing the plough engaged. Some spoil does arise in this instance from the shearing action caused by the plough. Most of the sediment falls back into the trench as the plough progresses forwards, and the cable is placed at the base of the trench. These ploughs can trench through a wide variety of soils and are particularly suited to projects where long continuous lengths of cables are to be buried through variable ground conditions.

Figure 3.18: Photo Of Typical Power Cable Plough (Photo Credit: Boskalis)

3.4.5.2 Programme for cable installation

An indicative summary schedule for the electrical cable laying and tie-ins to the CCS platforms is shown in Figure 3.19. This shows the cable laying activities are scheduled to commence and be completed in Q2 2026. Prior to this from July 2025 until April 2026, the onshore HDD tunnel under the Talacre sand dunes will be constructed in preparation for the offshore cable lay and pull in operations during spring 2026. During winter 2026/2027 the cable ends will be wet stored (i.e. left on the seabed) prior to the cable recovery and pull into each of the CCS platforms during Q2/Q3 2027.

Figure 3.20 presents the indicative activity durations for the electrical cable shore approach operations for the PoA to new Douglas CCS platform cable. There will be a period of approximately 3 months for the onshore preparatory works for the cable installation. The allocated activity durations for the foreshore pull in operation are presented in Figure 3.20. The electrical cable will be laid from the new Douglas platform to the nearshore area at Talacre Beach while the onshore preparation work for the cable shore pull operations is being carried out. The cable lay, including the pull in at the new Douglas, will take approximately 12 days. These activities are shown in Figure 3.22.

The indicative activity durations for electrical cable burial operations for the PoA to new Douglas CCS platform cable are shown in Figure 3.21. Cable burial will take approximately two days, assuming a burial rate of 3,000 m/day, with intervention works and the as-built survey taking the duration of the works to approximately seven days in total. The schedule shown in Figure 3.21 also indicates a 30% contingency to allow for poor weather conditions leading to vessel downtime. A similar period for cable burial can be anticipated for each of the electrical cables to the Hamilton Main, Hamilton North, and Lennox platforms. The overall duration for the laying and burial activities for all the electrical cables will take approximately two to three months, plus a 30% contingency to allow for poor weather conditions leading to vessel downtime.

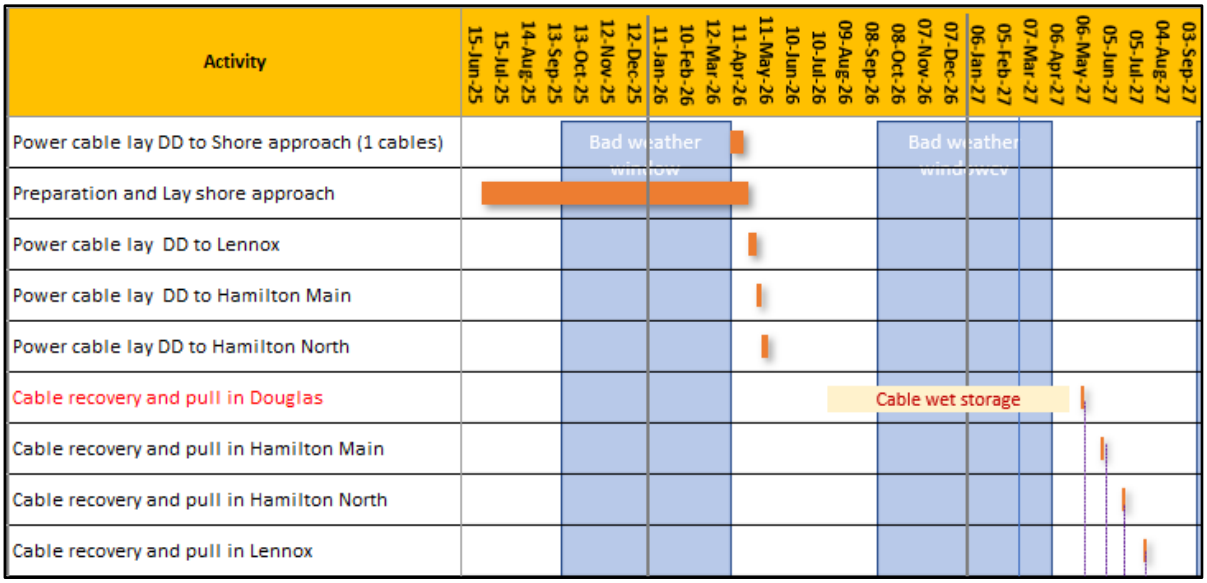


Figure 3.19: Indicative Summary Schedule For Electrical Cable Laying And Tie-Ins To CCS Platforms

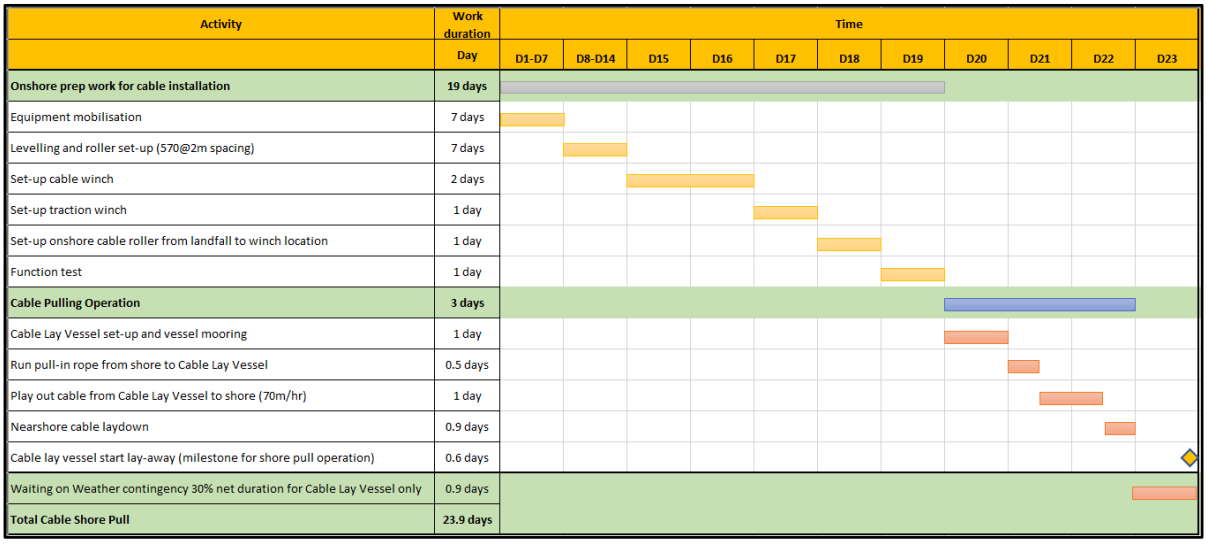


Figure 3.20: Indicative Activity Durations For Electrical Cable Shore Approach Operations For PoA To New Douglas CCS Platform Cable

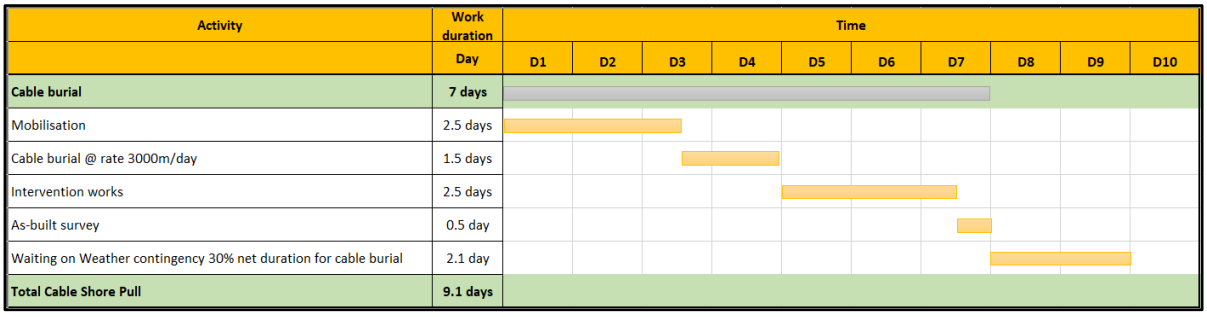


Figure 3.21: Indicative Activity Durations For Electrical Cable Burial Operations For PoA To New Douglas CCS Platform Cable, And New Douglas To Hamilton Main, Hamilton North, And Lennox

Activity	Work duration	Time (Day)
PoA to new Douglas (from KP 4.5km) Cable No. 1	**11.7 days**	
Mobilisation + dydnamic positioning (DP) trial + survey calibration	1 day	
Pre-Lay survey + intervention works	4.2 days	
Cable lay (laying rate 6,000m/day)	5.0 days	
Pull in at J-Tube at new Douglas	1.5 days	
PoA to new Douglas (from KP 4.5km) Cable No. 2	**11.7 days**	
Mobilisation + dydnamic positioning (DP) trial + survey calibration	1 day	
Pre-Lay survey + intervention works	4.2 days	
Cable lay (laying rate 6,000m/day)	5.0 days	
Pull in at J-Tube at new Douglas	1.5 days	
New Douglas to Lennox	**10.4 days**	
Mobilisation + dydnamic positioning (DP) trial + survey calibration	1 day	
Pre-Lay survey + intervention works	1 day	
Pull in at J-Tube at new Douglas	1.5 days	
Cable lay (laying rate 6,000m/day)	5.4 days	
Pull in at J-Tube at Lennox	1.5 days	
New Douglas to Hamilton Main	**6.8 days**	
Mobilisation + dydnamic positioning (DP) trial + survey calibration	1 day	
Pre-Lay survey + intervention works	1 day	
Pull in at J-Tube at new Douglas	1.5 days	
Cable lay (laying rate 6,000m/day)	1.8 days	
Pull in at J-Tube at Hamilton Main	1.5 days	
New Douglas to Hamilton North	**7.4 days**	
Mobilisation + dydnamic positioning (DP) trial + survey calibration	1 day	
Pre-Lay survey + intervention works	1 day	
Pull in at J-Tube at new Douglas	1.5 days	
Cable lay (laying rate 6,000m/day)	2.4 days	
Pull in at J-Tube at Hamilton North	1.5 days	
Post lay survey for all cables	**4 days**	
Demobilisation	**2 days**	
Waiting on Weather (WoW) for all cables (30%)	**15 days**	
Total	**67.2 days**	

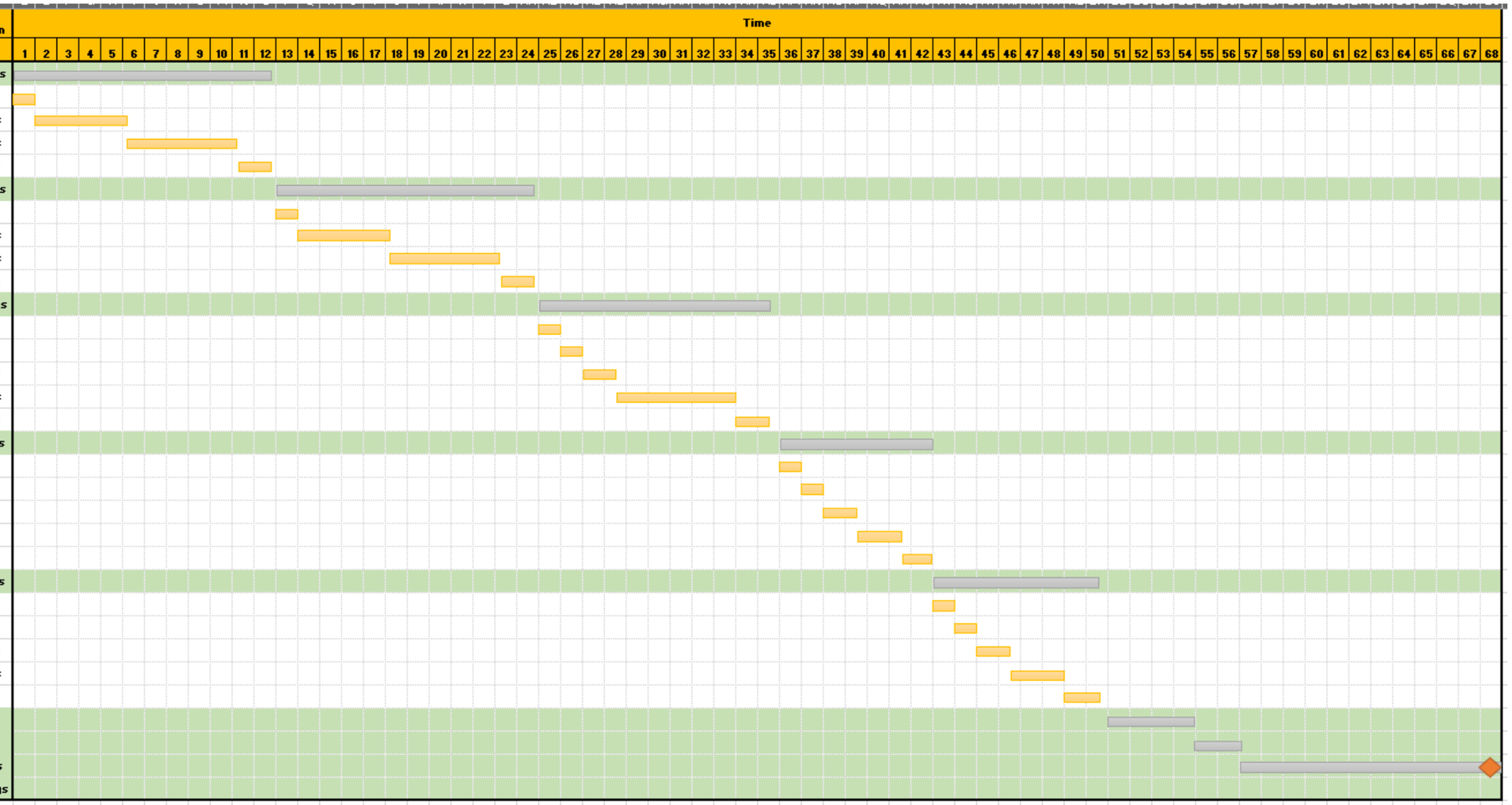


Figure 3.22: Indicative Activity Durations For Electrical Cable Lay Operations To All Platforms

3.4.6 Unexploded ordnance

There is potential for Unexploded Ordnance (UXO) to be encountered during the installation of the new infrastructure for the Proposed Development. The assumptions about the UXO that could be encountered, and the donor charges that could be used to detonate them *in situ* are set out in Table 3.11.

Table 3.11: Potential Donor Charge Configurations And UXO Sizes

Charge size (kg TNT equivalent)	Notes
Low-order and low-yield donor charge configurations	
0.08 kg	Maximum size of donor charge used for low-order technique
0.5 kg	Maximum size of clearing shot to neutralise any residual explosive material
2 x 0.75 kg	Charge configuration for low-yield technique for most UXO
4 x 0.75 kg	Maximum charge configuration for low-yield technique
High-order charge options	
1.2 kg	Most common donor charge for high-order UXO disposal
3.5 kg	Single barracuda blast-fragmentation charge for high-order disposal
Potential UXO (high order disposal)	
25 kg	Smallest potential UXO size
130 kg	Most common/likely UXO size
907 kg	Maximum UXO size

3.4.7 Vessel utilisation

A range of installation vessels would be used for the construction of the Proposed Development. This includes main installation vessels (e.g. jack-up or dynamic positioning vessels with heavy lifting equipment), support vessels, tugs and anchor handlers, cable installation vessels, guard vessels, survey vessels, crew transfer vessels and scour/cable protection installation vessels. In addition, helicopters are expected to be used for crew transfers to the OPs, when required. The potential location of these vessels during cable installation is shown in Figure 3.16 and Figure 3.17.

Alternatively, for well drill rig location and positioning, geotechnical and geophysical ‘ground truthing’, which includes borehole and seabed surveys with accompanying environmental analysis, may be carried out by two different types of survey vessel.

The main construction vessel for the cable laying work will be a dynamic positioning class two vessel or anchor mooring vessel with shallow draft and flatbed. Multi-Purpose Supporting Vessels (MSV) or Supply Vessel and crew boats will be utilised for Touch Down Point (TDP) monitoring, survey activities and post-trenching work. TDP monitoring provides live visualisation and monitoring of cable survey and installation activities. Additionally, anchor handling tugs will be utilised for anchor mooring vessels.

All the integrated decks for Hamilton Main, Hamilton North and Lennox OPs could be transported using a sea transportation barge. The offshore installation of these components would require Heavy Lift Vessels (HLV) or Floating Shear Legs (FSL) cranes.

Maintenance activity in Liverpool Bay is currently undertaken by the Irish Sea Pioneer (ISP) four-legged jack-up barge. It is intended to continue to use the ISP during the construction phase, to accommodate any major maintenance requirement for repurposing the Offshore OPs to CO_2 service.

