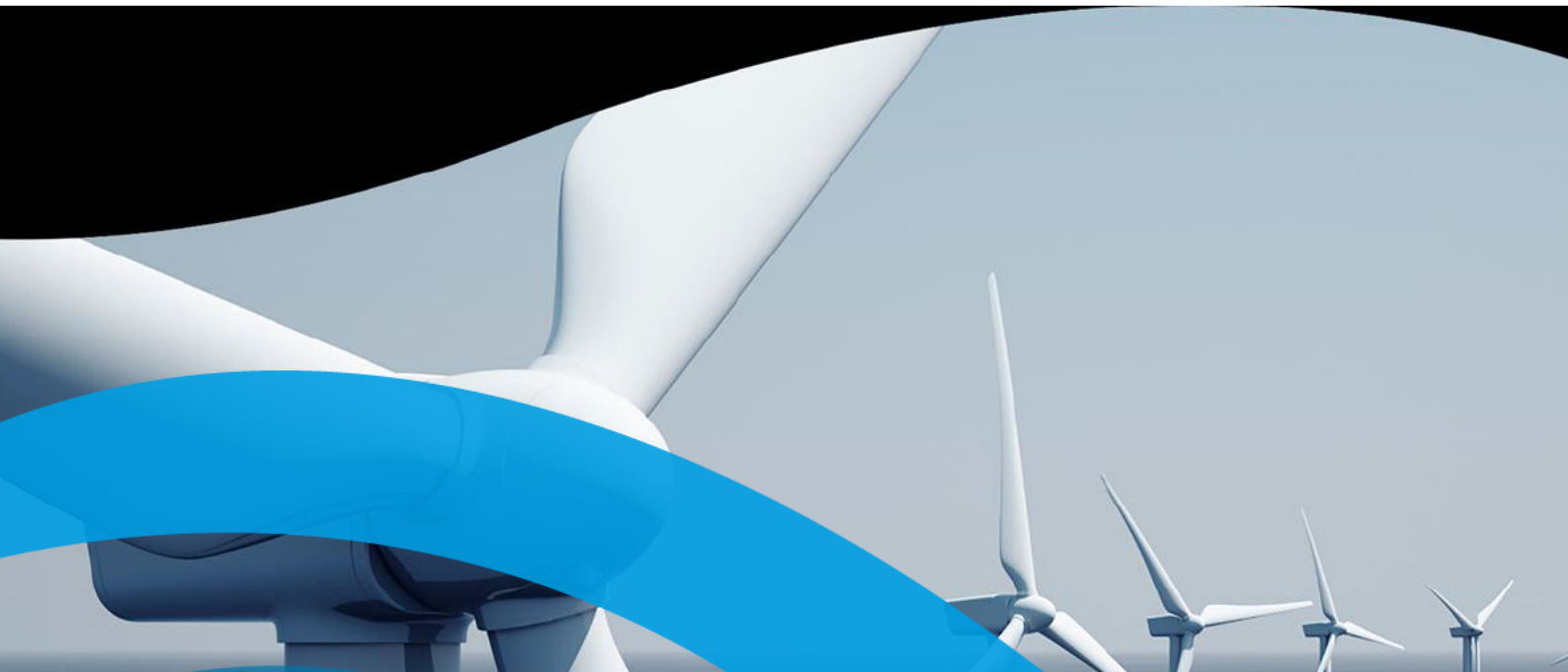
Muir Mhòr Offshore Wind Farm

Environmental Impact Assessment Report

Volume 2, Chapter 8: Marine Water and Sediment Quality



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Glossary

Term	Definition
Array Area	The area in which the generation infrastructure (including Wind Turbine Generators and associated foundations and inter-array cables), Offshore Electrical Platform(s), and an interconnector cable will be located.
Developer	Muir Mhòr Offshore Wind Farm Limited
EIA Regulations	Collectively the term used to refer to The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017, The Marine Works (Environmental Impact Assessment) Regulations 2007, and The Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2017.
Floating Foundations	The floating structures on which the wind turbine generators are installed.
Foundation anchors	The structures which anchor the Floating Foundations to the seabed, connected to the foundation mooring.
Horizontal Directional Drilling (HDD)	A method of cable installation where the cable is drilled beneath a feature without the need for trenching.
Inter-array cables	Cables which link the wind turbine generators to each other and the Offshore Electrical Platform(s).
Interconnector cable	Cable which links the Offshore Electrical Platforms to one another, allowing for power to be transferred between the platforms
Landfall	The area between Mean High Water Springs (MHWS) and Mean Low Water Springs (MLWS) where the offshore export cables are brought onshore.
Marine Water and Sediment Quality (MW&SQ)	The existing marine environmental characteristics, up to MHWS relating to: • Water quality (including physical parameters), Water Framework Directive (WFD) Protected Areas, Bathing Waters, Shellfish Water Protected Areas, Nutrient Sensitive Areas; • Sediment quality (including Particle Size Analysis and Total Organic Carbon); and • Sediment contamination (including Total Hydrocarbons, Polycyclic Aromatic Hydrocarbons, Polychlorinated Biphenyls, Polybrominated Diphenyl Ethers, Organochloropesticides, organotins and metals).
Offshore Electrical Platform (OEP)	Offshore platform consisting of High Voltage Alternating Current (HVAC) equipment, details depending on the final electrical set up of the Project.
Offshore Export Cable Corridor (ECC)	The area within which the offshore export cables will be installed.
Offshore export cables	The subsea electricity cable circuits running from the Offshore Electrical Platform(s) to the landfall which will transmit the electricity generated by the offshore wind farm to the onshore export cables for transmission onwards to the onshore substation and the national electrical transmission system along with auxiliary cables such as fibre optic cables.
Offshore transmission infrastructure	The proposed transmission infrastructure comprising: Offshore Electrical Platform(s) and associated foundations and substructures; the interconnector cable, the offshore export cables; and the landfall area up to Mean High Water Springs (MHWS).
Project	Muir Mhòr Offshore Wind Farm – comprises the wind farm and all associated offshore and onshore components.
Proposed Development	The offshore Muir Mhòr Offshore Wind Farm project elements to which this Offshore EIA Report relates.

Term	Definition
Wind Turbine Generators (WTG)	The wind turbines that generate electricity consisting of tubular towers and blades attached to a nacelle housing mechanical and electrical generating equipment.

Acronyms

Term	Definition
BERR	Department for Business Enterprise and Regulatory Reform
BGS	British Geological Survey
CAR	Controlled Activity Regulations
CEA	Cumulative Effect Assessment
Cefas	Centre for Environment, Fisheries and Aquaculture Science
CMS	Construction Method Statement
CoP	Construction Programme
CSEMP	Clean Seas Environmental Monitoring Programme
CSO	Combined Sewer Overflow
CTD	Conductivity, Temperature, Depth
d/s	Downstream
DO	Dissolved Oxygen
DP	Decommissioning Programme
DSLP	Development Specification and Layout Plan
E. Coli	Escherichia Coli
ECC	Export Cable Corridor
EEA	European Economic Area
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EMP	Environmental Management Plan
EQS	Environmental Quality Status
EU	European Union
FEPA	Food and Environment Protection Act
GES	Good Environmental Status
GPP	Guidance for Pollution Prevention
GW	Gigawatt
HAT	Highest Astronomical Tide
HDD	Horizontal Directional Drilling
HMWB	Heavily Modified Waterbody
ICCI	In-combination Climate Change Impact
ICES	International Council for the Exploration of the Sea
IE	Intestinal Enterococci
JUV	Jack Up Vessel
LSE	Likely Significant Effect
MAC	Maximum Allowable Concentration
MARPOL	International Convention for Prevention of Marine Pollution by Ships
MD-LOT	Marine Directorate - Licensing Operations Team
MDS	Maximum Design Scenario
MHWS	Mean High Water Springs

Term	Definition
MLWS	Mean Low Water Springs
MPA	Marine Protected Area
MSFD	Marine Strategy Framework Directive
MW&SQ	Marine Water and Sediment Quality
NMPi	National Marine Plan Interactive
NVZ	Nitrate Vulnerable Zone
OC	Organic Carbon
OEP	Offshore Electrical Platform
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic
OWF	Offshore Wind Farm
PAHs	Polycyclic Aromatic Hydrocarbons
PBDEs	Polybrominated Diphenyl Ethers
PCBs	Polychlorinated Biphenyls
PLONOR	Pose Little or No Risk
PSA	Particle Size Analysis
PSU	Practical Salinity Unit
RBMP	River Basin Management Plan
RIAA	Report to Inform Appropriate Assessment
SEPA	Scottish Environment Protection Agency
SFW	Shellfish Water
SPM	Suspended Particulate Matter
SSC	Suspended Sediment Concentration
SWD	Shellfish Water Directive
SWPA	Shellfish Water Protection Area
UK	United Kingdom
UKMMAS	United Kingdom Marine Monitoring Assessment Strategy
UKTAG	United Kingdom Technical Advisory Group
UV	Ultraviolet
UWWTD	Urban Wastewater Treatment Directive
WFD	Water Framework Directive
WODC	World Ocean Data Centre
WTG	Wind Turbine Generator
WWTP	Wastewater Treatment Plant

8. MARINE WATER AND SEDIMENT QUALITY

8.1. INTRODUCTION

8.1.1. Muir Mhòr Offshore Wind Farm Limited (hereafter referred to as 'the Developer') is proposing to develop the Muir Mhòr Offshore Wind Farm (hereafter 'the Project'). The Project is made up of both offshore and onshore components. The subject of this offshore Environmental Impact Assessment Report (EIAR) is the offshore infrastructure of the Project seaward of Mean High-Water Springs (MHWS) which is hereafter referred to as 'the Proposed Development'.

8.1.2. The Muir Mhòr Array Area covers an area of approximately 200 km^2 and is located approximately 63 km east of Peterhead on the east coast of Scotland. The offshore infrastructure of the Proposed Development includes Wind Turbine Generators (WTGs) and associated floating foundations, the Offshore Electrical Platform (OEP) and associated foundations, the inter-array cables, interconnector cable, offshore export cables and landfall.

8.1.3. This chapter of the EIAR has been prepared by GoBe Consultants Limited on behalf of the Developer and presents an assessment of the potential impacts and associated Likely Significant Effects (LSE) to Marine Water and Sediment Quality (MW&SQ) from the Proposed Development and discusses appropriate mitigation and monitoring as required to address any significant effects.

8.1.4. This EIAR is accompanied by a Report to Inform Assessment (RIAA) (Muir Mhòr Offshore Wind Farm Limited, 2024) which assesses LSE on designated European sites.

8.1.5. This chapter should be read alongside the following other chapters and technical appendices:

- Volume 2, Chapter 7 (Marine and Coastal Processes);
- Volume 2, Chapter 9 (Benthic Subtidal and Intertidal Ecology);
- Volume 2, Chapter 10 (Fish and Shellfish Ecology);
- Volume 2, Chapter 12 (Marine Mammals);
- Volume 3, Appendix 7.1 (Marine and Coastal Processes Technical Report);
- Volume 3 Appendix 7.2 (Marine Processes Modelling Report);
- Volume 3, Appendix 8.1 (Water Framework Directive Report); and
- Volume 3, Appendix 9.1 (Offshore Baseline Survey Reports).

8.1.6. This Chapter includes a summary of information contained in Volume 3, Appendix 8.1 (Water Framework Directive Report) which provides a detailed assessment of the potential impacts the Proposed Development could have on the relevant designated Water Framework Directive (WFD) waterbodies. In the absence of Scottish specific guidance, the WFD assessment follows the current Environment Agency's 'Clearing the Waters for All' guidelines (2023) to adequately assess the impact of the Proposed Development on the relevant coastal and transitional waters. The MW&SQ aspects of this assessment are summarised within this EIAR chapter.

8.1.7. This Chapter refers to the design of the Proposed Development as described in Volume 1, Chapter 3 (Project Description) of the EIAR.

8.2. PURPOSE OF THE CHAPTER

8.2.1. The primary purpose of the EIAR is defined in Volume 1, Chapter 1 (Introduction).

8.2.2. The key objective of this Chapter is to provide Scottish Ministers and statutory and non-statutory stakeholders the information required to assess for LSE on MW&SQ. This assessment will consider those effects from the Proposed Development in isolation, and also cumulative effects (the effects of the Proposed Development combined with the effects from other plans and projects).

8.2.3. This Chapter presents the following:

- A detailed description of current environmental baseline conditions relevant to MW&SQ receptors. These have been established from desk-based studies, site-specific surveys, numerical modelling studies, and consultation with stakeholders;
- Discussion of assumptions and any limitations with respect to the information used to define the baseline;
- Identification of potential impacts and any resulting LSE upon MW&SQ receptors related to Proposed Development activities. This process is informed by the application of embedded commitments;
- Consideration of the need for any 'secondary' mitigation measures (in addition to embedded commitments) to avoid, minimise, reduce, or offset LSE upon MW&SQ from the Proposed Development;
- Consideration of any residual effects following application of secondary mitigation; and
- Identification of monitoring measures to support proposed mitigation.