3.5 Operation and maintenance phase

The following operational schedule is based upon a phased approach for Stage configurations in Gas Phase Operating Mode. These stages are as follows, with respect to the impact to the existing offshore platform infrastructure:

- **Stage 1** – Free Flow: in this early operating mode in which the initial pressures of the storage reservoirs are building up, CO_2 can flow in gas phase from the emitters directly into the storage reservoirs without the need for intermediate pressure boosting. The Offshore configuration does not require any flow control system or continuous heating requirements at this stage.
- **Stage 2** – Compression at PoA: due to the constant reservoir pressures build-up and the flowrate ramp-up, the installation of a pressure boosting unit at PoA is required. During this stage, the Offshore configuration again does not require any flow control system. Heaters are required on each satellite platform for transient/shutdown conditions.
- **Stage 3** – Pressure Control at Douglas CCS: when CO_2 volumes approach 4.5 MTPA, some hydraulic limitations could be observed in the existing 20" PoA to Douglas pipeline. The Joule-Thompson (JT) effect in the 20" pipeline can lead to a very cold arrival temperatures at Douglas CCS, especially during winter conditions. These cold temperatures may give rise to ice formation in the topside piping and liquid CO_2 drop-out in the rest of the distribution network. To avoid this issue, a pressure control system will be brought into operation at the Douglas CCS to maintain a minimum pipeline operating pressure, which will in turn, reduce the pressure to drop along the pipeline. With this pressure regulation, the minimum CO_2 receiving temperature at Douglas CCS (topside) can be maintained at acceptable levels to avoid the risk of ice formation. In conjunction with the pressure control, a heating unit is also required at Douglas and on each of the satellite platforms. The two existing pipelines (12" and 16") between Douglas and Lennox OPs will be used to support a more homogeneous distribution of the CO_2 injection.

3.5.1 Operation and maintenance activities

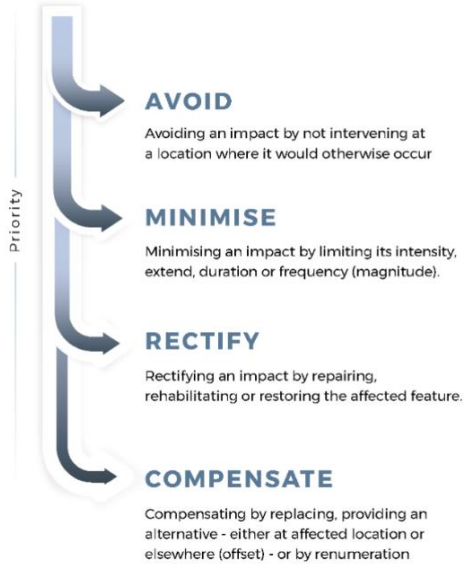
3.5.1.1 Fugitive and venting emissions

During the operation phase of the Proposed Development, fugitive and venting emissions may take place but every effort will be made to minimise. Fugitive emissions are unintentional leakages of gases or vapours from pressure-containing equipment or facilities and typically would occur at flanges, valves, and other equipment interfaces. During the operation phase, fugitive emissions will be monitored through a Leak Detection and Repair (LDAR) programme as part of the preventive maintenance activities, to avoid or minimise their presence as low as reasonably practicable.

There is no requirement currently set out for routine venting of CO_2 equipment during the operation phase. However, there would be a requirement for periodical venting of CO_2 equipment during planned maintenance activities and the potential for venting in case of pipeline depressurisation required for maintenance or decommissioning.

3.5.1.2 Measurement, Monitoring and Verification Programme

The effectiveness of the storage sites depends upon the ability to prevent potential environmental impacts connected to leakages. Preventing the migration of injected fluid from the storage formation to the atmosphere or water column requires correctly tailored monitoring, measurement, and surveillance activities. This is also a requirement for ensuring safe and reliable operations.



Given the integrity of the storage sites is dependent on the effectiveness of the whole storage system, the monitoring is based on a **monitoring plan** that is grounded in the principles of the 'mitigation hierarchy'. The 'mitigation hierarchy', shown in the adjacent diagram, demonstrates that the priority for the Proposed Development was to prevent leaks from occurring by embedding 'avoidance' and 'minimisation' measures.

The 'avoidance' measures that have been embedded into the design of Proposed Development, include the repurposing of depleted oil and gas reservoirs, of which much is known about their integrity from over 30 years of operating the assets. This knowledge, coupled with the design of the new elements of the storage system, provide evidence for confidence in the effectiveness of the **containment** systems within the LBA Storage Complex. This should allay stakeholder concerns about the potential for leakage, and has provided knowledge to trigger early intervention, should this be needed.

The physical, operational, and abatement controls built into the Proposed Development system, present 'minimisation' measures that will demonstrate that the storage sites are progressing as expected and the long-term behaviour of the CO_2 is understood. The data collected through these controls will demonstrate **conformance** with the required performance requirements and help to show that predictive models are consistent with the collected monitoring data.

The collected data will also provide **confidence** that the storage complex is performing as predicted and required, and support emission accounting and the transfer of long-term responsibilities to relevant authorities to maintain the licence to operate.

Therefore, as part of the Storage Permit application requirements, a Measurement, Monitoring, and Verification (MMV) programme has been developed, The MMV programme covers the pre-injection, operation and maintenance and post-closure phases of the Proposed Development. The objective of the MMV programme is to establish an environmental baseline and to assess whether injected CO_2 is behaving as expected, and to detect if any unexpected migration or leakage occurs.

The preparation of the MMV Programme has adopted the following stepwise approach:

1. **Assessed site-specific storage risks**: established definitions for loss of conformance and loss of containment as reported in the Containment Risk Assessment.
2. **Characterised geological safeguards**: identified and appraised the integrity of each geological seal within and above the storage complex.
3. **Defined engineered safeguards**: identified and assessed the engineering concept selections that provide safeguards against unexpected loss of well integrity.
4. **Established monitoring requirements**: defined monitoring tasks to verify the performance of the initial safeguards and, if necessary, triggers timely control measures.
5. **Selected monitoring plans**: selected monitoring technologies according to a cost-benefit ranking. This includes baseline monitoring as well as monitoring during the injection and closure phases (including seismic, micro-seismic, ground deformation, wellbore, and environmental monitoring).
6. **Identified control measures**: design interventions to reduce the likelihood or the consequence of any unexpected loss of conformance or containment. These include operational controls and updates to model-based predictions.

The MMV programme contains Regular Environmental Monitoring proposals that will identify long-term changes in environmental features. Additionally, should the data collected through the 'avoidance' and

'minimisation' measures identify any potential or actual loss of containment, targeted Environmental Monitoring is proposed, as an Environmental Contingency Monitoring, to identify the magnitude and extent of this loss, and the environmental consequences. This data would then be used to identify the action required to 'rectify' through repairing, restoring, or rehabilitating the affected feature. Where required, 'compensating' by replacing, or providing an alternative, either at the affected location, or elsewhere (offsetting).

Additionally, UK regulation (UK Statutory Instruments, 2010) and EU directive (EU Commission 2009/31/CE Directive, 2009) and relative guidelines (EU Commission, 2011), (NSTA, Guidance on Applications for a Carbon Storage Permit, 2022) establish that the operator monitors the storage complex to be able to:

1. Compare the actual and modelled behaviour of the CO_2 in the storage site.
2. Detect any significant irregularities anomaly.
3. Detect of any migration and/or leakage of CO_2.
4. Detect of any significant adverse effects on the surrounding environment, and on offshore and nearshore water resources, human and biological receptors.
5. Assess of the effectiveness of any corrective measures taken.

Monitoring is split into a series of phases across the Proposed Development:

- **Baseline characterisation (pre-injection):** Before injection of CO_2 into the reservoir commences, there will be comprehensive baseline data acquisition for technical assessment and for future comparison.
- **Operational phase (injection):** During the 25-year CO_2 injection period, data acquired will be monitored to assess CO2 movement within the storage sites; and
- **Closure/post-closure/pre-transfer phase (post-injection):** Site closure is anticipated to be performed from 2052 onwards. Post-closure period and obligations are to be defined during dialogue with authorities and will be documented in a post-closure plan.

The MMV programme developed covers the full extent of each storage complex, meeting the requirements of the CCS Directive and incorporating lessons learned from the Applicants best practices. At the core of the MMV plan, there are three main documents:

- **Monitoring Plan (MP)**: This document stems from CRA findings, providing additional safeguards through monitoring. The objective is to demonstrate effective conformance (i.e., the CO_2 plume behaviour is as expected) and to verify containment (i.e., CO_2 remains within the storage complex), identifying any deviations or irregularities.
- **Corrective Measure Plan (CMP)**: identification of corrective measures to be employed in the unlikely event of significant irregularities identified during the standard monitoring activities, defined in the Monitoring Plan.
- **Provisional Post Closure Plan (PPCP)**: The purpose of this document is to clarify how closure will take place and to demonstrate that CO_2 remains permanently enclosed in the reservoir, with the current state of technology and experience. Monitoring activities in the post-injection phase are aimed at demonstrating the absence of any detectable leakage and the conformance with the dynamic modelling.

The MMV programme will be applied for the 25-year life cycle of the Proposed Development, and throughout the post-closure phase, which is currently anticipated for a further 20 years. The plan will be updated according to the requirements and, in any case, every five years. The update process will include learnings from the initial phase of injection and from new information from wells, site-specific technical feasibility assessments, and monitoring performed during the injection phase. Updated MMV programmes will also consider changes to the assessed risk of leakage, changes to the assessed risks to the environment and human health, new scientific knowledge, and improvements in best available techniques. The key parameters for the assessment of the Monitoring Programme are set out as the Maximum Design Scenario (MDS) within each of the environmental assessment topic chapters.

3.5.1.3 Environmental Monitoring

3.5.1.3.1 Purpose of monitoring

The storage project will include pre-injection, injection, and post-closure environmental monitoring. To ensure CO_2 containment and compliance with permit conditions, the environmental monitoring will support the asset integrity monitoring that is covered elsewhere in the MMV.

Two types of environmental monitoring are proposed: Regular Environmental Monitoring (REM); and Environmental Contingent Monitoring (ECM). These are described in the following sections.

3.5.1.3.2 Regular environmental monitoring

REM will be carried out at locations around, and above the storage project assets i.e., at the injection and monitoring wells, P&A and legacy wells, and along CO_2 pipelines. The REM will be carried out during the pre-injection, injection, and post-closure phases of the storage project, as shown in Figure 3.23. The REM will include collecting environmental data from the seabed, the water column, and the atmosphere, using the methods and analysis set out in Table 3.12, Table 3.13, and Table 3.14 respectively.

During the pre-injection phase, the REM will be carried out simultaneously with the 3D/4D seismic acquisition, and ground deformation, and micro-seismic monitoring, as shown in Figure 3.23: Illustrates the frequency of environmental monitoring. These pre-injection surveys will provide a robust baseline characterisation against which future observable, and measurable changes to the subtidal environment can be attributed to the geological storage of carbon dioxide.

The pre-injection REM will then be repeated on a frequency to coincide with the 3D/4D seismic acquisition. The REM carried out to the same scope and specification identified in the Monitoring Plan, using the methods and analysis set out in Table 3.12, Table 3.13, and Table 3.14 respectively.

3.5.1.3.3 Environmental contingent monitoring

ECM will be carried out when the findings of other monitoring activities, such as the continuous Ground Deformation (GD), seismic (VSP or 4D) Microseismic Monitoring (MM) and well monitoring (SLM, SLI, WRM, WRI).

The ECM will be carried out during the injection, and post-closure phases of the storage project, as shown in Figure 3.23. The ECM will be carried out only when the findings of other monitoring activities, such as the continuous Ground Deformation (GD), seismic (VSP or 4D) Microseismic Monitoring (MM) and well monitoring (SLM, SLI, WRM, WRI) indicate that a potential pathway for a CO2 leak has opened.

For example, regular 2D/3D/4D seismic has detected the unexpected lateral and vertical migration of the CO2 plume towards areas where it may breakthrough to the seabed. (see Monitoring Plan item 11 in Appendix 1). Also, ground deformation monitoring, coupled with the 2D/3D/4D seismic, can show significant geomechanical changes that could identify ground surface deformations, and fracture initiation and propagation, or pre-existing fault opening and slippage, which present pathways for CO_2 leakage (see Monitoring Plan item 14, Appendix 1).

The ECM will then be mobilised to the relevant location to confirm if CO2 leaks are appearing at the surface of the seabed, and into the water column. The ECM will include collecting environmental data from the seabed, the water column, and the atmosphere, using a suite of methods and analysis from those set out in Table 3.12, Table 3.13, and Table 3.14 respectively.

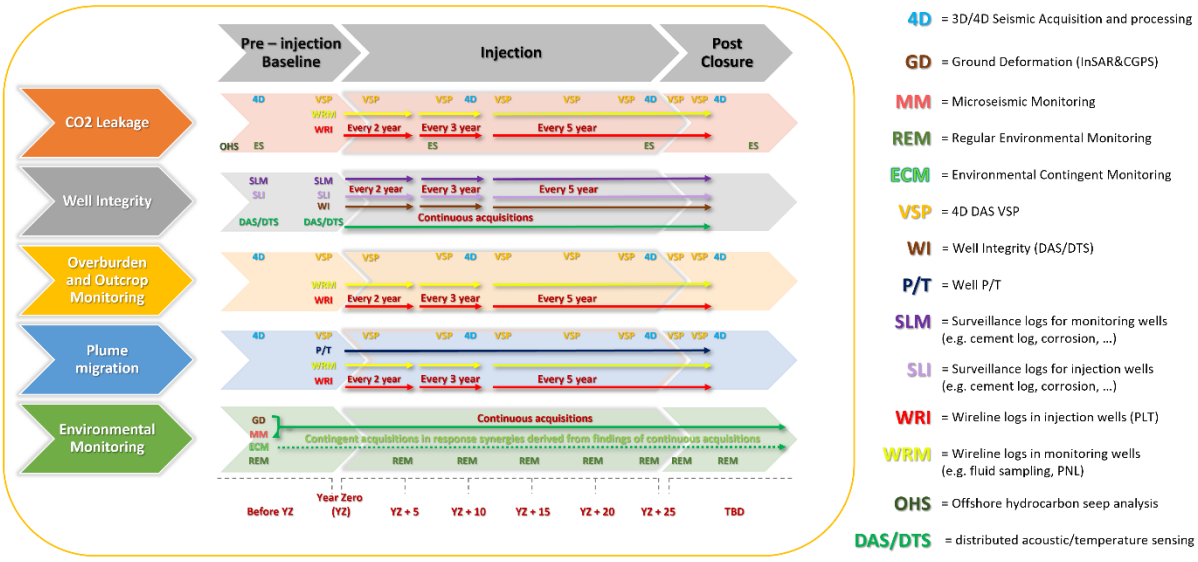


Figure 3.23: Indicative frequency of environmental monitoring

3.5.1.3.4 Survey data collection

The proposed survey methods and analysis are set out in Table 3.12, Table 3.13, and Table 3.14. These methods would be deployed in a variety of combinations for both the REM, and ECM dependent on the situation being monitored.

Table 3.12: Proposed seabed survey methods

Collection method	Sample	Analysis and interpretation
Drop down video	• Transect at each location minimum of 50 m in length; • Centred on the seabed feature of interest; • Location details; • Geographic coordinates; • Survey date and time; and Water depth.	• Identification of benthic megafauna (>1cm), faunal density, diversity, and community composition. • Macrofauna (>1mm). A log sheet of seabed features such as sediment type, bedforms, local topographic features, significant epifauna and/or macro-fauna and habitat related features (e.g. geogenic [cobble] and biogenic reefs, pockmarks, sponge aggregations, potential ocean quahog siphons.)
Photographic stills	• A minimum of either five (5) photographs at each photographic station, or a series of a single shots along the 50 m transects; • Location details; • Geographic coordinates; • Survey date and time; and • Water depth.	• Identification of benthic megafauna (>1cm), faunal density, diversity, and community composition. • Macrofauna (>1mm). A log sheet of seabed features such as sediment type, bedforms, local topographic features, significant epifauna and/or macro-fauna and habitat related features (e.g. geogenic [cobble] and biogenic reefs, pockmarks, sponge aggregations, potential ocean quahog siphons.)
Sonar bubble stream detection (see Monitoring Plan Appendix 1, Item 9)	detect bubble streams using video /photo surveys from the seabed	Identification of bubble streams from potential leak sites.

Collection method	Sample	Analysis and interpretation
Benthic grab samples	• A minimum of four (4) replicate grab samples at each sampling station, as follows: ○ Replicate 1: physicochemistry samples; Replicates 2, 3 and 4: macrofauna samples.	• Benthic infaunal analysis. Identification of benthic megafauna (>1cm), faunal density, diversity, and community composition. • Macrofauna (>1mm). • Physico-chemical analysis ○ Full particle size distribution; ○ Total organic matter; ○ Total petroleum hydrocarbons; ○ Saturate/aliphatic hydrocarbons; ○ Polycyclic aromatic hydrocarbons; and ○ Heavy and trace metals.

Table 3.13: Proposed water column survey methods

Collection method	Sample	Analysis and interpretation
Water column samples (e.g. CTD sampling frame)	Conductivity/salinity; Temperature; pH; Depth; Dissolved oxygen; phytoplankton; Chlorophyll-a	• Higher Conductivity demonstrates a PH range 6.5- 7.5 in presence of CO_2 ; • Temperature increase when CO_2 concentration increase; • Depth; if CO_2 release, currents will slowly carry it to the surface. • Dissolved oxygen: Presence of carbonic acid – effect on aquatic animals
Deployment of lander* with multiple sensors/probes	• Deployment at well injection sites, or potential leak sites, for at least 10 days to measure: • Pressure; Temperature; Conductivity/salinity; pH; Depth; Dissolved oxygen; nitrate; phosphate; water current; and acoustic data	• Higher Conductivity demonstrates a PH range 6,5- 7,5 in presence of CO_2; • Temperature increase, when CO_2 concentration increase; • Depth; if CO_2 release, currents will slowly carry it to the surface; and • Dissolved oxygen: Presence of carbonic acid – effect on aquatic animals.

* *similar to NOC lander from Goldeneye monitoring*

Table 3.14: Proposed atmospheric survey methods

Collection method	Sample	Analysis and interpretation
infra-red diode lasers or non-dispersive infra-red gas analysers	Atmospheric CO_2 measurement	○ Measure any increase in CO_2 % taking into consideration the environment of the area (vessels movement, wind, etc.)

3.5.1.4 Vessel utilisation and asset integrity

It is expected that there will be fewer supply vessel, standby vessel coverage, and helicopter traffic movements than current operations at the Liverpool Bay fields area, due to the unmanned OPs.

Cable repair, pipeline maintenance, and associated surveys are expected to utilise one supply vessel and one standby vessel. However, during the operations and maintenance phase, no cable repairs are anticipated, as the cable will be buried, and installed as a single, unjointed length offshore. Where the cable cannot be buried (e.g. at crossings), it will have external cable protection. General inspection works will be carried out, including using high resolution Multibeam Echosounder, Side Scan Sonar, and drop-down camera of the entire cable length cable in one event every two years. From experience of existing operations, reburial of up to 500 m of cable in one event every 5-10 years is anticipated. It is anticipated that the external cable protection at existing cable crossings is unlikely to require maintenance, as the rock and concrete mattresses are expected to remain in place. Maintenance or repairs are only anticipated should the cable protection be impacted by either fishing activity, or anchor snagging. Any movement of the rock and mattresses from these external interventions would be identified through the annual asset integrity surveys, and the necessary repairs carried out accordingly. These repairs would be carried out within the maximum design envelope described for the cable crossings external protection in Table 3.7.

Well interventions and service activity in Liverpool Bay is currently undertaken by the Irish ISP, a four-legged jack-up barge, as the OPs are relatively small and without cranes. It is intended to continue to use the ISP or similar for future well interventions and to support general maintenance activity. There will also be a requirement for drilling rig and support vessels from time to time. The ISP is a self-propelled jack-up vessel that has four lattice legs (73 m) and four 360-degree thrusters. Additionally, the ISP is equipped with two cranes designed for supply boat operations. It is intended to continue to use the ISP or similar for future well interventions and to support general maintenance activity.

3.6 Decommissioning phase

3.6.1 Overview

Existing UK legislation requires that when an offshore Carbon Capture, Usage, and Storage (CCUS) site is closed, the installations and injection facilities must be removed when decommissioned. In addition, all other items of equipment, infrastructure and materials that have been installed or drilled are expected to be entirely removed for disposal onshore in accordance with the government's aim to achieve a clear seabed.

When the Proposed Development reaches the end of its useful life or is no longer required, it will be decommissioned safely, with due regard to the environment. A comprehensive decommissioning and restoration plan would be developed for the Offshore Infrastructure and would be agreed with the relevant stakeholders.

The decommissioning process would be undertaken in accordance with all the environmental legislation and the technology available at the time. Any necessary licences or permits would be acquired.

3.7 References

National Infrastructure Planning (2018) Advice Note Nine: Rochdale Envelope. Republished July 2018 (version 3). Available at: https://infrastructure.planninginspectorate.gov.uk/legislation-and-advice/advice-notes/advice-note-nine-rochdale-envelope/ Accessed April 2023.

North Sea Transition Authority (NSTA) (2020) Carbon dioxide appraisal and storage licence – CS004 (ENI UK Limited), 8 October 2020. Available at: https://www.nstauthority.co.uk/licensing-consents/carbon-storage/ Accessed April 2023.

Offshore Petroleum Regulator for Environment and Decommissioning (OPRED) (2023). Scoping Opinion for HyNet Carbon Dioxide Transportation and Storage Project - Offshore.

Wood (2023) Extended Soil Temperature Analysis P908 Onshore Pipeline. Document No. 809424-00-FA-REP-0001-000

4 SITE SELECTION AND CONSIDERATION OF ALTERNATIVES

4.1 Introduction and overview

This chapter of the Offshore Environmental Statement (ES) provides a description of the site selection process and the alternatives considered, from award of the Carbon Dioxide Appraisal and Storage Licence (CS004) (awarded on the 8 October 2020) through to final design and definition of the offshore components of the HyNet Carbon Dioxide Transportation and Storage Project, hereafter referred to as the 'Project' (with the offshore components seaward of Mean High Water Springs (MHWS) hereafter referred to as the 'Proposed Development').

This chapter has been prepared in accordance with Schedule 6(2) The Offshore Oil and Gas Exploration, Production, Unloading and Storage (Environmental Impact Assessment) Regulations 2020 (The 2020 EIA Regulations), and Regulation 12(2)(b) of the Marine Works (Environmental Impact Assessment) (Amendment) Regulations 2017 (The 2017 EIA Regulations), which respectively state that an EIA should include:

'6(2) - A description of the reasonable alternatives (for example in terms of project design, technology, location, size and scale) studied by the developer and an indication of the main reasons for the option chosen, taking into account the effects of the project on the environment and including a comparison of environmental effects.'

and

'12(2)(b) - a description of the reasonable alternatives studied by the applicant which are relevant to the project and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the project on the environment.'

As outlined above there is a requirement under the 2017, and 2020 EIA Regulations for all projects, as part of the consent application process, to provide information on the options considered and process used to inform selection of the Proposed Development for which consent is sought.

4.2 Project overview

The UK Government considers Carbon Capture Utilisation and Storage (CCUS) as necessary to meet national and international climate change targets (HM Government, 2017). Failure to deploy CCUS would also mean the country could not credibly adopt a 'net zero emissions' target in line with the Paris Agreement's 1.5°C aspiration.

The UK is considered to have one of the most favourable environments globally for commercial CCUS, ranking fourth in the Global Carbon Capture Storage (CCS) Institute's CCS Readiness Index (Global CCS Institute, 2018). The Liverpool Bay Area (LBA), with its offshore fields of Hamilton Main, Hamilton North, and Lennox, was identified as one of the best sites for CO_2 storage in a 2015/16 Government sponsored study (Pale Blue Dot, 2016). These fields are approaching the end of their economic life and would be progressively decommissioned over the period 2023 to 2025 without the prospect of re-configuring as a CCS project.

The Proposed Development is being developed in parallel with, and as a key part of the HyNet North West full-chain hydrogen and CCS industrial decarbonisation project (the HyNet Project), which is designed to transform a region of the UK into the world's first low carbon industrial cluster by 2030. The HyNet Project was conceived in 2016 with the objective of decarbonising the entire industrial cluster to Net Zero. While industrial decarbonisation is the anchor, the HyNet Project builds the infrastructure backbone for a full regional hydrogen economy, and leverages the opportunity to repurpose, for future CCS service, the existing oil and gas facilities at Point of Ayr (PoA) and offshore in Liverpool Bay. CO_2 storage is provided by depleted and well-known gas fields that are owned and operated by Eni UK Limited (Eni) and are coming to the end of their economic life. The HyNet Project's CCS network will provide the infrastructure to transport and store the CO_2 produced as a

by-product of the hydrogen production process, and CO_2 from a number of the UK's largest industrial emitters, including Stanlow Refinery, Ince Fertiliser plant, and Padeswood Cement plant located in this cluster.

In October 2020, the Oil and Gas Authority (OGA), known as the North Sea Transition Authority (NSTA) since March 2022, announced that it had awarded a CO_2 appraisal and storage licence (CS licence) to Eni. The CS licence covers an area located within the Liverpool Bay Area of the East Irish Sea. Under the CS licence, Eni plans to reuse and repurpose depleted hydrocarbon reservoirs (the Hamilton Main, Hamilton North, and Lennox fields) and associated infrastructure to permanently store CO_2 captured in NW England and N Wales.

CO_2 coming from industrial facilities in the Merseyside region will be sent to the coast at PoA, where a pipeline, previously used to transport natural gas inland from the fields, will be re-purposed to transport CO_2 offshore to a new Douglas platform, and from there via existing Wellhead Platforms, to the reservoirs, where it will be permanently stored.

4.3 Assessing the 'Do Nothing' scenario

A 'Do Nothing' scenario is a projection of the existing baseline to show what changes, if any, would take place if the project did not go ahead. The following section considers the 'do nothing' scenario in the context of the Project objectives set out above in particular in relation to tackling climate change.

In accordance with the EIA Regulations, an assessment of the future baseline under the 'do nothing' scenario has been completed for all technical topics (see volume 2, chapters 6 to 14).

For the Proposed Development, the 'Do Nothing' alternative would mean that following the end of life of the natural gas reserves in the Liverpool Bay Area fields, the gas pipeline and existing infrastructure would be decommissioned. Decommissioning would mean removal of all above ground structure as originally intended and would result in a significant increase in the decommissioning scope compared with the Proposed Development. Furthermore, the Proposed Development, which is also a key component of the low carbon hydrogen network in the region, would not be progressed. As an integral part of HyNet (the Project), this would mean that carbon emissions from industrial sources in North Wales and the North West of England region would remain unabated.

One of the key risks with the 'do nothing' scenario is being unable to contribute to addressing the climate change emergency and the need for rapid decarbonisation. Climate change is the defining challenge of our time. Human-induced global warming has reached approximately 1°C above pre-industrial levels and without a significant and rapid decline in carbon emissions across all sectors, global warming is not likely to be contained (IPCC, 2021).

The 6th and most recent Intergovernmental Panel on Climate Change (IPCC) Synthesis Report, published in 2022, presents a narrowing window to mitigate and reduce the probability of the most catastrophic events that could result from anthropogenic climate change, and which are forecast to have far-reaching negative effects on human populations globally. It also states that every ton of carbon dioxide (CO_2) emitted increases global warming and that the more rapidly decarbonisation is achieved noticeable reductions in the rate of climate change will likely be observed.

Any delay in reducing carbon emissions today results in greater carbon emissions to the atmosphere, higher global temperature rises and an increased level of and speed of action required to halt impacts. A rise in global temperatures above 1.5°C has potential to cause irreversible climate change, the potential for widespread loss of life and severe damage to livelihoods. Yet greenhouse gases projected at a global scale (using Nationally Determined Contributions (NDCs)) are now set to exceed 1.5°C by 2030 and look increasingly likely to exceed 2°C after 2030 (IPCC 2021). Therefore, any delays incurred now, make the challenge significantly more difficult for the years ahead.

4.4 Approach to Site Selection, Project Definition and Refinement

The alternatives assessment undertaken for the Proposed Development was a phased process, starting with undertaking considerations of the best method for the transportation of CO_2 in gas phase, followed by comprehensive assessments of the best corridor for the refurbished pipelines and associated infrastructure. The identified site is considered to be most suitable for the Proposed Development, given its reutilisation of existing infrastructure, proximity to existing infrastructure (onshore and offshore), and strong transport connections.

The Proposed Development strategy is to make use of existing assets wherever possible, including pipelines and offshore platforms (OPs). Specifically, the existing offshore natural gas export pipeline to the PoA gas terminal will be repurposed to become a CO_2 import pipeline and will transport the CO_2 to the Douglas Complex. From the Douglas Complex, CO_2 will be transported along repurposed natural gas pipelines to the Hamilton OP for injection into the Hamilton reservoir, to the Hamilton North OP for injection into the Hamilton North reservoir, and to the Lennox OP for injection into the Lennox reservoir.

Additionally, the Proposed Development is based on the utilisation of new facilities and partial re-utilisation of the existing facilities which provide flexibility in decommissioning activities. A new Douglas CCS platform will be installed to the northwest of the exiting Douglas complex (see volume 1, chapter 3 for full details).

Well sites and reservoirs at Hamilton Main, Hamilton North, and Lennox are notable for their significant pressure depletion and shallow depth. Therefore, these well sites have been denoted as being some of the most suitable CO_2 storage sites within UK Waters.

As part of the iterative design process, the detailed design of the Proposed Development will continue to evolve to take account of issues including environmental, health, and safety and engineering constraints and opportunities. The Enhancement, Mitigation and Monitoring Commitments intended to reduce the potential environmental impacts that are included within the design are summarised in volume 3, appendix E.

As part of the aforementioned process of assessing alternatives to the Proposed Development, the option of ‘do nothing’ or ‘no development’ was considered. However, the potential beneficial socio-economic outcomes of the Proposed Development (including alignment with Net Zero objectives and local employment opportunities) and associated environmental risks of not progressing with the Proposed Development, were considered greater than the potential adverse environmental and social impacts that will result from the construction, operation and maintenance, and decommissioning of the Proposed Development and its associated infrastructure.

4.5 Re-use of existing facilities

4.5.1 Wellhead OPs

The design concept for the Proposed Development aimed to re-utilise the existing Hamilton Main, Hamilton North and Lennox OPs and to convert them to CO_2 injection through the installation of an additional new module on each OP. To facilitate the future conversion of the Proposed Development to dense phase CO_2 injection would also require the installation of new risers and riser protection frames to connect the OPs with new offshore pipelines that would be installed in the future.

Structural analysis has been carried out to identify the effect of installing a new CCS equipment module supported on the top of the existing topsides. The CCS module would be positioned to avoid obstructing access to the existing conductors. A new helideck would be installed at the top of the new module, replacing the existing helideck. Electrical power would be supplied from a new submarine electrical cable that would be installed via some new risers and J-tubes on each platform. The new risers and J-tubes, and the riser protection structures, would create additional environmental loads (wind and wave loading), which would increase the overall weight of the new module.

The structural analysis demonstrated that each repurposed platform would be affected by additional loads due to an increase in:

- topsides' weight;
- wave loading on the newly installed risers and boat impact protection frames;
- dynamic amplification factor (increase in platform natural period i.e. the natural sway of the platform structure); and
- wind loading on the newly installed topsides modules.

The results of jacket structural analysis for the satellite OPs showed that the existing platform substructures are not capable of supporting the extra topsides' equipment weight, and the additional environmental loads arising from new risers and J-tubes.

Therefore, the existing topsides will be removed and replaced with the new topsides, reducing the overall weight, and allowing the installation of new risers inside the jackets, so avoiding the need for additional protection frames, resulting in a reduction of the environmental loads.

The new topsides components will be delivered to the OPs completely fabricated and ready for integration onto their respective jackets.

4.5.2 New Douglas CCS Platform

4.5.2.1 Concept evaluation

The initial concept for the Proposed Development, which was brought forward in the Offshore EIA Scoping Report (September 2022) (Liverpool Bay CCS Limited, 2022; see volume 3, appendix A), proposed the existing Douglas Platform Complex to be repurposed for CO_2 service, by reconfiguring it to receive and distribute CO_2 to the Hamilton Main, Hamilton North, and Lennox OPs.

Specifically for the Douglas Platform Complex, the concept was to reuse the Douglas Main (DD) jacket and topsides, remove the hydrocarbon surface facilities from the topsides and replace them with CCS equipment, and convert the facility into a Normally Unmanned Installation (NUI). This would be done by adding a dedicated helideck and shelter, and then disconnecting from the other two bridge-linked Platforms in the Douglas Complex; Douglas Accommodation (DA) and Douglas Wellhead (DW). This would leave these two platforms free to be decommissioned outside of the CCS project schedule. This concept is hereafter referred to as 'Douglas Conversion'.