8.3. LEGISLATION AND POLICY CONTEXT

8.3.1. Overarching legislation, policy, and guidance in relation to the EIAR for the Proposed Development is provided in Volume 1, Chapter 2: (Legislation and Policy) of the EIAR. Below is provided a summary of legislation, policy, and guidance directly relevant to MW&SQ.

LEGISLATION AND POLICY

8.3.2. All legislation directly applicable to MW&SQ is presented in Table 8-1, with all applicable policy presented in Table 8-2.

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Table 8-1 Legislation relevant to MW&SQ

Legislation	Summary	How Chapter has considered this
The Bathing Waters (Scotland) Regulations 2008 (as amended)	Formerly designated under the Bathing Water Directive (76/160/EEC), these waters are now covered by the revised Bathing Water Directive (rBWD) (2006/7/EC) which are transposed into Scottish law through the Bathing Waters (Scotland) Regulations 2008 (as amended. The rBWD has four different classifications of performance, these are: • Excellent – the highest, cleanest classification; • Good – generally good water quality; • Sufficient – the water meets minimum standards; and • Poor – the water has not met the minimum required stands. Under these Regulations, local authorities measure and monitor the number of certain types of bacteria which may indicate the presence of pollution, mainly from sewage or animal faeces, these are *Escherichia coli* (*E. coli*) and intestinal enterococci (IE). An increase in the concentrations of these bacteria indicates a decrease in water quality. The Scottish Environmental Protection Agency (SEPA) is responsible for compiling Bathing Waters information. . Five successive poor classifications will result in permanent advice against bathing being displayed at the relevant Bathing Water.	A description of the baseline water quality is provided in Section 8.5 of this EIAR including the current and historical classification of the relevant Bathing Waters. An assessment of the potential impacts of the Proposed Development upon Bathing Waters is presented in Section 8.7.
The Environmental Authorisations (Scotland) Regulations 2018	The Environmental Authorisations (Scotland) Regulations 2018 aim to deliver an integrated authorisation framework which will integrate the authorisation, procedural and enforcement arrangement relating to water, waste management, radioactive substances and pollution prevention and control. SEPA must ensure that all appropriate measures are taken to prevent or, where that is not practicable, to minimise environmental harm; to prevent and to limit the consequences of accidents which could have an impact on the environment and to use resources in a sustainable way. These aims apply to operation and decommissioning of regulated activities and following cessation of the carrying on of the regulated activity.	Development of and adherence to an Environmental Management Plan (EMP). This will set out mitigation measures and procedures relevant to environmental management, including but not limited to chemical usage, invasive and non-native species, pollution prevention and waste management.as set out in commitment C-08 of Volume 3, Appendix 6.1 (Commitments Register).

Legislation	Summary	How Chapter has considered this
The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended)	The Controlled Activity Regulations (CAR) arose from the European Union (EU) Water Framework Directive (WFD) 2000/60/EC in 2011. The regulations provide a regulatory framework for controlling activities which could have an adverse effect on Scotland's water environment. The regulations, as amended, cover rivers, lochs, transitional waters (estuaries), coastal waters, groundwater and groundwater dependent wetlands.	The quality and classification of Scotland's water environment relevant to the Proposed Development is considered with Section 8.5 of this chapter.
The Water Environment (Shellfish Water Protected Areas: Environmental Objectives etc.) (Scotland) Regulations 2013	The Water Environment (Shellfish Water Protected Areas (SWPAs): Environmental Objectives etc.) (Scotland) Regulations 2013 replaced the Shellfish Waters Directive. The regulations aim to prevent deterioration of the shellfish water (SFW) quality of each Shellfish Water Protected Area (SWPA) and protect and improve each SWPA with the aim of achieving good SFW quality by 2015. The directions specified in the legislation were subsequently updated following consultation by Scottish Government in 2021 (revoking the 2015 version), and published in the Scotland River Basin District (Quality of Shellfish Water Protected Areas) (Scotland) Directions 2021, and The Water Environment (Shellfish Water Protected Areas: Objectives and Classification etc.) (Solway Tweed) Directions 2021. These updated regulations direct the SEPA on how to assess and classify the quality of SWPAs for the Scotland River Basin District.	A description of the baseline water quality is provided in Section 8.5 of this chapter including the SWPAs in proximity to the Proposed Development.
Water Environment and Water Services (Scotland) Act 2003	This legislation covers rivers, lochs, transitional waters (estuaries), coastal waters groundwater, and groundwater dependent wetlands with the primary aim of protecting and improving the ecological status of the water environment whilst also supporting social and economic interests.	The relevant waterbodies relating to this legislation and the Proposed Development are incorporated within Section 8.5. A separate WFD assessment is presented in Volume 3, Appendix 8.1 (Water Framework Directive Report) to address this legislation

Legislation	Summary	How Chapter has considered this
Action Programme for Nitrate Vulnerable Zones (Scotland) Regulations 2008 (as amended)	The Action Programme for Nitrate Vulnerable Zones (Scotland) Regulations 2008 (as amended) aims to reduce water pollution from agricultural sources. Nitrate Vulnerable Zones (NVZs) are designated across Scotland where concentrations of nitrate in water exceed or are likely to exceed the levels set in the Directive. In designated NVZs there are mandatory rules enforced to reduce the nitrate pollution from agricultural land, protecting vulnerable resources against water pollution. Currently there are five NVZs in Scotland, one of which coincides with the study area. The Moray, Aberdeenshire/Banff and Buchan NVZ incorporates the proposed landfall location.	A description of the baseline water quality is provided in Section 8.5 of this chapter including the relevant NVZs to the Proposed Development.
The Urban Waste Water Treatment (Scotland) Regulations 1994 (as amended)	The Urban Waste Water Treatment (Scotland) Regulations 1994, as amended, enhance the regulatory framework governing the treatment of urban wastewater in Scotland. These regulations are part of Scotland's efforts to comply with the EU Urban Waste Water Treatment Directive (91/271/EEC). They set standards and requirements for the collection, treatment, and discharge of urban wastewater to protect water quality and public health.	The relevant waterbodies relating to the UWWTD and the Proposed Development are incorporated within Section 8.5.
The Marine Strategy Regulations 2010	The Marine Strategy Regulations 2010 implement the requirements of the EU Marine Strategy Framework Directive 2008/56/EC in the United Kingdom. These regulations establish a framework for the sustainable management of Scotland's marine environment, aiming to achieve Good Environmental Status (GES) of marine waters by 2020 (and afterwards). The Scottish Ministers are responsible for ensuring compliance with these regulations, in coordination with other UK administrations and stakeholders, to protect and preserve the marine environment.	A description of the baseline water quality is provided in Section 8.5 of this chapter including the current classifications of waterbodies in relation to the Proposed Development.
Pollution Prevention and Control (Scotland) Regulations 2012	These Regulations provide an integrated pollution control regime for Scotland for the purposes of implementing Directive 2010/75/EU of the European Parliament and of the Council on industrial emissions and of regulating other environmentally polluting activities not covered by the Industrial Emissions Directive. They designate the Scottish Environment Protection Agency (SEPA) as the competent authority for the purposes of the Industrial Emissions Directive and provide for applications for permits and make general provision as to granting of permits including the conditions that SEPA may include in a permit. The	Consideration has been given in Section 8.5 to the quality of sediment within the Proposed Development and including the sediment characterisation, composition, particle size analysis and the associated contaminants that may theoretically cause harm to the MW&SQ environment if/when they are released at sea into the water column. Commitment C-08 of Volume 3, Appendix 6.1 (Commitments Register) also considers pollution prevention

Legislation	Summary	How Chapter has considered this
	regulations state a list of polluting substances for water that must be considered including (but not limited to), their compounds, arsenic and its compounds, materials in suspension persistent hydrocarbons etc.	and waste management.
Water Framework Directive (WFD) 2000/60/EC	The WFD establishes a comprehensive regulatory framework for the sustainable management and protection of surface waterbodies (including rivers, lakes, coasts and estuaries) and groundwater. Waterbody classification is based on two categories: ecological and chemical status. For a waterbody to achieve an overall good status, both its ecological and chemical status must be at least good. Ecological status is determined by evaluating biological, hydromorphological, physico-chemical, and specific chemical parameters. The ecological status is classified as either high, good, moderate, poor, or bad.	The relevant waterbodies relating to this legislation and the Proposed Development are incorporated within Section 8.5. The WFD assessment for the Proposed Development is presented in Volume 3, Appendix 8.1 (Water Framework Directive Report) to address this legislation.
EU Environmental Quality Standards Directive (2008/105/EC) Subsequently amended: Directive (2013/39/EU)	The Environmental Quality Standards Directive (2008/105/EC), also known as the EQSD, sets out quality standards for waterbodies across the European Union to protect aquatic environments and human health. These standards are in line with the strategy and objectives of the European Union (EU)'s water framework directive (Directive 2000/60/EC). Within this directive, there are two key terms related to the assessment of pollutants in surface/ coastal waters: • Annual Average - refers to the average concentration of a particular pollutant over the course of a year; and • Maximum Allowable Concentration (MAC) - refers to the highest concentration of a particular pollutant that is allowed in surface water at any given time.	The relevant quality standards are applied throughout Section 8.5 for water and sediment quality parameters.
EU Bathing Waters Directive 2006/7/EC	The EU's revised Bathing Water Directive (rBWD) (2006/7/EC) came into force in March 2006, replacing the previous Bathing Water Directive (76/160/EEC). The directive requires member states to identify and designate Bathing Waters, monitor them for specified microbiological parameters, and classify them based on water quality standards. The rBWD establishes more stringent standards and places an emphasis on providing information to the public.	A description of the baseline water quality is provided in Section 8.5 of this chapter including the current and historical classification of the relevant Bathing Waters. An assessment of the potential impacts of the Proposed Development upon Bathing Waters is presented in Section 8.7.

Legislation	Summary	How Chapter has considered this
EU Marine Strategy Framework Directive (MSFD) 2008/56/EC	The objective of the MSFD was to achieve Good Environmental Status (GES) of the EU's marine waters by 2020, now extended to 2024, and beyond. It establishes a framework for the protection and sustainable use of Europe's seas, ensuring they remain healthy and resilient for current and future generations. Key objectives include reducing marine pollution, protecting biodiversity, promoting sustainable fishing, and mitigating the impacts of human activities on marine ecosystems.	An assessment of whether potential impacts from the Proposed Development will impact the receptor's ability to meet GES is provided in Section 8.7.
EU Nitrates Directive 91/676/EEC	The Nitrates Directive (91/676/EEC) aims to protect water quality from agricultural pollution by regulating the use of nitrates. The directive requires member states to designate Nitrate Vulnerable Zones (NVZs) where agricultural practices contribute to nitrate pollution of waters. It mandates the development and implementation of action programs that include measures to reduce nitrogen pollution from agricultural sources. Member states must monitor and report on water quality in NVZs, ensuring compliance with set standards and promoting sustainable agricultural practices.	A description of the baseline water quality is provided in Section 8.5 of this chapter including the relevant NVZs to the Proposed Development.
EU Urban Waste Water Treatment Directive (UWWTD) 91/271/EEC	The Urban Waste Water Treatment Directive (UWWTD) aims to safeguard the environment from the negative impacts associated with the collection, treatment, and discharge of urban wastewater. Under the UWWTD, 'sensitive areas' refer to waterbodies affected by elevated nitrate concentrations or eutrophication, signaling the need for targeted measures to prevent further nutrient-related pollution.	The relevant waterbodies relating to the UWWTD and the Proposed Development are incorporated within Section 8.5.
International Convention for Prevention of Marine Pollution by Ships (MARPOL)	MARPOL is the main international convention regarding prevention of pollution of the marine environment by ships from operational or accidental causes. The MARPOL Convention was adopted in 1973 and has subsequently been amended.	The commitments register sets out mitigation measures and procedures relevant to environmental management, including but not limited to chemical usage, invasive and non-native species, pollution prevention and waste management through C-08 of Volume 3, Appendix 6.1 (Commitments Register).

Table 8-2 Policy relevant to MW&SQ

Policy	Summary	How/Where Chapter has considered this
Scotland's National Marine Plan (2015) – GEN 1 General planning principle	States "There is a presumption in favour of sustainable development and use of the marine environment when consistent with the policies and objectives of this Plan." This principle is relevant to all marine activities but especially relevant for the key growth sectors which Scotland specializes in, such as renewable energy activities.	Consideration to this policy has been given throughout the EIAR process in relation to the impacts of the Proposed Development on the marine environment. Sustainable development of the Proposed Development aims to protect and enhance Scotland's marine environment, of which both water and sediment quality are critical indicators.
Scotland's National Marine Plan (2015) – GEN 12: Water quality and resource	States "Developments and activities should not result in a deterioration of the quality of waters to which the Water Framework Directive, Marine Strategy Framework Directive or other related Directives apply."	A description of the baseline water quality is provided in Section 8.5 of this EIAR including the WFD waterbodies in proximity to the Proposed Development. An assessment of the potential deterioration of MW&SQ receptors has been undertaken in Sections 8.7 and 8.9 for the Proposed Development alone and cumulatively, respectively A separate WFD assessment is presented in Volume 3, Appendix 8.1 (Water Framework Directive) to address this policy.
Scotland's National Marine Plan (2015) – GEN 21 Cumulative Impacts	States "Cumulative impacts affecting the ecosystem of the marine plan area should be addressed in decision making and plan implementation."	This policy is addressed within Section 8.9 of this EIAR.
Sectoral Marine Plan for Offshore Wind Energy	Effects on water quality, sediments and ecological status are identified as potential negative impacts (relevant to MW&SQ) that will require further consideration at project-level.	The effects on water quality, sediments and ecological status are assessed for the Proposed Development alone and cumulatively in Section 8.7 and 8.9
The River Basin Management Plan (RBMP) for Scotland 2021 – 2027	The RBMP for Scotland 2021-2027 outlines strategies and actions to protect and improve the water environment across Scotland. The plan aims to achieve good ecological and chemical status by 2027, in line with the WFD.	The baseline conditions of the Proposed Development are considered within Section 8.5 of this EIAR The assessment considered within Section 8.7 details how the Proposed Development may affect the achievement of these goals.