During the Front-End Engineering Design (FEED) stage, the Applicant has undertaken extensive work on the Douglas Conversion concept to develop it into a deliverable strategy. This work led to a more well-defined understanding of the challenges of implementing the Douglas Conversion strategy following the incorporation of resourcing and sequencing constraints. The main findings from this work were:

1. **Interdependencies with Decommissioning and Hydrocarbon Safety Systems.** The Douglas Complex is the existing hub for the whole Liverpool Bay Hydrocarbon Field, and as such is connected via pipelines and control systems to all the other Liverpool Bay Offshore Assets (including those not being re-used). Operationalising the Douglas Conversion strategy found that:
    a. All offshore hydrocarbon assets would need to be flushed and cleaned after production cessation (including non-reuse assets) before the Douglas Conversion could commence; and
    b. Real estate currently used by key field safety/control systems would be needed for CCS; therefore, multiple complex safety systems (field communications, fire and gas detection, power distribution) would need to be temporarily duplicated/replaced to allow CCS equipment installation to occur, whilst simultaneously maintaining the essential safety functionality for compliance with Health and Safety Case legislation.

2. **Brownfield Risks.** Detailed analysis of the necessary equipment removals on Douglas Main and subsequent CCS equipment installation revealed a large, complex, and interdependent volume of brownfield works:
    a. Douglas Main has congested multi-deck 'stick built' topsides, which were originally assembled 'piece-small' in a construction facility onshore. To create space for CCS facilities, and reduce weight to create structural integrity for the extension of the platform life, more than 5,000 tonnes of equipment would need to be removed 'piece-small'. The design does not facilitate modular or bulk equipment removal;
    b. During offshore conversion, the Douglas Main site would be subject to many constraints, including People on Board (POB) limits. Amongst other things, these POB limits ensure safe egress and evacuation, safe systems of work by limiting adjacent work-fronts, and necessary enabling work such as safety system maintenance/replication; and
    c. The cumulative cost impact of a significant volume of brownfield manhours has offset any re-use cost benefits in the base case. The volume and nature of brownfield work also has consequential significant schedule and cost growth risk.
3. **Market Response.** In parallel to the FEED process, the Applicant has been preparing contracting strategies for the Project Execution Phase, with part of this work involving market enquiries for the offshore scopes. Douglas Conversion excepted, the Applicant has received a strong market response for the other major offshore scope elements including Engineering Procurement Construction (EPC) and Transportation and Installation (T&I) for NUI topsides for Hamilton Main, Hamilton North, and Lennox. However, due to the identified brownfield risks, the Applicant has received insufficient market response to its requests for Expressions of Interest to carry out the Douglas Conversion from financially and technically capable EPC companies.

Whilst the Douglas Conversion option remains a feasible design, when considering safety, technical, and environmental factors, the New Douglas option is considered preferable.

Overall, the reduced number of manhours offshore, and the reduction in complexity of the tasks being undertaken, the introduction of the New Douglas option significantly reduces the risk to personnel. Moreover, the new concept reduces the risks to the Proposed Development associated with simultaneous decommissioning, as the Douglas Complex will be decoupled from the CCS activities. The Douglas Conversion would have significant technical complexities that include the need to provide temporary systems during transitional works and require multiple interdependent work fronts on a congested work site. The New Douglas technical work will largely be undertaken in an onshore fabrication facility, thereby avoiding these technical risks.

4.5.2.2 Comparative assessment

A comparative assessment of the original 'Douglas Conversion' scheme with the alternative options of either, installing a new NUI close to the existing Douglas Complex, or complete replacement of the Douglas Complex 'Douglas Deck' Replacement has been performed.

When conducting the comparative analysis between the Douglas Conversion and the New Douglas option, the following criteria (of equal weighting) were used:

Safety: The safety criteria consider elements that impact risk to offshore and onshore personnel, including any requirement for handling HazMat/NORM. It covers the impact associated with the risk to other users (e.g. collision impact to fishing, commercial transport, and other vessels). It considers any inherent potential for high consequence events i.e. major accident hazard and major environmental incident type events. It addresses residual safety risk to other sea users (e.g. residual snag hazard risk, collision risk, etc.).

Environmental: The environmental criteria consider marine impact from noise and vessel discharges, fuel use and atmospheric emissions, other consumptions (e.g. environmental burden from processing returned materials, use of quarried rock or other new material), direct or indirect seabed disturbance, and loss of habitat.

The assessment of greenhouse gas (GHG) emissions found that the emissions created by the Douglas conversion were more than double that of the New Douglas (130,000 vs 61,000 tonnes).

Technical: The technical criteria consider the various technical risks that could result in a major project failure. Concepts such as Technical Novelty and Potential for Showstoppers can be captured along with impact on the schedule due to overruns from technical issues such as operations being interrupted by weather conditions. Technical Feasibility and Technical Maturity is also considered. The technical criteria also consider the location for the execution of the works, whether onshore (fabrication facility) or offshore (marine installation or brownfield construction).

Societal: These criteria address the economic impact of the option on commercial fishing operations from both the decommissioning activities and any residual impacts such as reinstatement of access to the area. It also addresses any socio-economic impacts on other users both onshore and offshore. Impact on the health, well-being, standard of living, structure or coherence of communities or amenities are considered.

Cost: Addresses the short-term cost of delivering the option as described and long-term cost of any liabilities (e.g. monitoring, potential future remediation cost, risk of cost escalation).

In addition to the economic criteria, a comparison of cost and schedule risk analysis has been performed, demonstrating the higher impact of risks associated with the brownfield conversion.

The result of the comparative assessment shows that, whilst the Douglas Conversion option remains a feasible design, when considering safety, technical, and environmental factors, the New Douglas option is considered preferable.

4.6 PoA to Douglas cable routes

4.6.1 Overall concept

New power supply and fibre optic (FO) cables are required to provide electrical power and data communication to the New Douglas platform once the Proposed Development is operational. The Offshore power and FO cables will, as a general principle, follow the alignment of the existing gas export pipelines at an offset of around 100 m. There may be a need to micro-route the cables around identified obstructions such as heritage assets, and unexploded ordnance (UXO).

As such, new electrical and FO cables will be installed from the PoA Terminal to the New Douglas.

As a general design principle, the cable routes are following the existing infrastructure. The advantages of this approach are that the ground conditions are relatively well-known, the reduced footprint of seabed disturbance by co-locating in an area occupied by existing infrastructure, and subject to operational activity.

4.6.2 Design response to EIA findings

Since the Offshore EIA Scoping Report (September 2022) (Liverpool Bay CCS Limited, 2022; see volume 3, appendix A), the PoA to Douglas cable routes have been revised following design updates in response to the EIA. This is because offshore survey work has enabled the accurate location of the *Resurgam* and its protection area, and the actual location of the ‘gap’ around the east side of the West Hoyle Bank from the marine surveys.

4.6.2.1 Resurgam

The wreck of the *Resurgam* (see volume 2, chapter 11) has a statutory protection area of 300m under the Protection of Wrecks Act 1973 – although the wreck lies outwith the original Eni Development Area, the protection area is not centred on the does extent to within the previously proposed Area of Project Physical

Work. The revised cable route misses the *Resurgam* protected area and leaves enough spaces between the protected area and the cables to allow for maintenance activities (see Figure 4.1).

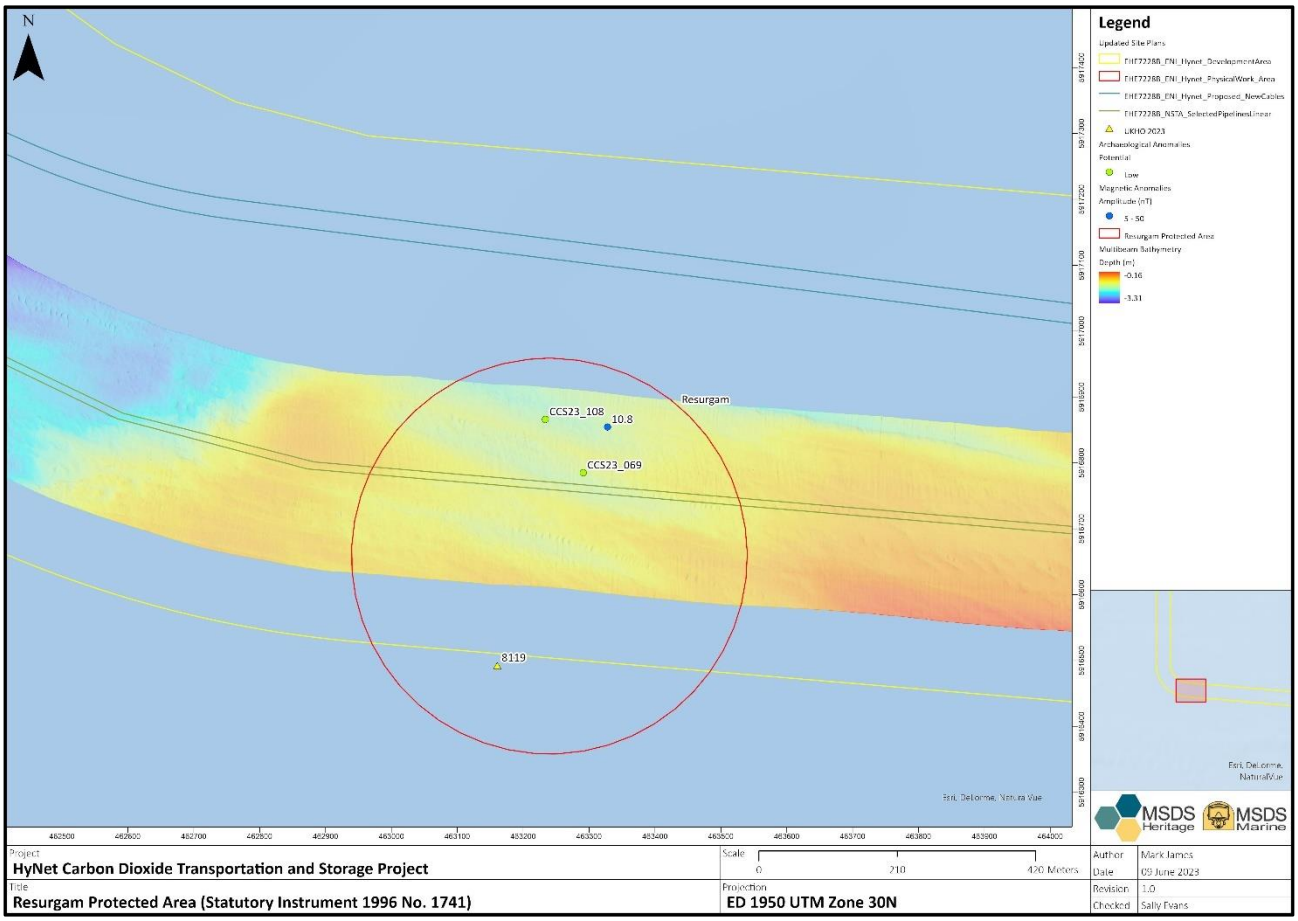


Figure 4.1: Revised Cable Routes, *Resurgam* Wreck And Protected Area

4.6.2.2 West Hoyle Bank

As discussed in the Onshore ES for the Town and Country Planning Act (TCPA) applications (Liverpool Bay CCS Limited, 2023), several route options have been developed for taking the new cables over the West Hoyle Bank. The route options are shown as high-level sketches in Figure 4.2 and described below:

- **Orange**: This route follows the existing gas export pipelines from the PoA terminal, all the way to the Offshore Douglas Complex. This is the most direct, and shortest of the three route options. Locating the foreshore cables on the east side of the gas export pipelines avoids the need for construction vehicles and equipment to cross and potentially damage the foreshore pipeline and newly laid cables. It limits construction activities to parts of the fields, dunes and intertidal area which have been previously disturbed by installation of the foreshore pipeline. To take the cable directly across the West Hoyle Bank, will require dredging a channel to provide safe navigation for the cable lay vessel. The Orange route is the preferred option for the cable.
- **Yellow**: This route aims to pass between two spits, both of which are constantly changing shape. Although beneficial for vessel draught, at low water, the tidal conditions within the channel between the spits would present a challenge for construction. The Yellow route also passes under pond habitats within the onshore dune system. A variation to the Yellow option was developed, following the foreshore pipeline and

diverting north to the Yellow route at the MLWS, as shown by a dashed yellow line on Figure 4.2. The benefit of the dashed yellow route is that it minimises construction activities in areas not previously disturbed by installation of the Foreshore Pipeline. The Yellow route was discounted, but the dashed Yellow route has been retained as a potential option to the orange route depending on the availability of specific cable lay vessels.

- **Pink**: This route deviates westwards and is the longest route offshore. Onshore cables from the offshore wind farms (including Gwynt-y-Môr) are located to the west of West Hoyle Spit, there is the potential to encounter shipwrecks in this location, and it is expected that this route would impact on the Port of Mostyn's shipping channel. In addition, this route would require the foreshore cables to cross the exisitng gas export pipeline twice to approach the Offshore Douglas Complex from the correct angle, which would create an avoidable construction risk. Additionally, this option would have the greatest impact on the the foraging areas for the Little Tern colony located on the North Wales coastline (see volume 2, chapter 8). The Pink route was therefore rejected.

The Orange route is considered the reasonable worst-case scenario, assessed in this Offshore ES, as even though it is the most direct of the options, it will require dredging a channel (most likely with a backhoe dredger) approximately 1,000 m in length, 60 m in width, and 7 m in depth (approximately 3 m to take the sandbank down to LAT, then approximately 3 m depth for cable burial). The excavated material would be side-cast along the length of the trench, and then backfilled after cable installation. It would take approximately two to three weeks to excavate the trench (see volume 1, chapter 3, section 3.4.4.1).

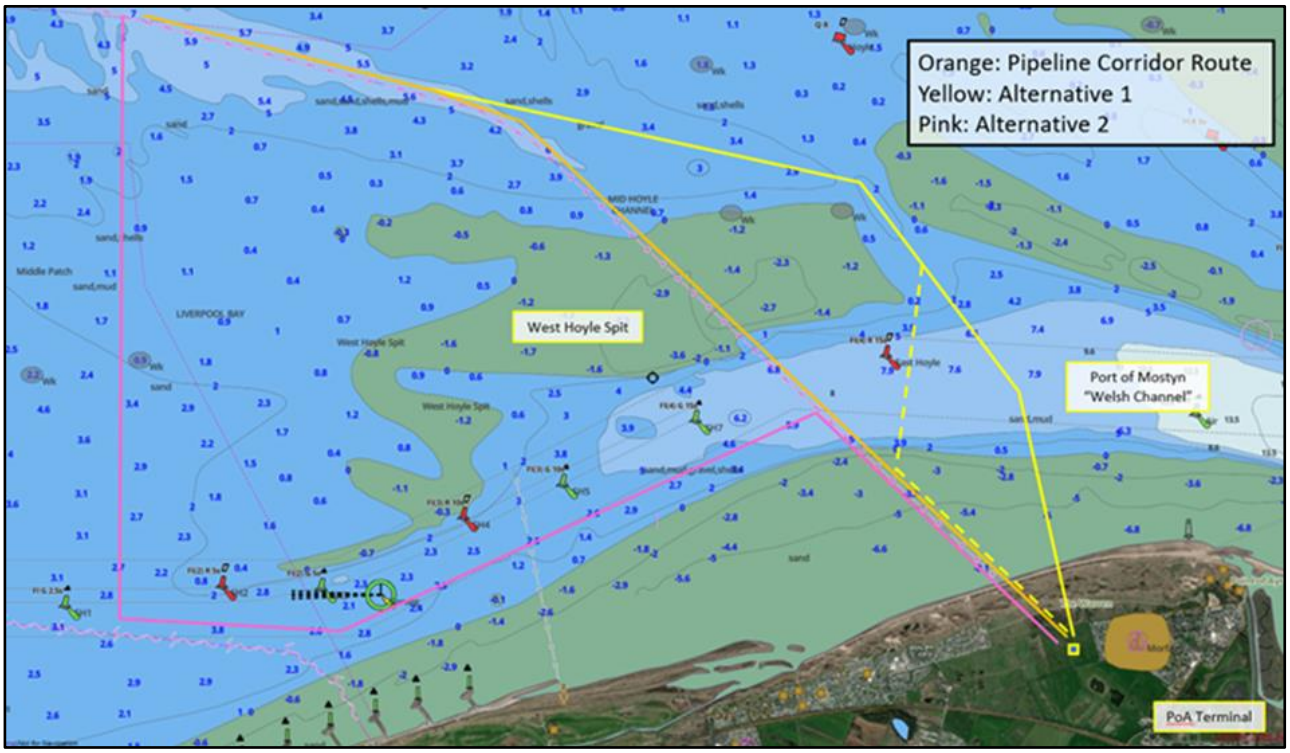


Figure 4.2: High Level Sketch Of Route Options Across West Hoyle Bank. Source: Admiralty Chart 2021 Modified By Liverpool Bay CCS Limited, 2023

4.7 Eni Development Area

Following the amendments to the PoA to Douglas cable routes, the Eni Development Area was revised accordingly, to avoid the *Resurgam* protection area, and to accommodate the options to navigate the West Hoyle Bank.