Policy	Summary	How/Where Chapter has considered this
United Kingdom (UK) Marine Policy Statement (MPS)	The MPS is the framework for preparing Marine Plans and taking decisions affecting the marine environment. The MPS emphasises the need to protect and conserve marine ecosystems, habitats, and species including water quality and sediment movement considerations.	Consideration is given to this policy throughout the EIAR process in relation to the impacts of the Proposed Development on the marine environment. The assessment considered within Section 8.7 ensures the Proposed Development will not negatively impact the water and sediment quality aspects of the marine ecosystems.

GUIDANCE

8.3.3. All guidance directly applicable to MW&SQ is detailed below:

- Scottish Environment Protection Agency (SEPA), Northern Ireland Environment Agency (NIEA), and Natural Resources Wales (NRW): Guidance for Pollution Prevention (GPP);
  - Works and maintenance in or near water: GPP 5 (SEPA, NIEA and NRW, 2018a)
  - Pollution incident response planning: GPP 21 (SEPA, NIEA and NRW, 2021);
  - Dealing with spills: GPP 22 (SEPA, NIEA and NRW, 2018b);
- 'Pre-disposal Sampling Guidance. Version 2 Marine Scotland (2017d);
- Supporting Guidance (WAT-SG-53) Environmental Quality Standards and Standards for Discharges to Surface Waters (SEPA, 2020); and
- Clearing the Waters for All guidance (Environment Agency, 2023).

8.4. CONSULTATION

8.4.1. Ongoing statutory and non-statutory consultation and incorporation of feedback is an integral part of developing a robust EIAR. The Offshore Scoping Report (Volume 3, Appendix 5.1 (Offshore Scoping Report)) for the Proposed Development was submitted to the Marine Directorate – Licensing Operations Team (MD-LOT) in June 2023. MD-LOT issued a detailed response to the Scoping Report's content in the September 2023 Scoping Opinion (Volume 3, Appendix 5.2 (Offshore Scoping Opinion)), covering its own opinion on the Scoping Report as well as the statutory and non-statutory consultees' advice on each topic.

8.4.2. A summary of the stakeholder consultation activities specific to MW&SQ are provided in Table 8-3. The issues raised and actions to address and incorporate this feedback into the EIAR are also outlined.

8.4.3. Further detail on the Proposed Development's overall Environmental Impact Assessment (EIA) stakeholder consultation process and subsequent actions is presented in Volume 1, Chapter 5 (Consultation) of this EIAR.

Table 8-3 Consultation Relevant to MW&SQ

Date	Consultee and Type of Consultation	Description/ Issues Raised	How this has been considered in this Chapter
September 2023	MD-LOT – Scoping Opinion	The Scottish Ministers are content with the baseline data sources regarding water and sediment quality used by the Developer in Section 7.3 of the Scoping Report.	The baseline data sources set out in the Offshore Scoping Report have been utilised alongside additional sources including site specific surveys to expand and detail the existing baseline in Section 8.5.
September 2023	MD-LOT – Scoping Opinion	The Scottish Ministers welcome the consideration of blue carbon as noted in Section 7.4.34 of the Scoping Report and that a full blue carbon assessment will be undertaken.	Section 8.5 of this chapter presents elements of the existing baseline specifically related to blue carbon and MW&SQ A Blue Carbon assessment is provided within Annex A of this chapter
September 2023	MD-LOT – Scoping Opinion	In Table 7-8 of the Scoping Report the Developer summarises the potential impact on water and sediment quality during the different phases of the Proposed Development. The Scottish Ministers agree with this approach. The Scottish Ministers also agree with the impacts scoped in and out of the EIA Report and provide no further comments.	Noted.
September 2023	MD-SEDD – Scoping Opinion and Consultation and Responses Advice	MD-SEDD suggested temperature, salinity and density profiles should be included in relation to stratification and frontal features.	Section 8.5 includes conductivity, temperature, depth (CTD) profile information from EGS (2023b) to characterise the water column. Stratification and frontal features are assessed in further detail within Volume 2, Chapter 7 (Marine and Coastal Processes) and Volume 3, Appendix 7.1 (Marine and Coastal Processes Technical Report).

8.5. BASELINE ENVIRONMENT

8.5.1. This section presents a summary of the MW&SQ baseline environment study area, the methodology, baseline conditions and limitations and assumptions of the data used. The supporting analysis undertaken to develop this baseline is provided in Volume 3, Appendix 7.2 (Marine Processes Modelling Report).

STUDY AREA

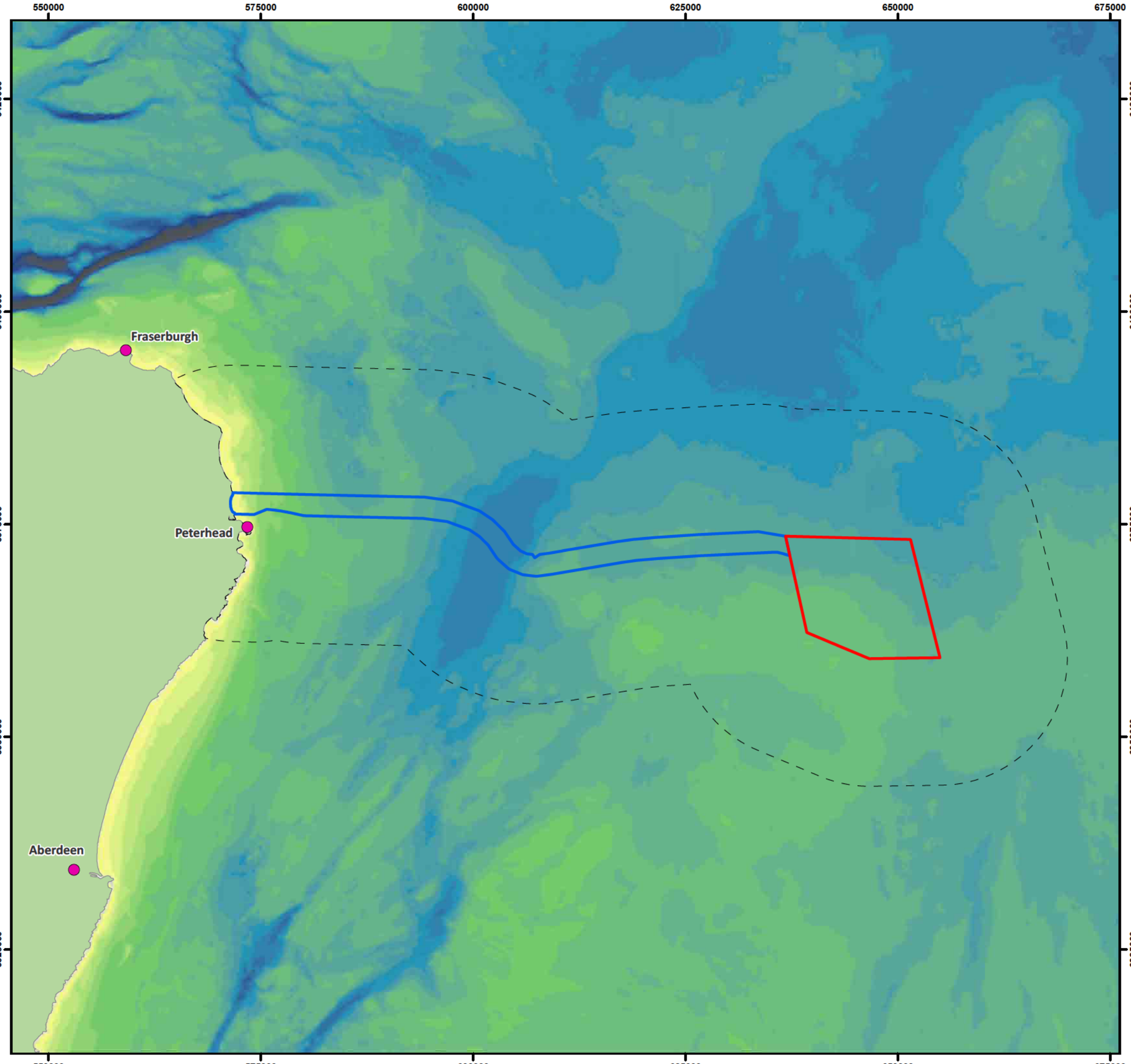
8.5.2. The MW&SQ study area is shown in Figure 8-1 and includes the following:

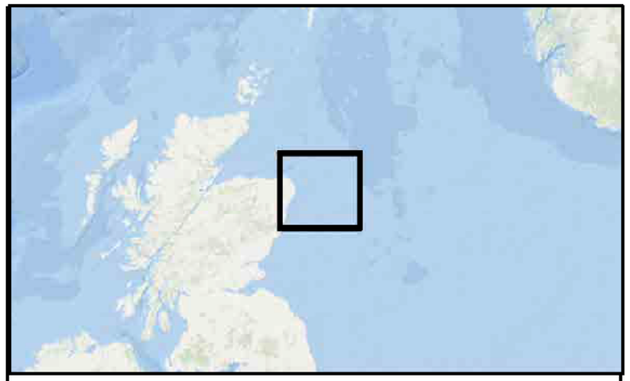
- Array Area including Wind Turbine Generators (WTGs), associated foundations, inter-array cables, interconnector cable and the location of OEP(s);
- Offshore Export Cable Corridor (ECC) from the OEP(s) to landfall;
- Intertidal area between MHWS and Mean Low Water Springs (MLWS); and
- Areas that may be impacted by changes in MW&SQ including the receptors identified within paragraph 8.6.7 and assessed throughout Section 8.7.

8.5.3. The study area, illustrated in Figure 8-1, has been used to identify MW&SQ receptors which have the potential to be affected by both the Proposed Development activities and infrastructure. The study area has been defined using outputs from project specific numerical modelling (Volume 3, Appendix 7.2 (Marine Processes Modelling Report). The study area is scaled conservatively to represent the equivalent distance of a mean spring tidal excursion. Consequently, the study area comprises a distance of 15 km from the limit of the Proposed Development, encapsulating the maximum dispersion of measurable sediment plumes.

8.5.4. In this MW&SQ report, the following elements are included:

- Water quality (including surface temperature, salinity, dissolved oxygen and suspended sediment concentration);
- Sediment quality (including sediment type, and sediment contamination); and
- WFD Designated Waterbodies and Protected Areas (including coastal and transitional waterbodies, Bathing Waters, SFWs and Nutrient Sensitive Areas).





Legend:

- Array Area
- Offshore Export Cable Corridor
- MW&SQ Study Area

Depth (m)

0 - 10	100 - 110
10 - 20	110 - 120
20 - 30	120 - 130
30 - 40	130 - 140
40 - 50	140 - 150
50 - 60	150 - 160
60 - 70	160 - 170
70 - 80	170 - 180
80 - 90	180 - 190
90 - 100	190 - 200
	>200

Project:	Report:
Muir Mhòr	Environmental Impact Assessment Report

The MW&SQ Study Area

Figure: 8-1	Drawing No: GoBe-0124		
Revision:	Date:	Drawn:	Checked:
01	29/08/24	[Redacted]	

Map scale 1:450,000 @ A3

0 5 10 km

Co-ordinate system: ETRS 1989 UTM Zone 30N **EPSG:** 25830

MUIR MHÒR OFFSHORE WIND FARM

A joint venture between Fred. Olsen Seawind & Vattenfall

Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

METHODOLOGY

8.5.5. Baseline data to inform the MW&SQ assessment was collected using the following methods:

DESKTOP STUDY

8.5.6. For the purposes of this MW&SQ Chapter, a desk-based review was undertaken using relevant spatial and scientific data sources. These existing data sets and literature encompassing the Proposed Development study area, are presented in Table 8-4.

SITE-SPECIFIC SURVEYS

8.5.7. Site-specific surveys were also carried out to collect data to inform assessment of the MW&SQ environment. These surveys are detailed in Table 8-5 and presented Volume 3, Appendix 9.1 (Offshore Baseline Survey Reports) for the Array Area, offshore ECC and intertidal area. The aspects of specific relevance to this MW&SQ chapter include sediment characterisation, specifically Particle Size Analysis (PSA) and sediment contaminants in relation to sediment quality. Surveys relating to water quality include a multi-parameter seawater profiler providing up and downcast water column profiles including conductivity, temperature, depth (CTD), Dissolved Oxygen (DO), pH and turbidity.