Figure 4.3 and Figure 4.4 provide an overview and a zoomed-in comparison of the original versus the revised Eni Development Area. It is noted that these are relatively minor amendments to reflect more detailed information being available during design development, and EIA. These amendments have not affected the definition of the reasonable worst-case and the likely significant effects of the project, as no new effects or receptors have been introduced.

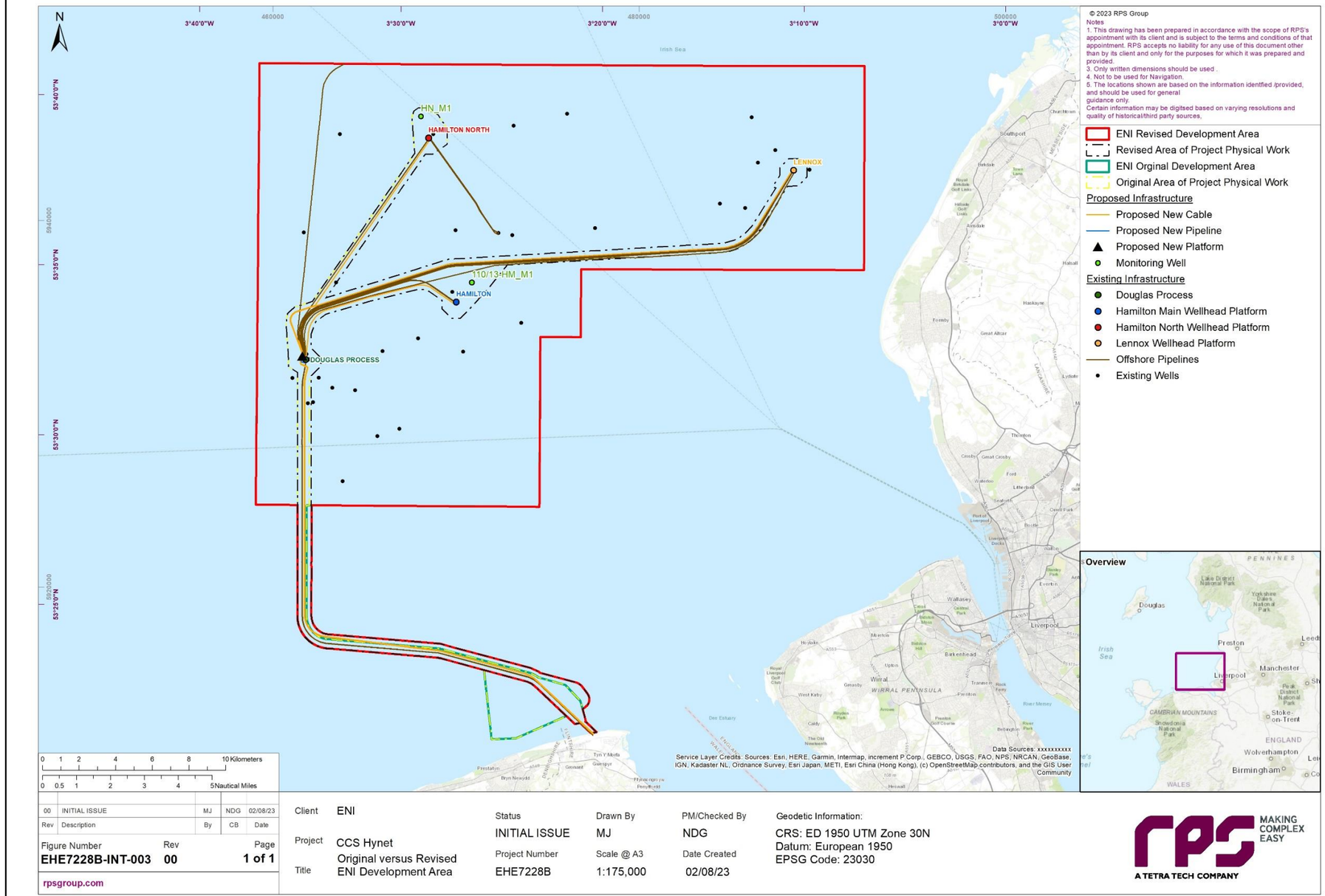


Figure 4.3: Original Versus Revised Eni Development Area

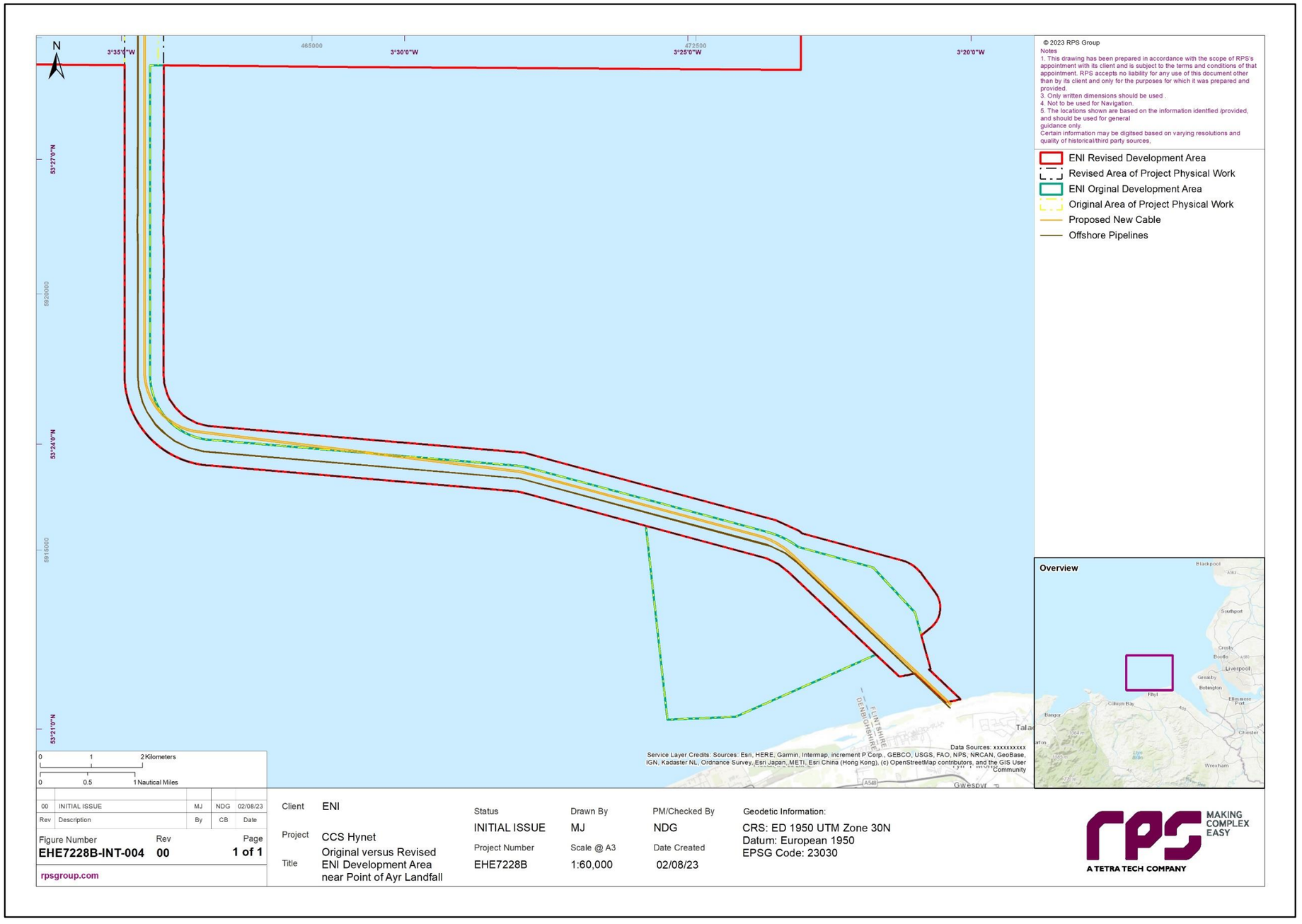


Figure 4.4: Zoomed In View Of Eni Development Area Revision Near Point Of Ayr Landfall

4.8 Overview of Project Design Envelope (PDE) Refinements

In addition to the new Douglas CCS platform, the Eni Development Area boundary change and the updated PoA to Douglas cable route, there have been a number of refinements made to the PDE since September 2022 (upon completion of the Offshore EIA Scoping Report (Liverpool Bay CCS Limited, 2022; see volume 3, appendix A)). These refinements are summarised below:

- number and design of foundation piles for new Douglas platform;
- number and design of the external electrical cable protection required at crossings of existing pipelines and cables;
- modifications to routing of existing pipeline and electrical cable connections to new Douglas platform;
- worst-case assumptions developed about the UXO that could be encountered, and the donor charges that could be used to detonate them *in situ*;
- development of electrical load profiles for air coolers, compressors, and heating duty;
- provision of baseline environmental emissions monitoring system (including CO_2 emissions) data;
- updates to location, length, and depth of wells; and
- updates to vessel and helicopter movements during installation, operation and maintenance, and decommissioning.

4.9 Consultation and Stakeholder Engagement

4.9.1 Scoping and Screening Documents Submitted

Table 4.1 below provides a summary of the key screening and scoping documents submitted to date as part of the development and refinement of the Proposed Development.

Table 4.1: Documents Submitted For The Proposed Development

Document	Submission Date
Offshore EIA Scoping Report	September 2022
Offshore EIA Scoping Opinion	January 2023
Offshore HRA Screening Report	May 2023

4.9.2 Stakeholder consultation

The change in development concept from Douglas Conversion to New Douglas CCS Platform, the cable route refinements and subsequent boundary change was notified to key consultees and stakeholders.

A summary of the key issues raised during consultation relating to Site Selection and Consideration of Alternatives are outlined below in Table 4.2.

Table 4.2: Summary Of Key Consultation Issues Raised During Consultation Activities Undertaken For The Proposed Development Relevant To Site Selection And Consideration Of Alternatives

Topic	Date	Consultee and type of response	Issues raised	Response to issue raised and/or how this has influenced Site Selection and Consideration of Alternatives
Shipping and Navigation	June 2023	Royal Yachting Association (RYA) – consultation meeting	RYA noted that a key consideration would be changes to water depth due to cable protection close to the landfall.	The proposed new cable will be drilled directly underneath the dune system and buried to a target depth of 3 m below beach and seabed level, so there would be no change in datum points at landfall. The proposed new platform will be built approximately 200 m from the existing Douglas accommodation platform, within the existing 500 m safety zone. Once operational, the three existing Douglas platforms will be removed, leaving only one, smaller platform.
Shipping and Navigation	June 2023	MCA, Trinity House and Port of Mostyn – consultation meeting	Trinity House asked if cable protection would be implemented at the crossing of the West Hoyle Spit, noting that existing pipelines had become exposed due to the movement of the Spit.	The Proposed Development relies on a target burial depth of 3 m across the Spit, and cable protection is not planned to be used other than where required at cable crossings. Crossing agreements are in progress with the wind farms, noting that the wind farm cables already cross the existing pipelines. Cable route options go around the bank or go through a gap. Both options will be standard burial using ploughs.
Marine Archaeology	June 2023	Royal Commission on the Ancient and Historic Monuments of Wales (RCAHMW) – consultation meeting	Introduction to the Proposed Development; discussion of geophysical data coverage, noting the data is not full coverage; discussion of the location of *Resurgam* (Protected Wreck) and re-routing of the cables around the protected area; discussion on Archaeological Exclusion Zones (AEZs) and current routing of some cables through AEZs. Agreed a way forward which has been reflected in the documents produced as part of this application.	Key issues to be addressed are the lack of full coverage data and the routing of some cables through AEZs. Lack of full coverage data: This issue is dealt with through a commitment to collect and assess full coverage data prior to seabed impacts. This data will be reviewed by a competent and experienced marine archaeological geophysicist. Routing of cables through AEZs: This assessment makes a commitment to either investigate the AEZs and to amend them if appropriate, or to re-route around them and assess the wider area. There will be no impacts to AEZs by construction activities. The Written Scheme of Investigation (WSI) will clearly set out how this investigation and mitigation is to be achieved. See volume 4, appendix U.
Route alternatives	10 May 2023	NRW – comments received in relation to planning application to FCC, application reference FUL/000246/23: DETAILED PLANNING APPLICATION FOR THE RETENTION AND REUSE OF THE POINT OF AYR GAS TERMINAL AND ASSOCIATED GAS PIPELINE TO THE MEAN LOW WATER SPRING MARK FOR THE MANAGEMENT AND PROCESSING OF CO2; THE CONSTRUCTION OF 33KV ELECTRICITY AND FIBRE OPTIC CONNECTIONS FROM POINT OF AYR GAS TERMINAL TO THE MEAN LOW WATER SPRING MARK; AND OTHER ASSOCIATED DEVELOPMENT AT LAND WEST OF STATION ROAD, TALACRE.	Environmental Statement (ES) Chapter 4: Consideration of Alternatives, paragraph 4.5.10 Foreshore Cables, explains that "*The yellow route was discounted, but the dashed yellow option may eventually be selected over the orange option depending on the shifting nature of the sand banks*". We advise that you seek clarification on whether the dashed yellow route is still in scope for this application and whether it has been assessed.	The dashed yellow and orange routes both remain under consideration and were both assessed within this Offshore ES, and the HRA. See Figure 4.2. The dashed yellow and orange routes are in the same location (east side of the existing PoA to Douglas Pipeline between MHWS and MLWS), following the same alignment up to the MLWS covered by the Onshore ES and HRA supporting the Planning Application FUL/000246/23. The benefit of the dashed yellow route is that it follows the orange route onshore, so it does not protrude east and provides a more accessible route for construction vessels. However, the issue associated with constructability between the two spits offshore remains (water rushes between the two spits at speed). Therefore, the dashed yellow route and the orange route are both still under consideration. The final choice will be made during detailed design. This is because each route requires bespoke cable installation vessels to implement, and the availability of the vessels cannot be confirmed at this time. Sediment dispersion modelling has been carried out for the reasonable worst-case installation scenario, and both options are being assessed in this Offshore EIA that will support the Marine Licence application to NRW-MLT. **This has been taken into consideration within this Offshore ES.**

4.10 Conclusion

The site selection process explained within this chapter of the ES has culminated in the Application for the Proposed Development. The Applicant has endeavoured to take on board points raised by stakeholders during the scoping phase for the Proposed Development in relation to site selection and/or design.

As discussed in volume 1, chapter 5, a maximum design scenario approach has been implemented when assessing any impacts arising from the Proposed Development in relation to the site selection and/or design.

4.11 References

Global CCS Institute (2018) Is the world ready for carbon capture and storage? Available at: https://www.globalccsinstitute.com/wp-content/uploads/2020/04/CCS-Readiness-Index-2018_digital-1.pdf . Accessed June 2023.

HM Government (2017) The Clean Growth Strategy – Leading the way to a low carbon future. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/700496/clean-growth-strategy-correction-april-2018.pdf Accessed June 2023.

HM Government (2021) North West Inshore and North West Offshore Marine Plan. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1004490/FINAL_North_West_Marine_Plan__1_.pdf Accessed June 2023.

IPCC (2021). Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. In Press.

Liverpool Bay CCS Limited (2022) *HyNet Carbon Dioxide Transportation and Storage Project - Offshore EIA Scoping Report*.

Liverpool Bay CCS Limited (2023) *HyNet Carbon Dioxide Pipeline TCPA - Onshore Environmental Statement*.

Offshore Petroleum Regulator for Environment and Decommissioning (OPRED) (2023). *Scoping Opinion for HyNet Carbon Dioxide Transportation and Storage Project - Offshore*.

Pale Blue Dot (2016) Progressing Development of the UK's Strategic Carbon Dioxide Storage Resource. A Summary of Results from the Strategic UK CO2 Storage Appraisal Project. Available at: https://s3-eu-west-1.amazonaws.com/assets.eti.co.uk/legacyUploads/2016/04/D16-10113ETIS-WP6-Report-Publishable-Summary.pdf Accessed June 2023.

Welsh Government (2019) Welsh National Marine Plan. Available at: gov.wales/sites/default/files/publications/2019-11/welsh-national-marine-plan-document_0.pdf Accessed June 2023.

5 ENVIRONMENTAL IMPACT ASSESSMENT METHODOLOGY

5.1 Introduction

This Offshore Environmental Statement (ES) has been developed to support an application for consent for the Proposed Development, in accordance with the requirements of the following regulations (collectively referred to hereafter as the EIA Regulations):

- in respect of a carbon storage permit: The Offshore Oil and Gas Exploration, Production, Unloading and Storage (Environmental Impact Assessment) Regulations 2020; and
- in respect of a marine licence application: The Marine Works (Environmental Impact Assessment) Regulations 2007 (as amended) ;

Volume 1, chapter 2 provides further details on the EIA Regulations and a detailed description of the Proposed Development can be found in volume 1, chapter 3.

This chapter of the Offshore ES presents the EIA methodology used for the assessment of likely significant environmental effects of the Proposed Development on physical, biological, and human receptors.

The HyNet Carbon Dioxide Transportation and Storage Project has both Onshore and Offshore elements.

The Onshore elements are being supported by two separate ESs:

- An ES to support the Development Consent Order (DCO) application for the HyNet Carbon Dioxide Pipeline DCO. The ES for the HyNet Carbon Dioxide Pipeline DCO application has been submitted in October 2022. National Infrastructure Planning Examination of the application started on the 20 March 2023 and is scheduled to close on the 20 September 2023.
- An ES to support the Town and Country Planning Act (TCPA) applications for the HyNet Carbon Dioxide Pipeline TCPA, these covering the elements located in Wales only. An EIA Scoping Report for the HyNet Carbon Dioxide Pipeline TCPA applications has been submitted in July 2021 and the EIA Scoping Opinion received in August 2021. Consultation on the ES closed in December 2022 and the planning applications were submitted on the 10 March 2023.

There is an overlap in jurisdiction in the intertidal area between Mean High Water Springs (MHWS) and Mean Low Water Springs (MLWS) of the Offshore and Onshore consenting and regulatory regimes. Both this Offshore ES, and ES to support the Onshore TCPA therefore present the relevant technical assessments for the landfall works in this area of overlap. Within this Offshore ES, 'Offshore' generally refers to the receptors on the seaward of MHWS, and 'Onshore' refers to the receptors on the landward of MHWS.

This chapter presents:

- the assessment methodology used to determine potential impacts including the approach that has been used to assess impact magnitude, sensitivity of receptors, and conclusion on the likely significance of effects;
- the methodology used for assessing cumulative effects assessment (CEA);
- the methodology for assessing inter-related effects; and
- the methodology for assessing transboundary effects.

Further details on topic-specific methodologies (e.g. methodologies for site-specific surveys) are provided in the relevant Offshore ES topic chapters (volume 2, chapters 6 to 14).

5.2 Environmental Impact Assessment legislation and guidance

The assessment of effects methodology employed in this Offshore ES draws upon relevant legislation, policy, and guidance, including those listed below:

5.2.1.1 Legislation

- The Offshore Oil and Gas Exploration, Production, Unloading and Storage (Environmental Impact Assessment) Regulations 2020 ('the 2020 EIA Regulations') (relevant to the Carbon Storage Permit application to the NSTA);
- The Marine and Coastal Access Act 2009 (as amended) (relevant to the Marine Licence application);
- The Marine Works (Environmental Impact Assessment Regulations) 2007 (as amended) (the 2007 EIA Regulations) (relevant to the Marine Licence application to Natural Resources Wales);
- The Conservation (Natural Habitats &c.) Regulations 1994;
- The Conservation of Habitats and Species Regulations 2017;
- The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019;
- The Marine Environment (EU Exit) (Amendment) Regulations 2019; and
- The Environmental Permitting (England and Wales) Regulations 2016.

5.2.1.2 Policy

- Overarching National Policy Statement (NPS) for Energy (NPS EN-1) (including updated consultation draft) (DECC, 2011a; BEIS, 2021a);
- NPS for Renewable Energy Infrastructure (NPS EN-3) (including updated consultation draft) (DECC, 2011b; BEIS, 2021b); and
- NPS for Electricity Networks Infrastructure (NPS EN-5) (including updated consultation draft) (DECC, 2011c; BEIS, 2021c).

5.2.1.3 Guidance

- The Offshore Oil and Gas Exploration, Production, Unloading and Storage (Environmental Impact Assessment) Regulations 2020 – A Guide (BEIS, OPRED, 2021d);
- Environmental Impact Assessment for marine activities (NRW, 2023);
- The Planning Inspectorate Advice Note Seven: Environmental Impact Assessment: Preliminary Environmental Information, Screening and Scoping (PINS, 2020a);
- The Planning Inspectorate Advice Note Twelve: Transboundary Impacts and Process (PINS, 2020b);
- The Planning Inspectorate Advice Note Seventeen: Cumulative effects assessment (PINS, 2019);
- Guidelines for Ecological Impact Assessment (EcIA) in the United Kingdom (UK) and Ireland (CIEEM, 2018);
- Environmental Impact Assessment Guide to: Delivering Quality Development (IEMA, 2016);
- Environmental Impact Assessment for Offshore Renewable Energy Projects (British Standards Institute (BSI), 2015);
- Delivering Proportionate EIA, A Collaborative Strategy for Enhancing UK Environmental Impact Assessment Practice (IEMA, 2017);

- Guidelines for data acquisition to support marine environmental assessments of offshore renewable energy projects (CEFAS, 2012); and
- Nature conservation considerations and environmental best practice for subsea cables for English Inshore and UK offshore waters (Natural England and JNCC, 2022).

Where relevant topic specific guidance and legislation exists, this is discussed within the relevant Offshore ES chapters (volume 2, chapters 6 to 14). References to legislation in this Offshore ES are to the relevant legislation as amended.

5.3 Consultation and scoping

Consultation on the proposed offshore EIA methodology (including the CEA methodology and approach to assessing transboundary and inter-related effects) was undertaken at the offshore EIA scoping stage. The HyNet Carbon Dioxide Transportation and Storage Project – Offshore EIA Scoping Report (Liverpool Bay CCS Limited, 2022) presented these methodologies and requested feedback on the proposed approaches. A summary of the key issues raised during consultation relating to this chapter are outlined below in Table 5.1, together with how these issues have been considered in the production of this chapter.

Table 5.1: Summary Of Key Consultation Issues Raised Relevant To The EIA Methodology

Consultee	Issue Raised	Response to Issue Raised/Where this has Been Considered in Chapter
OPRED (Scoping Opinion)	Application Process and Cumulative Assessment: Associated elements of the wider HyNet Carbon Dioxide Transportation and Storage Project are likely to be considered as part of the cumulative and in-combination effects of the Proposed Development. The ES should therefore demonstrate consideration of the wider HyNet Carbon Dioxide Transportation and Storage Project when assessing the environmental effects of the Proposed Development.	The wider HyNet Carbon Dioxide Transportation and Storage Project, including the DCO and TCPA applications being progressed by the Applicant for the Onshore elements of the HyNet Carbon Dioxide Transportation and Storage Project, are included in the CEA (see section 5.5.1).
	Best Practice Advice for Evidence and Data Standards: When completing the ES, the Developer should make use of the guidance document called 'Nature conservation considerations and environmental best practice for subsea cables for English Inshore and UK offshore waters.' This has been jointly developed by Natural England and the Joint Nature Conservation Committee (JNCC) in collaboration with the European Subsea Cable Association and provides high level advice on the main pressures, sensitive habitats and best practice for subsea cables.	This guidance has been accessed and used to inform the assessment of effects methodology (see section 5.2).
	Cumulative and In-combination Effects: The ES should identify, describe and evaluate the environmental effects that are likely to result from the Project in combination with other major developments and activities that are being, have been or will be carried out in the vicinity of the Project, for example other oil and gas developments, offshore wind and dredging activities. In particular (subject to the available information) the following types of projects should be factored in: 1. existing completed projects; 2. approved but incomplete projects; 3. ongoing activities;	The types of projects listed in the scoping opinion are included in the CEA (see section 5.5.1).

Consultee	Issue Raised	Response to Issue Raised/Where this has Been Considered in Chapter
	4. plans or projects for which an application has been made and which are under consideration by the consenting authorities (i.e. scoping projects); and 5. plans and activities which are reasonable foreseeable (i.e. projects for which an application has not yet been submitted but are likely to progress before completion of the Project and for which sufficient information is available to assess the likelihood of cumulative and in combination effects).	
	Environmental Data: All relevant environmental data is expected to be sourced, analysed and presented in relation to the project. A non-exhaustive list of potential sources of environmental information is provided, but the developer is expected to consult such other sources as it considers necessary. Relevant local environmental data should also be sourced from the appropriate local bodies which may include local environmental records centre, the local wildlife trust, local geo-conservation groups or other recording societies.	Where required, additional environmental data has been sourced and analysed to inform the EIA. See section 5.4.2.1.
	Landscape and visual impacts: It is advised that details of local landscape and seascape character areas (mapped at a scale appropriate to the Project's site) and any relevant management plans or strategies pertaining to the area are included. The ES should include assessments of visual effects of the Project (such as landscape and seascape) together with any physical effects (such as changes in topography). It is advised that the ES includes an assessment of the potential impacts of the Project on local landscape character using the methodology outlined within the landscape and seascape character assessment (LCA/SCA) which is almost universally used for landscape and visual impact assessment. It is also advised that this assessment includes effects of the special qualities of the designated landscape as set out in the statutory management plan for the area.	Following the scoping opinion, a Seascape, Landscape and Visual Impact Assessment (SLVIA) has been completed for the Proposed Development (volume 3, appendix C3). The SLVIA concluded the Proposed Development can be accommodated without significant effects on seascape, landscape character, and visual amenity and therefore this topic has been scoped out from further assessment.

5.3.1 Scope of impact assessment

Considering the nature, size and location, information provided in the scoping opinion and other consultation responses provided throughout the EIA process, the following topics have been identified as requiring consideration within this ES:

- Physical Processes (volume 2, chapter 6)
- Marine Biodiversity (volume 2, chapter 7)
  - Benthic Subtidal and Intertidal Ecology
  - Fish and Shellfish Ecology
  - Marine Mammals
- Ornithology (volume 2, chapter 8)
- Shipping and Navigation (volume 2, chapter 9)
- Commercial Fisheries (volume 2, chapter 10)

- Marine Archaeology (volume 2, chapter 11)
- Infrastructure and Other Sea Users (volume 2, chapter 12)
- Climate Change (volume 2, chapter 13)
- Inter-Related Effects (volume 2, chapter 14)

5.4 Key principles of the EIA

5.4.1 Overview

Within this Offshore ES, the assessment of each topic (e.g. physical processes, ornithology, shipping and navigation, etc.) is included in a separate chapter. Within each of the topic chapters, the following matters will be considered:

- identification of the study area for the topic-specific assessments;
- description of the planning policy and guidance context;
- summary of consultation activity, including comments received in the Scoping Opinion;
- description of the environmental baseline conditions; and
- presentation of impact assessment, which includes:
  - identification of the maximum design scenario for each impact assessment;
  - a description of the measures adopted as part of the Proposed Development, including mitigation and design measures which seek to prevent, reduce or offset environmental effects;
  - identification of likely impacts and assessment of the significance of identified effects, taking into account any mitigation measures adopted as part of the Proposed Development;
  - identification of any further mitigation measures required in respect of Likely Significant Effects (LSE) (in addition to those measures adopted as part of the Proposed Development), together with consideration of any residual effects.
  - identification of any future monitoring required;
  - assessment of any cumulative effects with other major developments, including those that are proposed, consented and under construction (including, where applicable, those projects, plans or activities that are currently operational that were not operational when baseline data was collected); and
  - assessment of any transboundary effects (i.e. effects on other states).

Inter-related effects (i.e. inter-relationships between environmental topic areas) have been assessed in a separate standalone ES chapter (volume 2, chapter 14) which considers the impacts of the Proposed Development on each of the identified receptor groups.

Within each topic chapter a number of key principles have been applied, and these are detailed in sections 5.4.2 to 5.7.

5.4.2 Proportionate EIA

The importance of delivering EIAs that are proportionate and accessible to a wide range of stakeholders has been acknowledged by EIA practitioners, with a recent drive for improved quality of Environmental Statements and EIA reports from a number of organisations (e.g. IEMA, 2017).

The aim of producing a proportionate EIA has been a key consideration in the development of this Offshore ES. A number of tools and processes have been used to aid the proportionality of the Proposed Development EIA. This included:

- application of the existing evidence basis; and
- commitment to embedded mitigation measures.

5.4.2.1 Existing Evidence Basis

The development area is located in Liverpool Bay, for which there exists significant data and knowledge regarding the baseline environment. This data/knowledge has been acquired through the former Liverpool Bay zonal studies, from the surveys and assessments undertaken for Burbo Bank, Morgan and Mona, Rhys Flat, and Gwynt y Mór offshore wind farms, and the multiple oil and gas platforms and developments in the area. Where possible in this Offshore ES, the Applicant has made use of these data to provide an overview of the baseline environment and the availability of existing data to support the Offshore ES; to draw upon the pre-existing evidence base where appropriate.

To inform the EIA, additional relevant environmental data in relation to the Proposed Development has been sourced and analysed. This included relevant local environmental data which has been sourced from the appropriate local bodies. All data used to inform the assessment is described and discussed in the relevant Offshore ES topic chapters (volume 2, chapters 6 to 14).

5.4.2.2 Mitigation Measures

The EIA can influence the design of a project in many ways, including:

- amending the layout and extent of a development site to avoid key sensitive receptors;
- amending the design of a specific aspect of the development to manage impacts;
- specifying construction techniques to avoid effects on receptors; and
- changing materials to reduce volume and/or transport impacts (IEMA, 2016).

There are three distinct forms of mitigation which include:

- **primary inherent mitigation**: These include modifications to the location or design of the development made during the pre-application phase that are an inherent part of the Proposed Development and do not require additional action to be taken. This includes measures such as identifying an archaeological feature which should remain unaffected by the Proposed Development;
- **secondary foreseeable mitigation**: These include actions that will require further activity in order to achieve the anticipated outcome. These may be imposed as part of the consents and licences, or through inclusion in the Offshore ES. This includes measures such as those required to restore a sensitive habitat; and
- **tertiary inexorable mitigation**: Actions that would occur with or without input from the EIA feeding into the design process. These include actions that will be undertaken to meet other existing legislative requirements, or actions that are considered to be standard practices used to manage commonly occurring environmental effects. This includes measures such as the Code of Construction Practice (CoCP), and Environmental Management Plans (EMPs).

Both primary and tertiary measures can be embedded into the project design. The basis of the Offshore ES can therefore be undertaken on the basis that these measures will definitely be delivered and therefore any effects which might arise without these mitigation measures do not need to be identified as potential effects as there is no potential for them to arise (IEMA, 2016).

Primary mitigation is inherent with the Project Description and tertiary mitigation is inexorable as described above, both types of mitigation are considered as designed in measures. Secondary mitigation proposed to

reduce significance of impact are detailed within the topic chapters of this Offshore ES and summarised in volume 3, appendix E.

5.4.3 Design envelope approach and Maximum Design Scenario

The Project Design Envelope (PDE) approach (also known as the Rochdale Envelope approach) has been adopted for the assessment of the Proposed Development, in accordance with current best practice and the 'Rochdale Envelope Principle'. This approach allows for the Proposed Development to be assessed on the basis of project design parameters that are not specific at the time of writing but are indicated with a range of potential values. It is not possible to provide precise final details of the Proposed Development, or the way it will be built, a number of years ahead of the time it will be constructed. As a relatively novel industry, improvements in technology and construction methodologies occur frequently and information provided as part of the consent application could become rapidly outdated, resulting in an uneconomical and potentially unbuildable project.

For each impact assessment, the Maximum Design Scenario (MDS) from within the range of potential options for each development parameter has been identified, and the assessment has been undertaken on this basis. The Design Envelope Approach employed for the Proposed Development is consistent with the Planning Inspectorate's (PINS) Advice Note Nine: Rochdale Envelope (PINS, 2018).

An example of the PDE approach would be where several types of subsea cable installation methods are considered. The assessment in this case would be based on the installation method known to have the greatest potential impact on a given receptor. In this instance, the PDE for the installation method with the greatest seabed disturbance potential would be that which leaves the largest footprint. It can be assumed that any project parameters equal to or less than those assessed will have environmental effects of the same level or less upon the receptors for the topic under consideration.

Volume 1, chapter 3 sets out the Proposed Development parameters and identifies the range of potential project design values for all relevant components of the development. For each of the topic chapters (volume 2, chapters 6 to 14) within this Offshore ES and for each of the impacts assessed, the Design Envelope considered will be the scenario which would give rise to the greatest potential impact. If, after undertaking the impact assessment it is shown that no significant effect is anticipated, it can be assumed that any project parameters equal to or less than those assessed in this 'Design Envelope' will have environmental effects of the same level or less and will therefore also have no significant effect upon the receptors for the topic under consideration.

By employing the Design Envelope approach, the developer retains flexibility in design of the Proposed Development and associated offshore infrastructure within certain maximum extents and ranges, all of which are fully assessed in this Offshore ES.

5.4.4 Impacts and effects

The Proposed Development has the potential to create a range of impacts and effects with regard to the physical, biological, and human environment related to marine receptors. For the purposes of the Offshore ES, the term 'impact' is defined as a change that is caused by an action. For example, the laying of an inter-platform cable (action) is likely to result in seabed disturbance (impact). Impacts can be defined as direct, indirect, temporary, irreversible, secondary, cumulative and inter-related. They can also be either beneficial or adverse, although the relationship between them is not always straightforward.