8.5.8. Preliminary geophysical and environmental surveys were undertaken by EGS in 2023 and the output presented within Volume 3, Appendix 9.1 (Offshore Baseline Survey Reports):

- Environmental baseline report 'Offshore Wind Farm (OWF)': includes PSA from 49 grab sampling locations, including contaminant analysis of assorted hydrocarbons, endocrine disruptors, heavy and trace metals from nine locations across the Array Area; and
- Environmental baseline report 'ECC and intertidal': includes PSA from 52 grab sampling locations (15 intertidal and 37 subtidal), including contaminant analysis of assorted hydrocarbons, endocrine disruptors, heavy and trace metals from seven locations in both the intertidal and subtidal aspects of the offshore ECC.

MODELLING

8.5.9. Sediment plume modelling was conducted by Port and Coastal Solutions Ltd in support of this chapter to assess changes in Suspended Sediment Concentration (SSC) and associated sediment deposition in relation to the Proposed Development area. The modelling results are provided in Volume 3, Appendix 7.2 (Marine Processes Modelling Report) of this EIAR. The numerical models used in the EIAR cover the northern North Sea, seaward of the east Scottish coast using the MIKE software suite developed by the Danish Hydraulic Institute. The MIKE suite comprises hydrodynamic, spectral wave, and particle tracking modules, enabling the simulation of all relevant coastal processes. Of particular relevance to MW&SQ, the report presents sediment disturbance from construction from various sources including:

- Export cable installation;
- Inter-array cable installation;
- Horizontal Directional Drilling (HDD); and
- Foundation installation.

Table 8-4 Key Sources of MW&SQ Literature and Data

Source, Author, and Year	Summary	Coverage of Proposed Development Study Area
SEPA (2021/2022), 'Bathing Waters results for Scotland'. https://www2.sepa.org.uk/bathingwaters/Locations.aspx	SEPA monitors the water quality for the designated Bathing Waters in Scotland, through an annual sampling programme (running from 15 May to 30 September). Bathing Water profiles are provided online, giving a more detailed insight into the current status of individual Bathing Waters.	Bathing Water samples are taken annually, with samples from the vicinity of the landfall area within the study area. Partial coverage of the study area including Peterhead (Lido) and Cruden Bay designated Bathing Waters.
SEPA (2020), Water Classification Hub'. https://www.sepa.org.uk/data-visualisation/water-classification-hub//	SEPA provides an interactive mapping feature which presents the status of various quality elements for waterbodies in Scotland (e.g., surface waters, groundwaters, and protected areas).	Water quality elements of relevance to the offshore ECC and landfall areas. Partial coverage of the study area including Peterhead (Lido) and Cruden Bay designated Bathing Waters, Cruden Bay, Buchan Ness to Cruden Bay, Ugie Estuary to Buchan Ness and Cairnbulg Point to Ugie Estuary coastal waterbodies and Ugie Estuary transitional waterbody.
Scottish Government (2019), 'Shellfish Water Protected Areas: Maps'. https://www.gov.scot/publications/shellfish-water-protected-areas-maps/	Maps produced by the Scottish Government, presenting the designated SWPAs in Scottish waters. These waters are designated under the Water Environment and Water Services Act 2003.	Designated waterbodies under the SWD, of relevance to the offshore ECC and landfall areas. Partial coverage of the study area with the nearest SWPA being within the Inner Moray Firth.
Department for Environment, Food and Rural Affairs (Defra) (2012),"Waste Water Treatment in the United Kingdom- 2012. Implementation of the European Union Urban Waste Water Treatment Directive- 91/271/EEC'. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69592/pb13811-waste-water-2012.pdf	This report provides an overview of the various sensitive waters in Scottish territorial and inshore limits. This data is caveated that maps produced reflected the spatial data reporting and submission guidelines, as opposed to legal designations.	The various 'designated' waterbodies of relevance to the offshore ECC and landfall areas. Partial coverage of the study area including bathing and shellfish waters,
SEPA (2019), Urban Waste Water Treatment Directive (UWWTD) Sensitive Areas'.	A map produced by SEPA showing all the Scottish waters designated as sensitive to the	Waterbodies designated under the UWWTD, of relevance to the offshore ECC and landfall

Source, Author, and Year	Summary	Coverage of Proposed Development Study Area
https://www.gov.scot/binaries/content/documents/govscot/publications/map/2016/01/urban-waste-water-treatment-sensitive-areas-map/documents/urban-waste-water-treatment-sensitive-areas-map-2019/urban-waste-water-treatment-sensitive-areas-map-2019/govscot%3Adocument/UWWTD%2BDesignations%2B2019.pdf	effects of sewage discharges, under the Urban Waste Water Treatment (Scotland) Regulations.	areas. Partial coverage of the study area including bathing and shellfish waters and estuaries.
Scottish Government and SEPA (2021), 'Welcome to the 2021 Update to the Water Environment Hub'. https://informatics.sepa.org.uk/RBMP3/	A report previously produced by SEPA and the Scottish Government described the function of the third River Basin Management Plan (RBMP) for Scotland. The data underpinning this report (and the full written report) is available on the interactive Water Environment Hub of the SEPA webpage.	The RBMPs of relevance to the Proposed Development. Partial coverage of the study area including Peterhead (Lido) and Cruden Bay designated Bathing Waters, Cruden Bay, Buchan Ness to Cruden Bay, Ugie Estuary to Buchan Ness and Cairnbulg Point to Ugie Estuary coastal waterbodies and Ugie Estuary transitional waterbody.
(National Marine Plan interactive (NMPi) (2017), Mean Monthly Sea Surface Temperature and Salinity'. https://marine.gov.scot/maps/72, https://marine.gov.scot/maps/74	This data is available on the NMPi, denoting the salinity and sea surface temperature of the Scottish Continental Shelf areas of the North Sea.	The salinity and sea surface temperature of waters relevant to the Proposed Development. Full coverage of the study area
UK Marine Monitoring and Assessment Strategy (UKMMAS) community (2010), https://tethys.pnnl.gov/publications/charting-progress-2-assessment-state-uk-seas	In 2005, the UK Government and Devolved Administrations published 'Charting Progress', which was an overall assessment of the current state of UK seas. In 2010, 'Charting Progress 2' was published, which built upon the original report and set out a more structured and coordinated approach on assessing UK seas.	The report is general and covers the UK seas, so applies to the entirety of the Array Area and offshore ECC. Full coverage of the study area
OSPAR Conventions Commission (2017), 'Intermediate Assessment 2017- Contaminants'. https://oap-cloudfront.ospar.org/media/filer_public/0a/7f/0a7faa75-6817-4553-afdc-c617ab587339/p00712_cemp_rollover_assessment_2017.pdf	OSPAR produced a report in 2017 to assess the current status of the north-east Atlantic. This assessment considered sediment contamination from various chemical compounds, such as polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs).	Assessments considered covered the Northern North Sea, which the Array Area and offshore ECC are located entirely within. Full coverage of the study area.

Source, Author, and Year	Summary	Coverage of Proposed Development Study Area
Marine Scotland (2019), Contaminant and Biological Effect Data 1999-2019 for the National Performance Framework Clean Seas Indicator 2020'. https://data.marine.gov.scot/dataset/contaminant-and-biological-effect-data-1999-2019-national-performance-framework-clean-seas	The UK has a long-term environmental monitoring dataset, which details various measures of contamination in UK waters (e.g., sediment contaminants, biological effects data). This dataset provides records from as early as 1999 and was last updated following the 2018 assessment for the UK's CSEMP.	This dataset covers Scottish offshore waters which encapsulates the Proposed Development within the 'East Scotland Coast' and 'Forties' monitoring regions of the data set. Full coverage of the study area
Cefas (2016), Suspended Sediment Climatologies Around the UK'. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/584621/CEFAS_2016_Suspended_Sediment_Climatologies_around_the_UK.pdf	Cefas produced this report to support the Offshore Energy Strategic Environmental Assessment (OESEA3). The report provides background on the spatial and temporal variations in suspended sediment concentrations around the UK.	The report is general and covers the UK seas, so applies to both the Array Area and offshore ECC. Full coverage of the study area.

Table 8-5 Site-Specific Surveys undertaken to inform MW&SQ

Survey	Summary	Coverage of Proposed Development Study Area
Muir Mhòr, Environmental Baseline Report OWF (LOT 1), (EGS), 2023a. Volume 3, Appendix 9.1 (Offshore Baseline Survey Reports)	Analysed geophysical and benthic data for the Array Area including PSA and contamination levels of surficial sediments in the Array Area.	Partial coverage of the study area restricted to the Array Area alone.
Muir Mhòr Environmental Baseline Report ECC and Intertidal (LOT 2 & LOT 3) (EGS), 2023b Volume 3, Appendix 9.1 (Offshore Baseline Survey Reports)	Analysed geophysical and benthic data for the offshore ECC, including particle size analysis and contamination levels of surficial sediments. Presents CTD data for the nearshore ECC.	Partial coverage of the study area restricted to the offshore ECC and intertidal area.
Muir Mhòr, Operations Report LOT 3 – Intertidal Environmental Survey. Volume 3, Appendix 9.1 (Offshore Baseline Survey Reports)	Characterised the environmental aspects of the intertidal area at the offshore ECC landfall, including sediment sampling for PSA and contamination and shore inspections.	Partial coverage of the study area restricted to the intertidal area at the offshore ECC landfall.

DESCRIPTION OF BASELINE ENVIRONMENT

8.5.10. A description of the baseline environment relevant to MW&SQ is provided in the following sections of this chapter.

WATER QUALITY

8.5.11. The physical characteristics of the study area are presented within this MW&SQ chapter, informing the baseline characterisation. The physical characteristics described include temperature, salinity, and dissolved oxygen concentrations and suspended sediment concentrations (SSC). Collating this data allows for a thorough baseline characterisation to be made, as well as a determination as to whether the Proposed Development has the potential to affect the physical MW&SQ characteristics of the study area itself.

TEMPERATURE AND SALINITY

8.5.12. Two of the most important characteristics of seawater are temperature and salinity – together they determine the density and subsequently the vertical movement of the water column. These parameters are well reported for in the climatology data presented via Scotland's NMPi. The available data layers present a 30-year (1971 to 2000) temperature/salinity climatology for surface regions of the Northwest European shelf seas (Marine Scotland, 2017a, 2017b). All data within the Array Area or the offshore ECC boundary have been analysed and presented in Figure 8-2. From the original data, which are irregularly distributed in space and time, the mean monthly surface temperature and salinity are calculated, as well as the climatic mean annual cycle. These regional data were validated against the site-specific survey data between April and August 2023 (EGS 2023a, EGS 2023b) to provide a robust characterisation of temperature and salinity across the receiving environment backed with high data confidence.

8.5.13. The mean monthly surface water temperatures within the Array Area and offshore ECC are presented in Table 8-6 ranged from 5.8°C in March to 13.4°C in August. The annual average surface water temperature has minimal variation between the Array Area and the offshore ECC calculated at 9.5°C and 9.4°C respectively. Near bed temperatures showed more monthly disparity between the offshore ECC and Array Area than surface temperatures as expected due to the higher average depths across the Array Area in comparison with the offshore ECC.

8.5.14. The environmental baseline survey (EGS, 2023b) collected CTD profiles in the nearshore ECC across 11 sample locations in May 2023. These results were compared to the NMPi datasets to further develop the characterisation of the baseline environment. Average temperature was found to be reflective of the expected water column temperature characteristic of May. Typically, annual water temperature in the region is coldest in March and warmest in August as shown in Table 8-6. Temperature ranged between 9.6°C and 10.01°C across all 11 nearshore ECC sampling sites as presented in Table 8-7. The survey showed the whole water column to be thermally well mixed with no presence of a thermocline likely due to the relatively shallow depth (less than 50 m) across the sample locations and tidal mixing close to shore. Additional historical water column profiles were analysed in further detail regarding stratification as part of the SAMS Enterprise study within Annex A of Volume 3, Appendix 6.4 (Ecosystem Level Effects).

8.5.15. The NMPi data were also analysed to determine the mean surface and near bed salinity with the outcome showing less variability (34.7 to 35.0 ‰) remaining fully marine throughout the year across the offshore ECC and Array Area. Minor freshwater influence was identified at

the coastal cell (myid[1]: 9680) with, approximately, 0.1 ‰ less salinity when compared with the Array Area (myid: 9836).

8.5.16. Site specific data in a survey by EGS (2023b) sampled data from 11 stations in the nearshore ECC region in May 2023 and identified a consistent salinity profile across all stations with no halocline observed averaging 34.33 psu as shown in Table 8-7.

Table 8-6 Mean monthly surface water temperature and salinity for pooled cells of relevance to the Array Area and offshore ECC. (Marine Scotland 2017a, 2017b)

Month	Mean Surface Temperature (°C)		Mean near bed Temperature (°C)		Mean Surface Salinity (‰)		Mean near bed Salinity (‰)	
	Array	ECC	Array	ECC	Array	ECC	Array	ECC
January	7.30	7.30	7.50	7.50	34.90	34.90	35.00	34.90
February	6.60	6.50	6.70	6.50	34.90	34.80	34.90	34.80
March	5.90	5.80	6.30	6.00	34.90	34.80	35.00	34.90
April	6.60	6.70	6.50	6.50	34.80	34.70	34.90	34.80
May	8.10	8.10	7.00	7.20	34.80	34.70	34.90	34.80
June	10.70	10.50	7.50	7.80	34.80	34.70	34.90	34.80
July	12.30	12.00	8.20	8.90	34.80	34.80	34.90	34.90
August	13.40	13.10	9.20	10.20	34.90	34.80	35.00	34.90
September	12.00	12.10	10.30	11.20	34.90	34.90	35.00	35.00
October	11.40	11.60	10.30	11.10	35.00	35.00	35.10	35.00
November	10.00	10.00	9.90	9.90	35.00	34.90	35.00	34.90
December	9.30	9.20	9.20	9.30	35.00	34.90	35.00	35.00

Table 8-7 Nearshore ECC temperature and salinity data (EGS, 2023b).

Site	Temperature (°C)			Salinity (‰)		
	Max	Min	Average	Max	Min	Average
MM_NEC_01_WAT	13.80	9.70	9.86	34.50	32.70	34.30
MM_NEC_02_WAT	13.30	9.90	10.01	34.60	29.30	34.32
MM_NEC_03_WAT	11.02	9.78	9.89	34.40	33.47	34.30
MM_NEC_04_WAT	10.87	9.62	9.68	34.57	33.71	34.33
MM_NEC_05_WAT	11.27	9.60	9.64	34.54	33.22	34.34
MM_NEC_06_WAT	11.58	9.54	9.62	34.43	31.17	34.31
MM_NEC_07_WAT	10.19	9.59	9.66	34.38	29.13	34.32
MM_NEC_08_WAT	11.27	9.55	9.60	34.37	33.86	34.30
MM_NEC_09_WAT	11.77	9.57	9.70	34.54	33.70	34.35
MM_NEC_10_WAT	11.27	9.50	9.68	34.39	33.15	34.35
MM_NEC_11_WAT	10.83	9.26	9.58	34.47	29.02	34.37

[1] Refers to the location of relevant data grid presented on Scotland's NMPi for annual mean temperature and salinity (Marine Scotland, 2017a, 2017b).

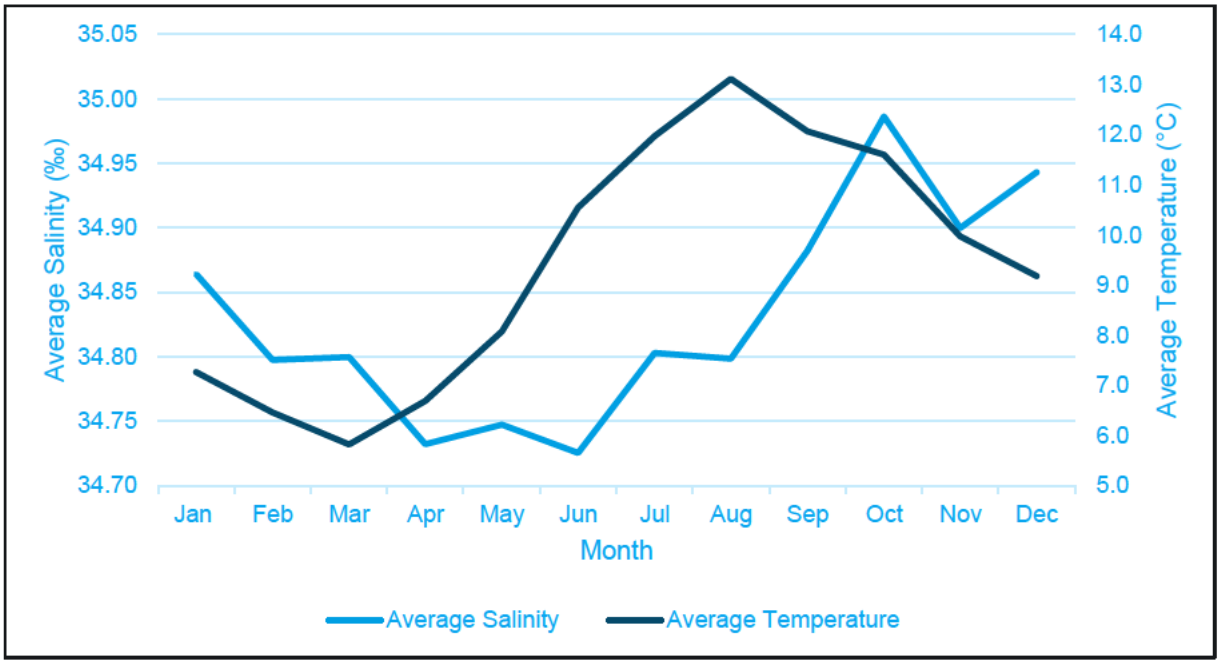


Figure 8-2 Mean monthly surface water temperature and salinity for eight cells of relevance to the Array Area and offshore ECC (Marine Scotland, 2023a, 2023b),

DISSOLVED OXYGEN

8.5.17. The amount of DO in sea water affects the metabolism of marine organisms and provides information on marine ecosystem health. Depletion of DO can lead to a region being defined as either oxygen deficient, which occurs when dissolved oxygen concentrations are less than 6 mg/l or hypoxic, which occurs when oxygen concentrations are less than 2 mg/l. Reports of DO concentrations in the North Sea are typically between ~ 6 mg/l and ~10 mg/l (Mahaffey *et al*., 2020) with hypoxia occurring at less than 2 mg/l.

8.5.18. The DO profile from EGS (2023b) showed the water column to remain relatively stable with a slight decrease in correlation to depth. Both stations closest to shore (NEC_01_WAT and NEC_02_WAT (Figure 8-4)) showed slightly higher percentage DO saturation with results averaging 99.21% and 100.34% in comparison to the NEC_10_WAT and NEC_11_WAT data average of 95.46% and 95.75% as presented in Table 8-8.

Table 8-8 Dissolved Oxygen profile of nearshore ECC sampling locations (EGS, 2023b)

Site	Dissolved Oxygen (% Saturation)[2]			
	Max	Min	Average	Max Depth (m)
MM_NEC_01_WAT	105.60	89.40	100.34	10.20
MM_NEC_02_WAT	101.30	93.00	99.21	14.60
MM_NEC_03_WAT	99.00	92.48	97.50	18.62
MM_NEC_04_WAT	99.18	92.41	96.50	27.03
MM_NEC_05_WAT	99.40	92.75	96.16	33.17
MM_NEC_06_WAT	98.65	92.42	96.30	37.49
MM_NEC_07_WAT	93.72	93.72	96.16	43.54

[2] DO is measured either in milligrams per litre (mg/l) or 'percent saturation.' (% saturation). Milligrams per litre is the amount of oxygen in a litre of water. Percent saturation is the amount of oxygen in a litre of water relative to the total amount of oxygen that the water can hold at that temperature.

Site	Dissolved Oxygen (% Saturation)[2]			
	Max	Min	Average	Max Depth (m)
MM_NEC_08_WAT	99.41	91.74	96.06	47.64
MM_NEC_09_WAT	99.14	91.98	96.00	50.24
MM_NEC_10_WAT	98.81	91.67	95.46	49.94
MM_NEC_11_WAT	100.78	99.80	95.75	50.69

8.5.19. Higher temperatures decrease the solubility of oxygen in water which impacts the relationship between mg/l and % Saturation. Therefore, the relationship between the two units varies in relation to temperature and pressure. Taking the average temperature of the water samples (9.72°C) and the average 96.86 % Saturation at one atmosphere of pressure is equivalent to 11.01 mg/l across the intertidal area sample sites (University of Minnesota Natural Resources Research Institute, 2015).

SUSPENDED SEDIMENT CONCENTRATION

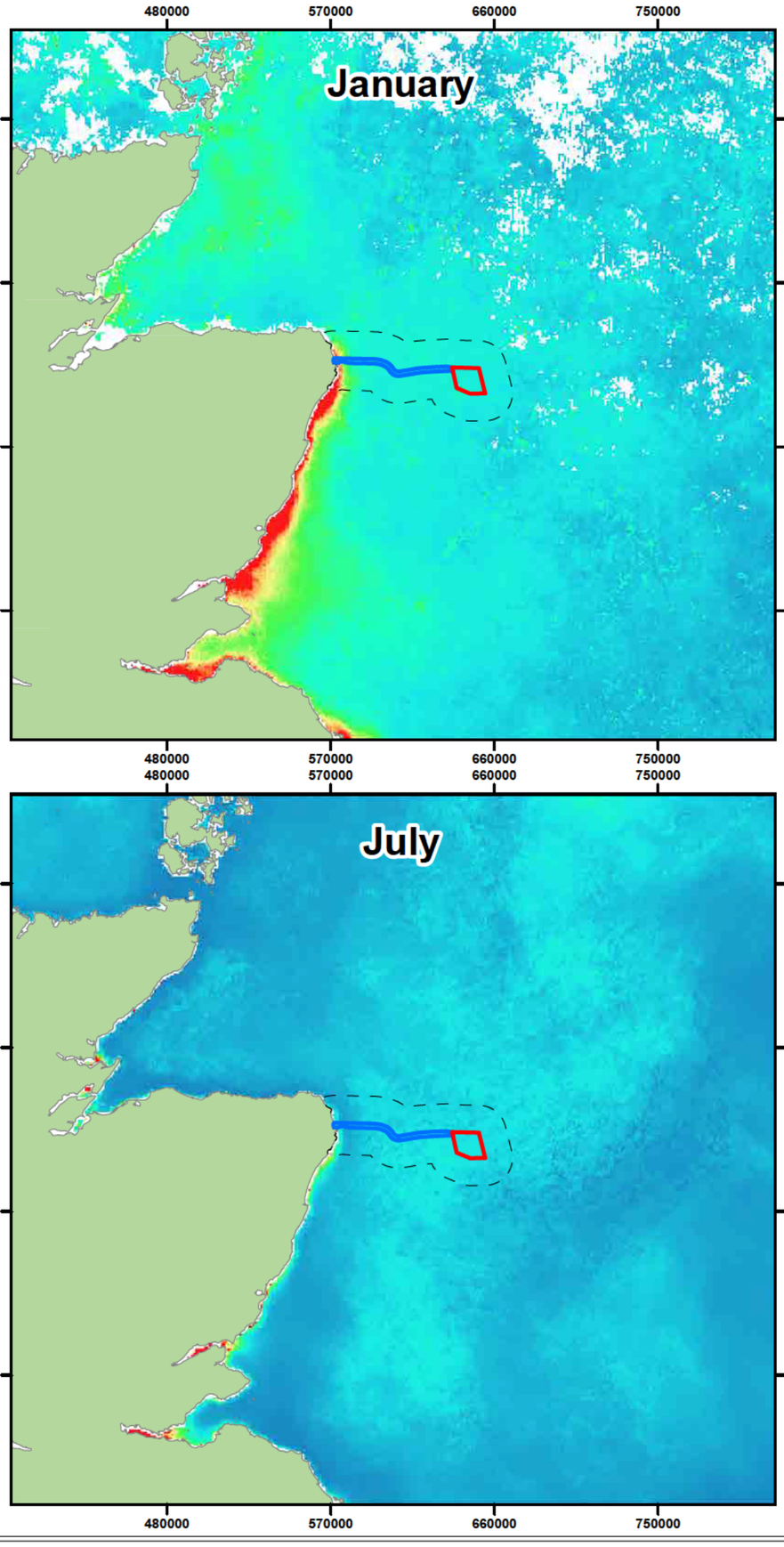
8.5.20. This section should be read in conjunction with Volume 3, Appendix 7.1 (Marine and Coastal Processes). The baseline section within that appendix includes additional detail on SSC relevant to the MW&SQ baseline.