The term 'effect' is defined as the consequence of an impact. Using the increased sedimentation example again, the laying of an inter-platform cable (action) results in seabed disturbance (impact), with the potential to disturb benthic habitats and species (effect). The significance of effects is determined by consideration of the magnitude of impact alongside the sensitivity of each receptor/receptor group.

The magnitude of an impact is the consideration of the extent, duration, frequency, and reversibility of an impact. Receptors can be defined as the physical or biological resource or user group that could be affected

by the potential impacts. In defining the sensitivity for each receptor/receptor group, the vulnerability, recoverability, and value/importance of that receptor will be taken into consideration.

In order to ensure consistency in defining the significance of an effect, a matrix approach will be adopted in the Offshore ES as presented in Table 5.2. In cases where a range is suggested for the significance of effect, there remains the possibility that this may span the significance threshold (i.e. the range is given as minor or moderate). In such cases the final significance is based upon the expert's professional judgement as to which outcome delineates the most likely effect, with an explanation as to why this is the case.

Table 5.2: Matrix Used For The Assessment Of The Significance Of Effect

Sensitivity of Receptor	Magnitude of Impact				
		Negligible	**Low**	**Medium**	**High**
	Negligible	Negligible	Negligible or Minor	Negligible or Minor	Minor
	Low	Negligible or Minor	Negligible or Minor	Minor	Minor or Moderate
	Medium	Negligible or Minor	Minor	Moderate	Moderate or Major
	High	Minor	Minor or Moderate	Moderate or Major	Major or Substantial
	Very High	Minor	Moderate or Major	Major or Substantial	Substantial

A level of effect of moderate or more will be considered a 'significant' effect for the purposes of the EIA. A level of effect of minor or less will be considered 'not significant'. Effects of moderate significance or above are therefore considered important in the decision-making process, whilst effects of minor significance or less warrant little, if any, weight in the decision-making process.

The matrix approach is consistent with the general approach described in the Design Manual for Roads and Bridges (DMRB) (Highways England *et al.,* 2020) and Environmental Impact Assessment for Offshore Renewable Energy Projects – Guide (BSI, 2015). A number of modifications have however been made in the interest of proportionality, including:

- a magnitude of impact of 'no change' will not be assessed since it will always lead to a non-significant effect;
- a negligible magnitude impact will not be considered further because it will always lead to a non-significant effect; and
- receptors of negligible importance, value, or sensitivity will not be considered further because it will always lead to a non-significant effect.

Where significant effects are initially identified, the EIA will follow a 'feedback loop' methodology, as illustrated within Figure 5.1. Through this process, an impact is initially assessed to determine the significance of the potential environmental effect. If the effect of an impact presents a major or substantial significant adverse outcome, changes are typically made to the Proposed Development design (primary mitigation) in order to reduce or offset the magnitude of impact. If the effect of an impact presents a moderately significant adverse outcome, mitigation such as engineering controls or construction methods (secondary and tertiary mitigation) are employed in order to reduce or offset the magnitude of the impact.

This process is repeated, as illustrated within Figure 5.1 until the EIA practitioner is satisfied that:

- the effect is reduced to a level that is not significant in EIA terms; or
- no further changes can be made to the Proposed Development design to reduce the magnitude of impact and therefore the significance of the effect. In these cases, an overall effect that is still significant in EIA terms may be presented.

Following this iterative approach ensures that the significance of effect presented for each identified impact may be presumed to be representative of the maximum residual adverse effect the development area may have on the receiving environment.

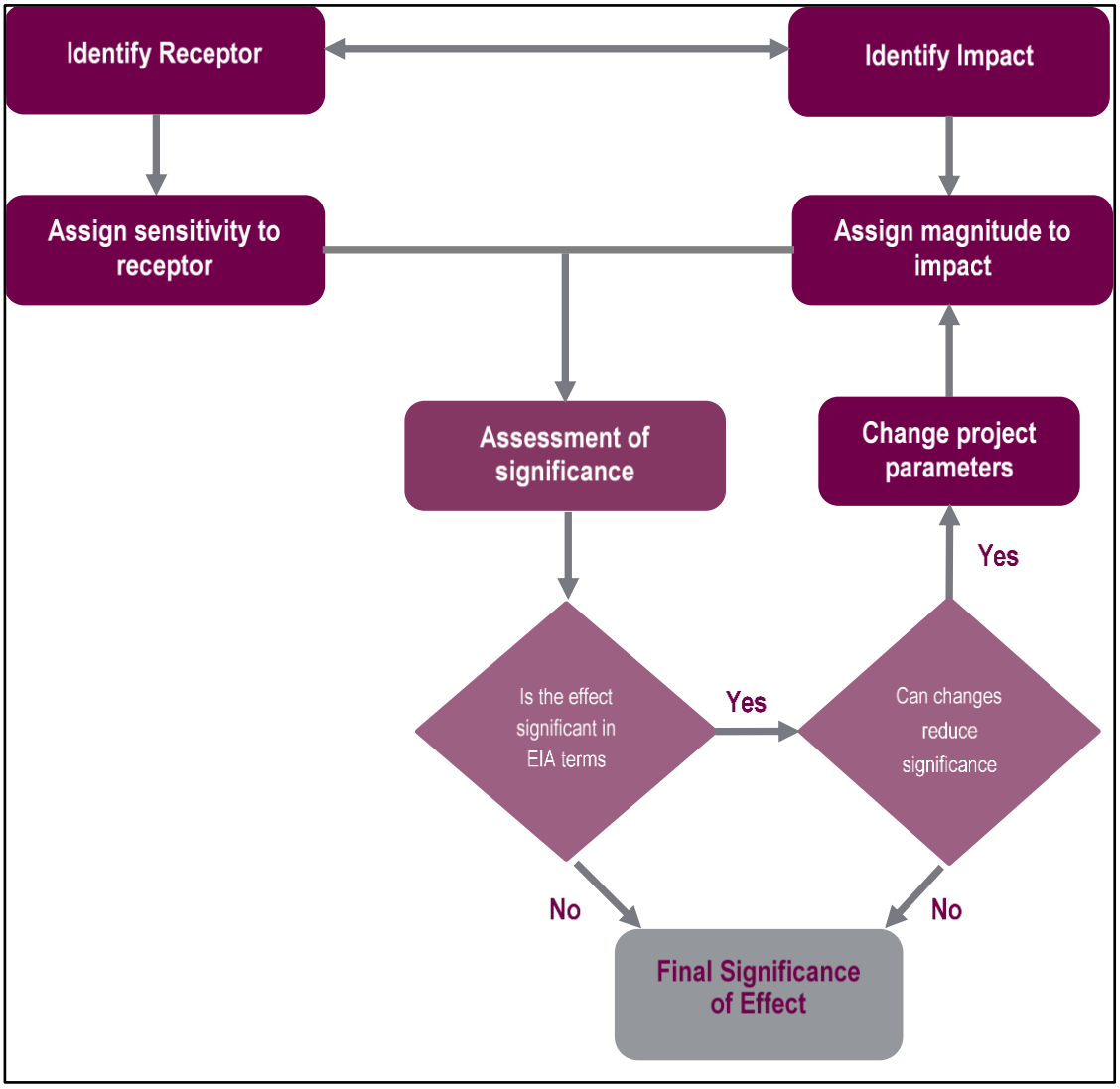


Figure 5.1: Iterative Approach To Mitigation Within The Proposed Development EIA

5.5 Cumulative Effect Assessment

5.5.1 Overview

A CEA is a legal requirement under the EIA Regulations. A CEA provides consideration of the impacts arising from the Proposed Development alone and cumulatively with other relevant plans, projects and activities. Cumulative effects are therefore the combined effect of the Proposed Development in combination with the effects from a number of different projects, on the same receptor or resource.

A fundamental requirement of undertaking the CEA is to identify those foreseeable developments or activities with which the Proposed Development may interact to have the potential to result in a cumulative impact. All

phases (construction, operation and maintenance, and decommissioning) of the Proposed Development may have the potential to lead to cumulative impact.

For the Proposed Development CEA (volume 3, appendix F), other proposed major developments in the area have been taken into account within the CEA. PINS Advice Note Seventeen: Cumulative Effects Assessment Relevant to Nationally Significant Infrastructure Projects (PINS, 2019) recommend that, through consultation with Local Authorities and other relevant consenting bodies, other major developments (both onshore and offshore) in the area should be taken into account when conducting a CEA, including those which are:

- already constructed;
- under construction;
- permitted application(s), but not yet implemented;
- submitted application(s) not yet determined; and
- plans and projects which are 'reasonably foreseeable' (i.e. developments that are being planned, including, for example, offshore renewable energy projects that have a Crown Estate Agreement for Lease (AfL), offshore renewable energy projects that have been scoped).

Similarly, the scoping opinion (OPRED, 2023) stated that '*The ES should identify, describe and evaluate the environmental effects that are likely to result from the Project in combination with other major developments and activities that are being, have been or will be carried out in the vicinity of the Project, for example other oil and gas developments, offshore wind and dredging activities. In particular (subject to the available information) the following types of project should be factored in:*

i. Existing completed projects;

ii. Approved but incomplete projects;

iii. Ongoing activities;

iv. Plans or projects for which an application has been made and which are under consideration by the consenting authorities (i.e. scoping projects);

v. *Plans and activities which are reasonable foreseeable (i.e. projects for which an application has not yet been submitted but are likely to progress before completion of the Project and for which sufficient information is available to as sess the likelihood of cumulative and I in combination effects).'*

The CEA considers all other relevant plans, projects and activities that are publicly available three months prior to the Proposed Development application, these including the DCO and TCPA applications being progressed by the Applicant for the Onshore elements of the HyNet Carbon Dioxide Transportation and Storage Project.

5.5.2 Screening stage

To ensure a thorough and comprehensive approach to identification of potential projects to be considered in the CEA, an initial 'long list' of projects within a defined Zone of Influence (ZOI) was developed based on the above listed criteria. The ZOI for the Proposed Development has been based on the Ornithology ZOI, which represents the maximum screening area.

The initial CEA long list was reduced following consideration of potential for cumulative effects for each potential impact-receptor pathway staged process as set out below:

- physical overlap – Ability for impacts arising from the Proposed Development to overlap with those from other projects/plans on a receptor basis. This means that an overlap of the physical extents of the impacts arising from the two (or more) projects/plans must be established for a cumulative effect to arise. Exceptions to this exist for certain mobile receptors that may move between, and subject to, two or more separate physical extents of impact from two or more projects; and
- temporal overlap – In order for a cumulative effect to arise from two or more projects, a temporal overlap of impacts arising from each must be established. It should be noted that some impacts are active only

during certain phases of development, such as piling noise during construction. The absence of a strict overlap however may not necessarily preclude a cumulative effect, as receptors may become further affected by additional, non-temporally overlapping projects.

This screening stage was based on the experience and knowledge of technical specialists, and the current guidance and regulations. The projects or plans that remain after review of the long list are taken forwards to the assessment stage.

5.5.3 Assessment stage

Following the screening stage outlined in section 5.5.2, information is gathered on the projects, plans or activities to be taken forwards into the CEA. Where the potential significant effect for the Proposed Development alone is assessed as negligible, or where an impact is predicted to be highly localised, these will not be considered within the Proposed Development CEA, as there is not considered to be a potential for cumulative effects with other plans, projects or activities.

The level of publicly available data for each project, plan and/or activity included in the CEA will be different and dependent on the development stage of the Proposed Development. Planning Inspectorate Advice Note Seventeen recommends that *'a level of certainty, reflecting the availability of detail and information necessary for the assessment, is assigned to each development and recorded'* (Planning Inspectorate, 2019). At this point of the assessment, topic authors assigned a data confidence value to each screening in project, plan and/or activity.

In the undertaking of the CEA for the Proposed Development, a tiered approach was adopted. This provides a framework for placing relative weight upon the potential for each project/plan to be included in the CEA to ultimately be realised, based upon the project/plan's current stage of maturity and certainty in the projects' parameters. The tiered approach to the CEA is as follows:

- Tier 1:
  - under construction;
  - permitted application;
  - submitted application; and
  - those currently operational that were not operational when baseline data were collected, and/or those that are operational but have an ongoing impact.
- Tier 2:
  - the scoping report has been submitted and is in the public domain.
- Tier 3:
  - the scoping report has not been submitted and is not in the public domain;
  - identified in the relevant development plan for the Proposed Development; and
  - identified in other plans or programmes.
- Tier 4:
  - no publicly available information.

All projects/plans that have been screened into the CEA via the screening process have been allocated into one of the above Tiers and assessed in the CEA.

The CEA considers all other relevant plans, projects and/or activities that are publicly available three months prior to the Proposed Development application.

Where practicable, the CEA methodology then follows the outline of the stand-alone assessment methodology as described in section 5.4. This approach allows consistency throughout the EIA.

5.6 Transboundary effect

Transboundary effects arise when impacts from the Proposed Development within one state affect the environment of another state(s). The need to consider such transboundary effects has been embodied by the United Nations Economic Commission for Europe (UNECE) Convention on EIA in a Transboundary Context (commonly referred to as the 'Espoo Convention'). The Convention requires that assessments are extended across borders between Parties of the Convention when a planned activity may cause significant adverse transboundary impacts.

In European Union (EU) member states, Directive 85/337/EEC (as amended) (the EIA Directive) implements both the Espoo and Aarhus Conventions. EIA Regulations were adopted to implement this Directive in UK law. Following the UK's departure from the EU, EU-derived legislation continues to have effect in domestic law under the European Union (Withdrawal) Act 2018. The EU Exit Regulations establish that the regimes that inform planning decisions will remain as set out in the founding legislation. Therefore transboundary impacts are still to be considered as part of the EIA.

Volume 3, appendix G presents the update to the transboundary screening work undertaken at the scoping stage, considering the more recent project information.

This exercise identified that the following receptors may experience transboundary impacts from the Proposed Development:

- Fish and Shellfish ecology (volume 2, chapter 7: Marine Biodiversity);
- Marine mammals (volume 2, chapter 7: Marine Biodiversity);
- Ornithology (volume 2, chapter 8);
- Shipping and Navigation (volume 2, chapter 9);
- Commercial Fisheries (volume 2, chapter 10); and
- Climate Change (volume 2, chapter 13).

Each of the above topic chapters provides an assessment of transboundary effects for each receptor group.

5.7 Inter-related effects

The EIA Regulations require consideration of inter-related effects. Inter-related effects refer to the inter-relationships between EIA topics that may lead to environmental effects. There are two categories of inter-related effects:

- project lifetime effects: effects that occur throughout more than one phase of the project (construction, operation and maintenance, and decommissioning) interacting to potentially create a more significant effect upon a receptor than if just assessed in isolation in a single phase; and
- receptor-led effects: effects that interact spatially and/or temporally resulting in inter-related effects upon a single receptor. For example, the impacts of increased sedimentation the surrounding benthic ecology may be greater when multiple sources of impact interact or combine to produce a different or greater effect upon this receptor than when single sources of impact are considered in isolation. Receptor-led effects might be short term, temporary or transient effects, or incorporate longer term effects.

Within the Offshore ES, assessment of inter-related effects has been undertaken with specific reference to the potential for such effects to arise in relation to receptor groups. The term 'receptor group' is used to highlight the fact that the proposed approach to inter-relationships assessment will, in the main, not assess every individual receptor assessed at the EIA stage, but rather, potentially sensitive groups of receptors.

Where the significance of an effect within the topic-specific assessment has been identified as 'no effect across all stages of the project', the assumption has been made that these effects can not contribute to any inter-

related effects. These effects have therefore not been included in the inter-related effects assessment as there will be no effect from the Proposed Development over the lifetime of the project.

The inter-related assessment considers only effects from the Proposed Development and not those from other projects, which have been considered in the CEA, see volume 2, chapter 14.

5.8 Topics scoped out of EIA

Table 5.3 identifies the effects that have been scoped out of the EIA and the reason for the exclusion. These effects will not be discussed or assessed further in this Offshore ES. The topics Seascape, Landscape and Visual Resources, Aviation and Radar, and Air Quality have been scoped out of the EIA due to no likely significant effect in EIA terms or no effect-receptor pathways identified. Justification for scoping out these topics is provided in volume 3, appendix C. Major accidents and disasters have also been scoped out of the assessment because the Proposed Development is not seen as vulnerable to, or introducing, risks of major accidents and/or disasters. Furthermore, all possible major accidents and/or disasters are covered by design measures and compliance with legislation and best practice.