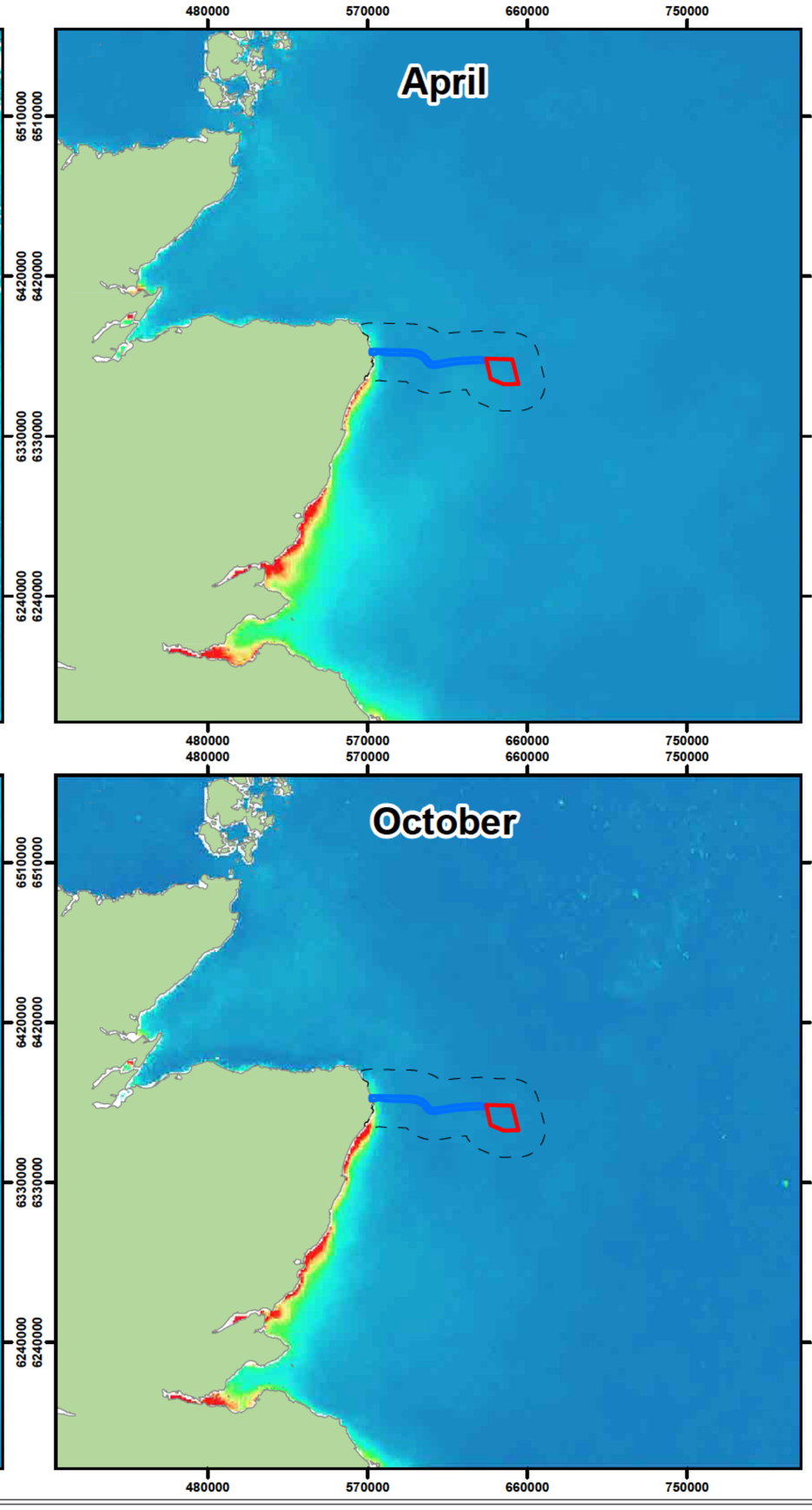
8.5.21. Turbidity is caused by the presence of small particles in the water, including organic materials. These particles are summarised under the term Suspended Particulate Matter (SPM). SPM provides an indication of turbidity and is highly variable according to water depth and the marine processes in the area (i.e. tide, current and wind regimes). The SPM concentration in the water column regulates the penetration depth of light and therefore is an important parameter influencing the primary production of plankton. SPM concentration increases around the autumn, winter and spring months in coastal areas. Notably, the highest concentrations are typically observed near the seabed. Higher concentrations coincide with the occurrence of larger significant wave heights during winter months, which deepen wave bases and intensify erosional processes along the seabed in suitable water depths. Consequently, sediment resuspension is heightened, contributing to elevated SPM levels. Furthermore, greater SPM concentrations result from increased precipitation during winter months which leads to amplified fluvial runoff (Dobrynin *et al.*, 2010).

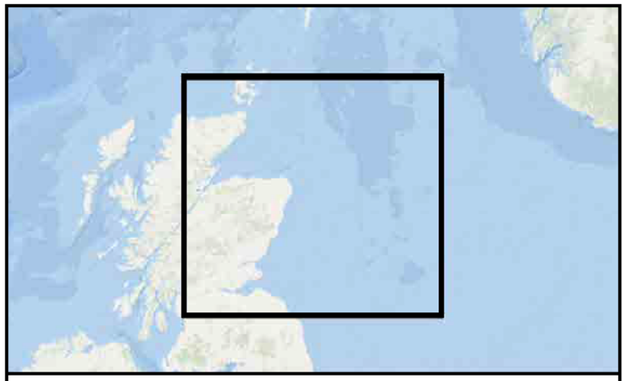
8.5.22. Spatially gridded, annual average of non-algal SPM across the study area is shown in Figure 8-3 (Cefas, 2016). These data are based on information collected by satellite and the derived Ifremer OC5 algorithm (Gohin, 2011). The data portray SPM, from the period 1998 to 2015 and shows limited variation within the Array Area and offshore ECC, with values typically less than 6 mg/l throughout an annual period (Cefas, 2016; Figure 8-3). There is a general trend of decreasing SPM concentrations with increasing distance offshore with the highest average concentrations recorded in the study area observed along the Aberdeenshire coast of, approximately, 5 mg/l in January.

8.5.23. These trends are regulated by tidal currents and intensify during wind-driven storm events and consequently SSC levels have a seasonal pattern due to the seasonality of storm events with the lowest concentrations recorded in summer and highest in winter within the Proposed Development (Cefas, 2016).

8.5.24. As shown in Figure 8-3, the Proposed Development and wider region follows this trend with highest SPM levels recorded in January and lowest in July. The Array Area and offshore ECC are influenced less by riverine and estuarine sources and are in typically deeper waters resulting in lower average SPM (Figure 8-3).







Legend:

- Array Area
- Offshore Export Cable Corridor
- MW&SQ Study Area

SPM Concentrations (mg/l) (CEFAS, 1998-2015)

High : 5

Low : 0

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Average Suspended Particulate Matter within the Proposed Development and Wider Area

Figure: 8-3	Drawing No: GoBe-0125		
Revision:	Date:	Drawn:	Checked:
01	04/07/24	[Redacted]	

Map scale 1:3,000,000 @ A3

0 50 100 km

N

Co-ordinate system: ETRS 1989 UTM Zone 30N **EPSG:** 25830

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SEDIMENT QUALITY

8.5.25. Sediments with a finer particle size, such as clays and muds, can act as adsorption surfaces for contaminants that may be released into the water column if the sediment is disturbed (Stronkhorst *et al*., 2003). This is due to their larger surface area to volume ratios and higher organic carbon (OC) content. Sediments consisting of coarser sand and gravel are expected to carry a much lower contamination risk. Information regarding particle sizes is therefore an important step in assessing the contamination risk to the marine environment. Further information on surficial sediment characteristics are included with the baseline section of Volume 3, Appendix 7.1 (Marine and Coastal Processes Technical Report).

8.5.26. Regional-scale publicly available sediment maps indicate surficial sediments within the Array Area and offshore ECC are typically comprised of sands and gravelly sands with increasing gravel content towards the south and west of the Array Area. These sediments reportedly contain less than 10% proportion of fines when utilising the same data (BGS, 2020). Of note is that the BGS sediment maps are compiled from a relatively low density of samples in the study area. However, these data can be used to support broad-scale characterisation, especially in-combination with site-specific sampling campaigns.

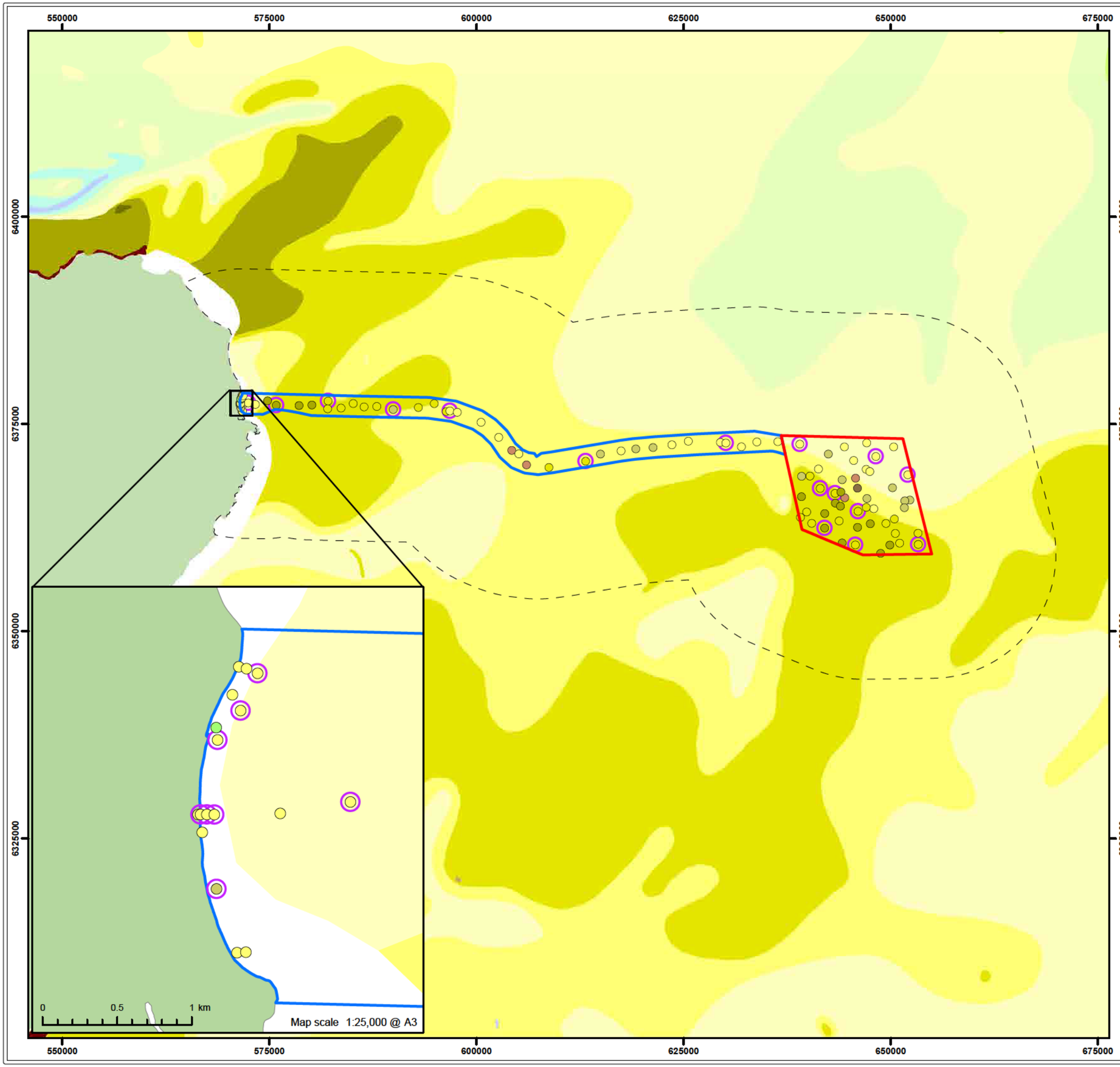
SEDIMENT TYPE – ARRAY AREA

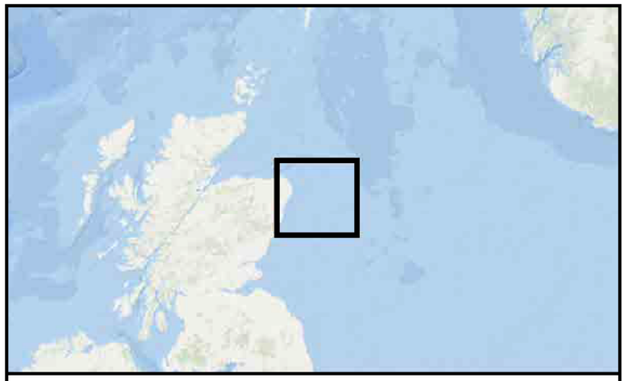
8.5.27. A site specific survey by EGS (2023a) acquired results from 49 grab sampling stations throughout the Array Area and identified the surficial sediments via PSA, as presented in Table 8-9 and Figure 8-4.

8.5.28. The surficial sediments within the Array Area are typified by a heterogenous mix of sand and gravel with a higher percentage of sands in the north of the study area corresponding with the increasing water depth. Southern reaches of the Array Area displayed higher gravel proportions increasing from 4.56% in the north to 24.89%. The proportion of fines was discovered to be low across all aspects of the Array Area with an average of 4.15% ranging between 10.91% and 0.25%.

8.5.29. Samples from the Array Area represented six separate Folk classifications with Gravelly Sand being the most frequent classification at 32% of the total stations with Sand and Sandy Gravel equating for 22% each of the remaining classifications

8.5.30. The small proportion of fine sediments across the Array Area indicates a low likelihood of sediment bound contaminants. Sediments with a finer particle size, such as clays and muds, can act as adsorption surfaces for contaminants that may be released into the water column if the sediment is disturbed (Stronkhorst *et al*., 2003). This is due to their larger surface area to volume ratios and higher OC content than larger grain sediments such as sand and gravel. Sediment contaminations is addressed further in paragraphs 8.5.37 to 8.5.42.





Legend:

- Array Area
- Offshore Export Cable Corridor
- MW&SQ Study Area
- Contaminant Samples

Sediment Grab Samples - Folk Class (EGS, 2023)

- Sand
- Slightly Gravelly Sand
- Gravelly Sand
- Sandy Gravel
- Muddy Sand
- Muddy Sandy Gravel
- Gravelly Muddy Sand

Seabed Sediments (Folk, 1954) (EMODnet)

- 1.1.1 Mud
- 1.2.1 sandy Mud
- 1.2.2 (gravelly) sandy Mud
- 1.3.1 muddy Sand
- 1.3.2 (gravelly) muddy Sand
- 2.1.1 Sand
- 2.1.2 (gravelly) Sand
- 3.1.1 gravelly Sand
- 3.2.1 sandy Gravel
- 3.3.1 Gravel
- 4.1.1 gravelly Mud
- 4.3.1 gravelly muddy Sand
- 5. Rock and Boulders

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Surficial Seabed Sediments within the Proposed Development (Folk, 1954)

Figure: 8-4	Drawing No: GoBe-0126		
Revision:	Date:	Drawn:	Checked:
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Map scale 1:450,000 @ A3

0 5 10 km

Co-ordinate system: ETRS 1989 UTM Zone 30N **EPSG:** 25830

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Table 8-9 Summary of Particle Size Data within the Array Area

Sediment Type	Minimum Fraction	Mean Fraction	Maximum Fraction	Standard Deviation
Fines (<63 µm)	0.25	4.15	10.91	2.31
Sand (63 µm – 2 mm)	41.15	79.25	97.18	16.57
Gravel (>2 mm)	0.05	16.59	56.74	16.92

SEDIMENT TYPE – OFFSHORE ECC SUBTIDAL

8.5.31. Within the EGS survey (2023b) the surficial sediments of the subtidal offshore ECC were collected from 37 subtidal grab samples. The analysed surficial sediments (Table 8-10) are shown to be predominantly sand dominated averaging 84.22%, with a higher gravel percentage present in 40m to 83m water depths. The proportion of fine sediments was low across the subtidal offshore ECC, as was the case with the Array Area averaging 4.53%.

8.5.32. Of the 37 samples from the subtidal offshore ECC Folk classifications were represented predominantly by Gravelly Sand and Sand at 30% and 43% of the classification, respectively.

8.5.33. The low proportion of fine sediments across the subtidal offshore ECC indicates a low likelihood of sediment bound contaminants. Sediment bound contaminants as presented in Stronkhorst *et al.* (2003) and further discussed in paragraph 8.5.30 can adsorb to fine grain sediments and released into the water column upon disturbance. Sediment contamination is addressed further in paragraph 8.5.37 to 8.5.42.

Table 8-10 Summary of Particle Size Data across the Offshore subtidal offshore ECC

Sediment Type	Minimum Fraction	Mean Fraction	Maximum Fraction	Standard Deviation
Fines	0.57	4.53	11.31	2.47
Sand	33.12	84.22	96.75	16.07
Gravel	0.04	11.26	65.29	16.71

SEDIMENT TYPE – OFFSHORE ECC INTERTIDAL

8.5.34. Within the EGS survey (2023b), the surficial sediments of the intertidal offshore ECC were collected from five intertidal stations. On average higher proportions of sand were recorded within the intertidal offshore ECC survey area (Table 8-11) than subtidal samples (Table 8-10) averaging 93.73% with very little gravel representation recorded at 0.25%. The proportion of fines was also relatively low averaging 6.02% albeit slightly higher than the Array Area and subtidal offshore ECC, this could be due to a smaller sample size.

8.5.35. Of the 15 sample stations 13 were designated as Sand by the Folk classification with the remaining two designated as Slightly Gravelly Sand and Muddy Sand.

8.5.36. The low proportion of fine sediments across the intertidal area indicates a low likelihood of sediment bound contaminants as there is less availability of adsorption surfaces as discussed in Stronkhorst *et al* (2003) and paragraph 8.5.30. Sediment contaminations is addressed further in Section 8.5.37 to 8.5.42.

Table 8-11 Summary of Particle Size Data across the intertidal offshore ECC

Sediment Type	Minimum Fraction	Mean Fraction	Maximum Fraction	Standard Deviation
Fines	1.22	6.02	14.34	3.40
Sand	85.64	93.73	98.73	3.31
Gravel	0.03	0.25	1.85	0.47

SEDIMENT CONTAMINATION

8.5.37. There is no formal quantitative Environmental Quality Status (EQS) for sediments, unlike for water quality. The standards presented in the EQS Directive (2008/105/EC) are in line with the EU's Water Framework Directive 2000/60/EC and mainly relate to concentrations of contaminants dissolved in the water column. As the Proposed Development will not result in the direct release of contaminants into the water column, this assessment focuses on the potential to disturb sediment bound contaminants.

8.5.38. In the absence of quantified standards, common practice for characterising baseline sediment quality conditions is to compare levels against the Cefas ALs for the Disposal of Dredged Material (as reported by MMO (2014) and Scottish Government (2017; Table 8-12). These Action Levels are used as part of a 'weight of evidence' approach to assessment of material suitable for disposal at sea. Generally, contaminant levels falling below Action Level 1 (AL1) are not of concern and are unlikely to impact the final licensing decision. If contaminant Levels fall above Action Level 2 (AL2), they are generally considered unsuitable for disposal at sea.

8.5.39. Dredged material with sediment contaminant levels between AL1 and AL2 require professional judgement to be employed for a decision to be made. The Action Levels should not be viewed as a pass or fail system but provides an appropriate context for professional consideration for contaminant levels in sediment for activities which propose to disturb the seabed (Marine Scotland, 2017d).

Table 8-12 Action Levels used in sediment contaminant assessment (Marine Scotland, 2017d).

Contaminant	Action Level 1 (mg/kg)	Action Level 2 (mg/kg)
Arsenic	20	70
Cadmium	0.4	4
Chromium	50	370
Copper	30	300
Lead	50	400
Mercury	0.25	1.5
Nickel	30	150
Zinc	130	600
Tributyltin	0.1	0.5
Polychlorinated biphenyls (PCBs)	0.02	0.18
Polycyclic Aromatic Hydrocarbons (PAHs)	0.1[3]	-
Total Hydrocarbons	100	-

8.5.40. Site-specific surveys by EGS assessed the sediment contaminants within the Array Area and offshore ECC to quantify the concentrations within the study area. Contaminants defined within the ALs were analysed at nine stations within the Array Area and the results are

[3] The AL1 for all contaminants within the United States Environmental Protection Agency Suite of 16 compounds is defined at 0.1, except Dibenzo(a,h)anthracene, which is set at 0.01 mg/kg.

provided in Table 8-13 and illustrated on Figure 8-4. Of these, all nine stations had contamination concentrations below AL1 for the full suite of assessed contaminants, including metals, PCBs and PAHs.

8.5.41. Within the offshore ECC, 14 stations assessed the sediment contaminants, seven from the intertidal region and seven from the subtidal aspect of the offshore ECC (Table 8-14 and Figure 8-4). Of these, 13 stations recorded concentrations below AL1 for all contaminants with one subtidal station (ECC_28_SEC_DNA) exceeding AL1 for Arsenic. Of note is that the AL2 threshold was not exceeded.

8.5.42. These stations are therefore not of concern and can be characterised as unlikely to impact the final licensing decision. Consequently, the material should be considered safe for disposal at sea.

Table 8-13 Array Area sediment contamination levels (EGS, 2023a)

Station	Arsenic (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Nickel (mg/kg)	Zinc (mg/kg)	Tributyltin (ug/kg)	PCBs (ug/kg)	PAHs (ug/kg)	Total Hydrocarbons (mg/kg)
OWF 32 SEC _DNA	13.9	<0.04	9.0	2.8	13.0	0.01	25.7	19.5	<1	<0.08	2.74	1.09
OWF_26_SEC _DNA	8.7	<0.04	12.0	3.5	5.5	0.02	15.4	21.2	<1	<0.08	0.00	0.98
OWF 15 SEC _DNA	6.3	<0.04	12.0	2.9	4.9	0.02	10.9	17.8	<1	<0.08	2.79	2.74
OWF_16_SEC _DNA	8.6	<0.04	14.1	3.0	4.5	0.01	9.7	19.9	<1	<0.08	12.50	2.46
OWF 47 SEC _DNA	12.9	<0.04	11.9	2.6	6.2	<0.01	10.2	25.0	<1	<0.08	0.00	1.42
OWF_36_SEC _DNA	14.1	0.07	11.8	2.5	8.9	<0.01	13.8	27.5	<1	<0.08	0.00	1.23
OWF 01 SEC _DNA	4.1	<0.04	9.0	1.7	4.3	0.02	3.9	13.5	<1	<0.08	4.59	2.39
OWF_07_SEC _DNA	4.3	<0.04	10.8	1.9	4.9	0.02	4.2	14.0	<1	<0.08	15.4	3.49
OWF 13 SEC _DNA	6.1	0.05	12.9	3.1	9.7	0.02	5.6	20.4	<1	<0.08	4.16	2.34

Table 8-14 Offshore ECC sediment contamination levels (EGS, 2023b)

Station	Arsenic (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Nickel (mg/kg)	Zinc (mg/kg)	Tributyltin (ug/kg)	PCBs (ug/kg)	PAHs (ug/kg)	Total Hydrocarbons (mg/kg)
INT_03	7.9	<0.04	3.8	2.1	2.2	0.02	3.4	10.7	<1	<0.08	132.71	2.08
INT_06	8.1	<0.04	2.6	1.0	1.8	0.01	2.3	8.5	<1	<0.08	130.89	1.27
INT_07	7.2	<0.04	2.2	1.3	1.7	0.01	2.3	7.1	<1	<0.08	0.00	0.38
INT_08	9.5	0.04	2.5	1.1	2.0	0.03	2.5	10.2	<1	<0.08	0.00	0.34
INT_09	7.4	0.04	2.2	0.9	1.6	0.02	2.0	6.7	<1	<0.08	0.00	0.34
INT_14	7.9	0.05	3.0	1.6	2.2	0.02	2.7	8.7	<1	<0.08	0.00	0.60
INT_15	6.9	<0.04	2.3	1.1	2.1	0.01	2.4	9.5	<1	<0.08	0.00	0.31
NEC_02_SWC_DNA	7.0	<0.04	3.6	1.5	2.2	0.02	2.6	6.9	<1	<0.08	0.00	1.68
NEC 06 SWC_DNA	10.9	0.05	11.4	3.1	4.2	0.01	8.0	20.0	<1	<0.08	10.4	1.78
ECC_10_SEC_DNA	13.4	0.06	11.3	3.3	5.9	<0.01	9.2	23.1	<1	<0.08	0.00	2.86
ECC 16 SEC_DNA	6.5	<0.04	6.1	2.2	3.4	<0.01	4.0	12.2	<1	<0.08	0.00	0.92
ECC_20_SEC_DNA	4.3	<0.04	9.8	2.6	4.3	<0.01	4.2	11.9	<1	<0.08	8.37	1.75
ECC 28 SEC DNA	22.8[4]	0.07	7.6	2.1	10.6	<0.01	8.8	14.4	<1	<0.08	0.00	1.58
ECC 36 SEC DNA	6.0	<0.04	8.3	1.8	4.8	0.03	3.7	12.3	<1	<0.08	0.00	2.08

[4] Shading indicates an exceedance of AL1

BLUE CARBON

8.5.43. Blue carbon is the term given to carbon sequestered by ocean and coastal ecosystems via biological metabolic processes which is subsequently buried in marine sediments. Particular habitats and species in Scotland are identified as contributing to blue carbon stores and include:

- Nearshore habitats including as kelp and seagrass beds;
- Calcifying aggregations including maerl and native oysters; and
- Seabed sediments.

8.5.44. This MW&SQ chapter focuses on sedimentary blue carbon across the Proposed Development. An assessment of Blue Carbon is presented in Annex A of this report. Marine sediments are considered separately to the blue carbon habitats previously discussed because they do not directly sequester carbon dioxide from the atmosphere but rather receive, bury and store organic and inorganic carbon.

8.5.45. Organic carbon stores are generally higher in surficial sediments with a large mud fraction in comparison to larger grain size. Encompassing this information, anthropogenic mobilisation of the sediment in such areas (such as anchor installation) provides a risk to blue carbon stores through remineralisation of OC. Inorganic carbon within seabed sediments is not threatened by disturbance in the same way. Calcium carbonate cannot be digested by microbes even if suspended within the water column. Ocean acidification however is a potential threat to the blue carbon stores if dissolution of calcified material from marine sediments begins to occur. Site-specific sampling indicates the pH levels in the region to be within expected limits, but uncertainty remains regarding how regional seas, like the North Sea, will respond to global pH decreases.

8.5.46. Reactivity of OC decreases with increasing distance from the coast. Sedimentary OC on the Scottish continental shelf is defined as being relatively stable to degradation (Smeaton and Austin, 2022). This stability is crucial as it prevents the rapid release of carbon dioxide into the environment, enhancing long-term carbon sediment storage. Understanding OC stability helps predict how activities like dredging or construction can affect carbon cycling and the overall carbon balance in coastal and marine ecosystems.