Table 5.3: Potential Impacts Scoped Out From The EIA

Potential Impact Scoped Out of EIA	Receptor	Reason for Scoping Effect out of the Assessment
Presence of infrastructure may lead to changes in the local tidal regime, wave climate, and sediment transport	Physical processes	**All phases** • The proposed platform at Douglas consists of four legs c.2 m in diameter at a spacing of 17 m. Given the diminutive nature of this structure compared to neighbouring wind turbine structures for which published information is available, the impacts on physical processes would be negligible. • At the early project stages, it is anticipated that the offshore cables and inter-platform cabling will be trenched and then backfilled. Cable protection, in the form of third-party cable crossings, will be utilised but will be profiled and <1 m in height minimising impacts on physical processes and sediment transport pathways. • The presence of infrastructure potentially leading to changes in the local tidal regime, wave climate, and sediment transport can therefore be scoped out of the assessment based on these preliminary design parameters and scale of infrastructure proposed. No permanent infrastructure is placed on the seafloor within the intertidal zone. The new electrical cables will be buried to a target depth of 2-3m.
Changes to seabed morphology and water quality due to the utilisation of jack-up vessels	Physical processes	**All phases** • The utilisation of jack-up vessels during the construction and decommissioning phases of the project within the Eni development area will only be temporary and any potential disturbances on the subsea surface, potentially increasing SSCs and/or causing toxicity effects through the mobilisation of contaminated sediments would likely infill over time and be brief. Therefore, it is not expected that jack-up vessels would have any implications on the surrounding seabed morphology or water quality and this impact is to be scoped out of the physical processes assessment.
Changes to seabed morphology and water quality due to sand wave clearance	Physical processes	**All phases** • The nature of sand waves and sandbanks within Liverpool Bay is a highly mobile and dynamic one, therefore sand waves which have been altered during the construction phase would be anticipated to readily reform and is not expected to alter seabed morphology in the longer term.

Potential Impact Scoped Out of EIA	Receptor	Reason for Scoping Effect out of the Assessment
Impacts to benthic ecology due to Electromagnetic Fields (EMFs)	Benthic Subtidal and Intertidal Ecology	**Operation and maintenance phase** • Low-frequency EMFs are present along subsea cables used to transmit electricity from the Eni Development Area to the appropriate substation and terminal locations. There are limited findings on the electro sensitivity of benthic organisms and on the associated impact of EMFs on the surrounding benthic invertebrates. Bochert and Zettler (2006) studied the effects of EMF on the survival and physiology of various crustaceans, marine worms, and echinoderms in the context of cables associated with OWFs in the Baltic Sea. The authors demonstrated no significant effects for any species after three months of exposure. Furthermore, Wilhelmsson *et al.* (2010) demonstrated that there were no differences between benthic community assemblages observed in visual surveys of OWF subsea cables and their peripheral areas. Finally, the presence of diverse and seemingly healthy benthic communities on existing offshore infrastructure indicates that EMF is unlikely to cause a long-term significant effect upon benthic receptors (Linley *et al.,* 2007; Walker *et al.,* 2009). • Embedded mitigation for this impact includes cable burial and/or protection when not available (such as at cable crossings). The target cable burial depth of 2 to 3 m is sufficient to reduce the potential for impacts from EMF on benthic invertebrates. Based on this, and the literature provided above, it is proposed to scope this impact out of the assessment on benthic subtidal and intertidal ecology.
Underwater noise from marine vessels during construction, operation and maintenance and decommissioning phases	Fish and Shellfish	**All phases** • The potential for underwater noise generated from marine vessels will only occur within the Eni Development Area and the immediate vicinity. Fish and shellfish receptors are unlikely to remain in the area for long periods of time during offshore construction, maintenance, and decommissioning activities.
Impacts to fish and shellfish ecology due to EMF	Fish and Shellfish	**Operation and maintenance phase** • Low-frequency EMFs are present along subsea cables used to transmit electricity from the Eni Development Area to the appropriate substation and terminal locations. Fish and shellfish receptors may be receptive to EMF; however a recent study has demonstrated that increased cable burial depth reduces the intensity of EMF for receptive species (Hutchison et al., 2021). As an embedded mitigation measure, cables within the Eni Development Area will be buried (target cable burial depth of 2 to 3 m) and/or protected therefore, there is limited scope for impacts from EMF on fish and shellfish ecology.
Accidental pollution during construction, operation and maintenance, and decommissioning phases	Fish and Shellfish	**All phases** • The potential for accidental pollution to be released during the construction, operation and maintenance, and decommissioning phases of the Proposed Development is present. This pollution could potentially result from sources including vessels/vehicles and equipment/machinery. However, the risk of these events is managed through embedded mitigation, such as an EMP, which includes Marine Pollution Contingency Plans (MPCPs).
Impacts to marine mammal ecology due to EMF	Marine Mammals	**Operation and maintenance phase** • Low-frequency EMFs are present along subsea cables used to transmit electricity from the Eni Development Area to appropriate substations and terminal locations. Cables within the development area will be buried (to a minimum of 2 m), and/or protected therefore, there is little expected impact on marine mammals and marine turtles. Additionally, there is limited data

Potential Impact Scoped Out of EIA	Receptor	Reason for Scoping Effect out of the Assessment
		illustrating marine mammals and turtles being affected by or responding to EMF.
Accidental pollution during construction, operation and maintenance, and decommissioning phases	Marine Mammals	**All phases** • The potential for accidental pollution to be released during the construction, operation and maintenance, and decommissioning phases of the Proposed Development is present. This pollution could potentially result from sources including vessels/vehicles and equipment/machinery. However, the risk of these events is managed through EMP, including MPCPs.
Injury, disturbance, and displacement to marine mammals from operational noise	Marine Mammals	**Operation and maintenance phase** • The operational noise expected to occur from the Proposed Development will be minimal due to the nature of the infrastructure; there will only be heaters on the platforms. Additionally, the Eni Development Area exhibits varying levels of subsea ambient noise sources, the most dominant being offshore shipping. Operational noise is unlikely to add to the existing underwater noise baseline in any significant manner given the context of industrial shipping in the vicinity.
Increased Suspended Sediment Concentrations (SSCs) and associated deposition	Marine Mammals	**Construction and decommissioning phase** • Increased suspended sediment concentrations and sediment deposition from construction and decommissioning activities related to subsea pipeline refurbishment and cable installation may potentially result in indirect impacts on marine mammal ecology related to effects on prey species; however, marine mammals are well known to forage in tidal areas where water conditions are turbid and visibility conditions are subsequently poor. • Whilst elevated levels of SSCs arising during construction of the Proposed Development may decrease light availability in the water column and produce turbid conditions, the maximum impact range is expected to be localised with sediments rapidly dissipating over one tidal excursion. Therefore, it is proposed to scope this impact out for marine mammals and marine turtles.
Operational underwater noise	Ornithology	**Operation and maintenance phase** • Underwater noise during the project's ongoing operation is unlikely to result in noise levels that would impact surrounding bird species.
Injury to biodiversity from potential collision with marine vessels	Ornithology	**All phases** • The presence of construction, maintenance and decommissioning marine vessels, in addition to increased vessel traffic in the area is unlikely to cause injury to seabirds through vessel strikes and collision risks given the industrialised nature of Liverpool Bay. • Shipping and marine traffic is heavily prevalent within Liverpool Bay and seabirds and vessel strikes have not been documented within the area. The majority of seabird strikes is a direct result of attraction and sometimes associated collision with lights (Ronconi *et al*., 2015). Although unpredictable, poor weather, precipitation and cloud cover have been known to exacerbate the effects of nocturnal attraction to lights (Ronconi *et al*., 2015).
Displacement of fishing activity into other areas	Commercial Fisheries and Aquaculture	**All phases** • Given that Liverpool Bay has historically been a site for offshore oil and gas, the displacement of fishing activities into other surrounding areas is unlikely. The Proposed Development will utilise pre-existing infrastructure and essentially turn the oil and gas OPs into a novel Carbon Capture and Storage (CCS) site, with little change to the surrounding marine environment. Where new infrastructure is being installed, it is being done so either

Potential Impact Scoped Out of EIA	Receptor	Reason for Scoping Effect out of the Assessment
		within the existing operational footprint, or in proximity to the alignment of existing linear infrastructure.
Long-term increased steaming distances to fishing grounds during operation and maintenance	Commercial Fisheries and Aquaculture	**Operation and maintenance phase** • Following construction of the Proposed Development, fishing vessels will be able to transit through and around the site as they have done so in the past. The presence of the CCS infrastructure and the associated development area should not have a direct effect on steaming distances to and from adjacent fishing grounds in the area.
Alterations to sediment transport pathways affecting aggregate extraction areas impacts	Infrastructure and Other Sea Users	**All phases** • Platform structures (within the water column) consist of four legs circa 2 m in diameter at a spacing of 17 m. It assumed that, given the sandy nature of the seabed, suitable scour protection will be provided to avoid scour holes developing. Given the diminutive nature of the structure, in comparison to, say a neighbouring wind turbine structure for which suitable published information is available, the impacts on sediment transport pathways would be diminutive and as such are scoped out of the assessment.
Greenhouse gas (GHG) emissions from leaks and/or damage to the Proposed Development components within the development area into the environment during operation or during long-term sequestration use following decommissioning of the infrastructure	Climate	**Operation and maintenance-, and Decommissioning phase** • Emissions from potential leaks and damage to the structural integrity of the development area offshore components could lead to increases in surrounding CO_2 pollution and concentration, causing impacts to environmental and human health in the immediate vicinity and/or partial or full reversal of the sequestration benefits of the development. • However, these are not considered to be likely or expected effects of the Proposed Development. Engineering and geological studies undertaken in the planning of the sequestration facility to date have shown its suitability for stable, long-term storage and the purpose of the engineering design of the facility will be to ensure this is achieved. • Further, during the operation of the facility, fugitive emissions will be monitored through a Leak Detection and Repair (LDAR) programme as part of preventative maintenance activities, to ensure any unplanned CO_2 release is avoided or minimised as much as is reasonably practicable. • Any material amount of CO_2 leakage is therefore considered to be possible in an accident or disaster scenario. However, such an event is considered highly unlikely (given the above designed-in protection). The risk assessment carried out by the Applicant for the project identified that there is no significant risk of CO_2 leakage from the storage complexes, or of harm to the environment or human health. The risk assessment identified and evaluated the leak paths via which CO_2 can leave the subsurface storage complexes, and included a register itemising each foreseeable leak scenario, its associated risk levels and prevention and mitigation control measures. Of all the scenarios considered, loss of containment due to an in-field legacy well providing a leak path was judged the highest risk, but even so was judged “unlikely” once the project-specific prevention and mitigation measures are taken into account. All other scenarios were considered less likely, being ranked either “rare” or “practically non-credible”. The risk assessment took account of the Measurement, Monitoring and Verification plan (MMV) that will be implemented during operation.
In-combination effects of climate change with	Climate	**All phases** • In-combination effects will be assessed in the applicable topic chapters within the ES, through consideration of how climate

Potential Impact Scoped Out of EIA	Receptor	Reason for Scoping Effect out of the Assessment
other environmental impact pathways		change is likely to affect the future baseline environment and sensitivity of receptors, and it will not be duplicated within the scope of the climate change ES chapter.
Climate change risk to the Proposed Development and resilience/adaptation measures	The Proposed Development	**All phases** • Studies conducted from Liverpool Bay have shown that extreme wind and wave climates are not expected to change significantly from those that are currently exhibited in present day. Additionally, long-term analyses have illustrated that although there was a slight increase in the severity of most extreme events, there was little change in the extreme wave climate predicted for Liverpool Bay. • The Proposed Development will be re-using and refurbishing existing offshore infrastructure, and introducing a new offshore platform that have been designed for resilience to storms in Liverpool Bay and have been proven operationally. The design of refurbishment works to the sea-surface infrastructure will be to appropriate engineering and safety standards taking into account metocean data for this location. The pipeline and gas injection well are all undersea (and indeed under the seabed in the case of the sequestration volume) with minimal vulnerability to storm events.
All	Socio-economics	• Given the pre-existing nature of the development area, it is unlikely that there will be any potential effects and/or impacts resulting from the construction, operation and maintenance, and decommissioning of the development area as compared to those previously exhibited on offshore socio-economics in the area. • Specifically, the Proposed Development will not alter any current socio-economic opportunities within the vicinity of the development area, as the Proposed Development will utilise the existing Point of Ayr (PoA) terminal and plans on having unmanned OPs within the development area. Additionally, there will only be routine maintenance events and the majority of operations can be run through the onshore control room and terminal located at Point of Ayr.

5.9 References

British Standards Institute (BSI) (2015). *Environmental Impact Assessment for Offshore Renewable Energy Projects – Guide*.

Centre for Environment, Fisheries and Aquaculture Science (Cefas) (2012). *Guidelines for Data Acquisition to Support Marine Environmental Assessments of Offshore Renewable Energy Projects*. Available at: https://tethys.pnnl.gov/sites/default/files/publications/CEFAS_2012_Eenvironmental_Assessment_Guidance.pdf Accessed August 2023.

Chartered Institute of Ecology and Environmental Management (CIEEM) (2018) *Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine version 1.1. Chartered Institute of Ecology and Environmental Management, Winchester*. Available at: https://cieem.net/wp-content/uploads/2018/08/ECIA-Guidelines-2018-Terrestrial-Freshwater-Coastal-and-Marine-V1.2-April-22-Compressed.pdf Accessed August 2023.

Department for Business, Energy, and Industrial Strategy (BEIS) (2021a) *Draft overarching national policy statement for Energy (EN-1).* Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1015233/en-1-draft-for-consultation.pdf Accessed August 2023.

Department for Business, Energy, and Industrial Strategy (BEIS) (2021b) *Draft national policy statement for renewable energy infrastructure (EN-3).* Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1015236/en-3-draft-for-consultation.pdf Accessed August 2023.

Department for Business, Energy, and Industrial Strategy (BEIS) (2021c) *Draft National Policy Statement for Electricity Networks Infrastructure (EN-5).* Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1015238/en-5-draft-for-consultation.pdf Accessed August 2023.

Department for Business, Energy, and Industrial Strategy (BEIS) (2021d) *The Offshore Oil and Gas Exploration, Production, Unloading and Storage (Environmental Impact Assessment) Regulations 2020 – A Guide – Revision 03*. Available at: 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 Accessed August 2023.

Department of Energy and Climate Change (DECC) (2011a) *Overarching National Policy Statements for Energy (NPS EN-1).* Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/47854/1938-overarching-nps-for-energy-en1.pdf Accessed August 2023.

Department of Energy and Climate Change (DECC) (2011b) *National Policy Statement for Renewable Energy Infrastructure (NPS EN-3).* Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/47856/1940-nps-renewable-energy-en3.pdf Accessed August 2023.

Department of Energy and Climate Change (DECC) (2011c) *National Policy Statements for Electricity Networks Infrastructure (NPS EN-5).* Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/47858/1942-national-policy-statement-electricity-networks.pdf Accessed August 2023.

Eni (2021) *Eni for 2021 – Carbon neutrality by 2050.* Available at: https://www.eni.com/assets/documents/eng/just-transition/2021/eni-for-2021-carbon-neutrality-2050-eng.pdf Accessed August 2023.

Highways England, Transport Scotland, Welsh Government, Department for Infrastructure (2020) *Design Manual for Roads and Bridges (DMRB) LA 104, Environmental assessment and monitoring, Revision 1,* Available at: https://www.standardsforhighways.co.uk/search/0f6e0b6a-d08e-4673-8691-cab564d4a60a Accessed August 2023.

Institute of Environmental Management and Assessment (IEMA) (2016) *Environmental Impact Assessment Guide to: Delivering Quality Development.* IEMA, St Nicholas House, 70 Newport, Lincoln.

Institute of Environmental Management and Assessment (IEMA) (2017) *Delivering Proportionate EIA - A Collaborative Strategy for Enhancing UK Environmental Impact Assessment Practice.* IEMA, Lincoln.

Liverpool Bay CCS Limited (2022) *HyNet Carbon Dioxide Transportation and Storage Project - Offshore EIA Scoping Report*.

Natural England and JNCC (2022) *Nature conservation considerations and environmental best practice for subsea cables for English Inshore and UK offshore waters.*

Natural Resources Wales (NRW) (2023) Environmental Impact Assessment for marine activities. Available at: https://naturalresources.wales/permits-and-permissions/marine-licensing/environmental-impact-assessment/?lang=en Accessed August 2023.

Offshore Petroleum Regulator for Environment and Decommissioning (OPRED) (2023). *Scoping Opinion for HyNet Carbon Dioxide Transportation and Storage Project - Offshore*.

Ronconi, R.A., Allard, K.A. and Taylor, P.D., (2015) *Bird interactions with offshore oil and gas platforms: review of impacts and monitoring techniques.* Journal of Environmental Management, 147, pp.34-45.

The Planning Inspectorate (PINS) (2018) *Advice Note Nine: Rochdale Envelope.*

The Planning Inspectorate (PINS) (2019) *Advice Note Seventeen: Cumulative effects assessment relevant to nationally significant infrastructure projects.*

The Planning Inspectorate (PINS) (2020a) *Advice Note Seven: Environmental Impact Assessment: Preliminary Environmental Information, Screening and Scoping.*

The Planning Inspectorate (PINS) (2020b) *Advice Note Twelve: Transboundary Impacts and Process.*