8.5.47. Marine sediments are known to trap and store large quantities of carbon over long timescales as a carbon sink process and the Scottish sector holds the majority of the carbon stock of the UK's Exclusive Economic Zone (EEZ). This is estimated at 356.5 (± 72.2) Mt organic carbon and 2,264.8 (± 156.3) Mt inorganic carbon, totalling 2,622 Mt carbon being held within the top 10 cm of seabed sediments (Smeaton *et al*., 2021). OC densities (the quantity of OC held per square metre (m^2)) are highest in muddy sediments within fjords and coastal zones, gradually decreasing offshore due to factors like higher dissolved oxygen, longer sediment transport times and increased sediment resuspension, which accelerate OC degradation. In the Array Area, sample analysis found concentrations of TOC were relatively low, ranging from 0.23% at MM_OWF_13_SEC_DNA to 0.46% at MM_OWF_32_SEC_DNA (mean 0.32 % ± 0.07 SD). In the offshore ECC, concentrations of TOC were relatively low, ranging from 0.21% at NEC_02_SWC_DNA to 0.31% at INT_15. Overall, organic material is considered to be reasonably low across the Proposed Development indicating the blue carbon levels are low in the study area as expected for sand dominated regions.

8.5.48. Sedimentary carbon burial rates in Scottish coastal and marine sediments vary significantly by sediment type and location (Cunningham and Hunt, 2023). Organic carbon rich sediments are more vulnerable to anthropogenic disturbance and may require additional management or protection to maintain their carbon resources (Luisetti *et al*., 2019). Larger grain sediment dominated areas (such as the majority of the Array Area) are less susceptible to disturbance.

8.5.49. A report on carbon budget and blue carbon stores was commissioned by Scottish National Heritage (SNH[5]) in 2014 to define the percentage of carbonate in the top 10 cm of superficial sediments. Within the Array Area, the percentage of carbonate in surficial sediments range from 13% in the north-east to 50% in the south-west of the Array Area seemingly aligning with the changing depths of the seabed.

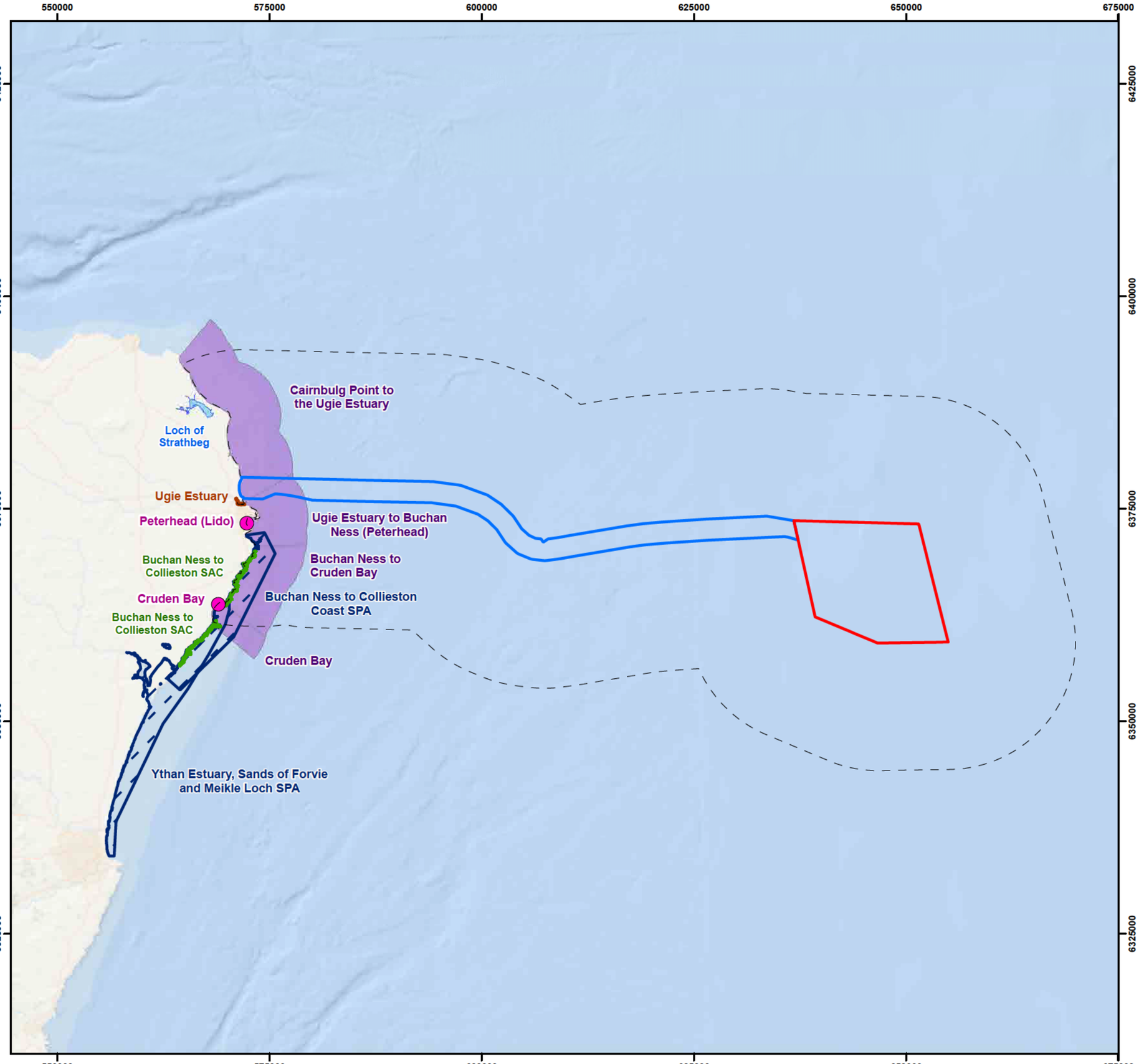
DESIGNATED SITES

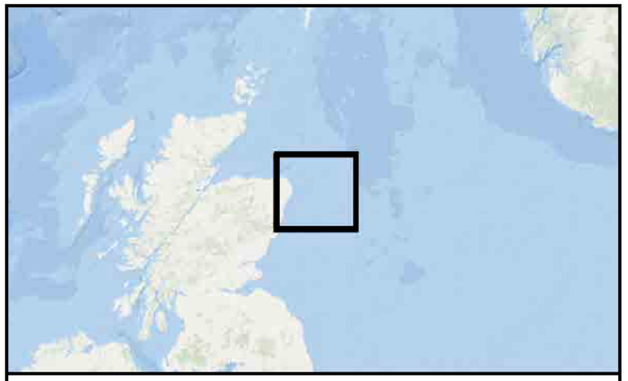
8.5.50. Designated sites to be considered within the MW&SQ Chapter are summarised in Table 8-15. Sites relevant to MW&SQ within the 15 km study area were considered in this section of the chapter and presented in Figure 8-5. The current status of these waterbodies is presented within Table 8-16 and Table 8-17.

Table 8-15 Designated Sites and Qualifying Interest Features considered within the MW&SQ Chapter

Designated Site	Qualifying Interest Feature	Distance to Array Area (km)	Distance to Export Cable Corridor (km)
Cruden Bay (ID: 200118)	Coastal Waterbody	67.65	12.77
Buchan Ness to Cruden Bay (ID: 200125)	Coastal Waterbody	57.40	5.15
Ugie Estuary to Buchan Ness (Peterhead) (ID: 200131)	Coastal Waterbody	57.21	Overlaps with offshore ECC
Cairnbulg Point to Ugie Estuary (ID: 200142)	Coastal Waterbody	59.42	Overlaps with offshore ECC
Ugie Estuary (ID: 200129)	Transitional Waterbody	64.78	0.47
Peterhead (Lido)	Designated Bathing Water	64.46	2.88
Cruden Bay	Designated Bathing Water	68.44	12.83

[5] The lead advisory body in Scotland for nature, wildlife management, and landscape management. SNH rebranded to NatureScot on 1st May 2020 to adapt the organisation to meet current environmental challenges.





Legend:

- Array Area
- Offshore Export Cable Corridor
- MW&SQ Study Area
- Special Protection Areas
- Special Areas of Conservation
- WFD Coastal Waterbodies
- WFD Transitional Waterbody
- Bathing Water Locations

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Designated Sites of relevance within the MW&SQ Study Area

Figure: 8-5	Drawing No: GoBe-0127		
Revision:	Date:	Drawn:	Checked:
01	30/09/24	[Redacted]	

Map scale 1:450,000 @ A3

0 5 10 km

Co-ordinate system: ETRS 1989 UTM Zone 30N **EPSG:** 25830

MUIR MHÒR OFFSHORE WIND FARM

A joint venture between Fred. Olsen Seawind & Vattenfall

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COASTAL AND TRANSISTIONAL WATERBODIES

8.5.51. Across Scotland there are currently 457 designated coastal waterbodies and 50 designated transitional waterbodies that are monitored and managed under the WFD (SEPA, 2024). Of which, one transitional and four coastal waterbodies wholly or partially overlap with the MW&SQ study area (Table 8-15) A detailed summary of the latest (2022) classification status of these five coastal and transitional waterbodies as shown in Table 8-16.

Table 8-16 Coastal and Transitional Waterbodies within the MW&SQ study area (SEPA, 2022)

Parameter	Coastal or transitional waterbody				
	Cruden Bay	**Buchan Ness to Cruden Bay**	**Ugie Estuary to Buchan Ness (Peterhead)**	**Cairnbulg Point to Ugie Estuary**	**Ugie Estuary**
Waterbody ID	200118	200125	200131	200142	200129
Waterbody type	Coastal	Coastal	Coastal	Coastal	Transitional
Waterbody size (km^2)	19.3	57.7	46.3	127.8	0.1
Overall status	High	High	Good ecological potential	High	High
HMWB	No	No	Yes	No	No
Overall ecology	High	High	Moderate	High	High
Biological elements	High	High	Good	High	-[6]
Invertebrate animals	High	High	Good	High	-
Imposex assessment	-	-	Good	-	-
Benthic invertebrates (Infaunal Quality Index)	High	High	High	High	-
Macroalgae	-	High	High	-	-
Macroaalgae (Full Species List)	-	High	High	-	-
Macroalgae Reduced Species List)	-	Good	Good	-	-
Phytoplankton	High	High	High	High	-
Hydromorphology	High	High	Moderate	High	High
Morphology	High	High	Moderate	High	High
Water Quality	High	High	Good	High	-

8.5.52. The one transitional waterbody within the study area is Ugie Estuary (ID: 200129), which has maintained an overall status of 'High' since 2008 indicating a healthy and resilient environment.

[6] Information provided by SEPA (2022) varies between waterbody due to the sampling regime dependant on waterbody type, size, location and associated pressures on the waterbody.

8.5.53. Three of the four coastal waters also achieved 'High' overall status, with no results of concern with Ugie Estuary to Buchan Ness (Peterhead) (ID:200131) designated as good ecological potential. On account of physical alterations that cannot be addressed without a significant impact on navigation Ugie Estuary to Buchan Ness (Peterhead) has been designated as a Heavily Modified Water Body (HMWB). The objectives of HMWBs under the WFD is to achieve Good Ecological Potential which allows for protection of the ecology whilst considering their role for human use. Ugie Estuary to Buchan Ness (Peterhead) meets this objective.

BATHING WATERS

8.5.54. There are currently ten Bathing Waters in Aberdeenshire, of which Peterhead (Lido) and Cruden Bay fall within the MW&SQ study area. Both Bathing Waters have been classified as 'Excellent' for 2023 (Table 8-17), indicating a high capacity to accommodate a change to current water quality status:

- Peterhead (Lido) was classified as Excellent in 2018 and has maintained this standard to date; and
- Cruden Bay was designated as a Bathing Water for the first time in 2019 and improved from Good to Excellent in the 2023 season.

8.5.55. Both Bathing Waters fall within the Aberdeenshire, Banff, Buchan and Moray Nitrate Vulnerable Zone (NVZ) (paragraph 8.5.63) and consequently the surrounding area must follow the Action Programme for Nitrate Vulnerable Zones (Scotland) Regulations 2008 (as amended), to meet Scotland's legal and environmental obligations for NVZs (Table 8-1).

8.5.56. Peterhead (Lido) is predominantly an urban (65%) and rural (30%) catchment area providing impact pathways for urban drainage and Combined Sewer Overflows (CSOs) to deteriorate the water quality in the short-term following wet weather events (SEPA 2024a). However, it does not pose much risk to the classification of the waterbody during usual conditions following improvements to the local sewerage system in recent years.

8.5.57. Cruden Bay has an agricultural catchment supporting mixed farming providing impact pathways for agricultural runoff to affect the water quality at the designated Bathing Water. Agricultural pollution in the result of rain driven events has improved due to mitigation measures being agreed between SEPA and land managers (SEPA, 2024b). There is a CSO to the north of the Bathing Water potentially impacting the water quality with discharges during storm events.

Table 8-17 Designated Bathing Waters within the MW&SQ study area

Bathing Water	Classification			
	2023	2022	2021	2019
Peterhead (Lido)	Excellent	Excellent	Excellent	Excellent
Cruden Bay	Excellent	Good	Good	Good

URBAN WASTEWATER TREATMENT SENSITIVE AREAS

8.5.58. The EU Urban Wastewater Treatment Directive (UWWTD) transposed into Scottish law via the Urban Wastewater Treatment (Scotland) Regulations aims to protect the environment from the adverse effects of the collection, treatment and discharge of urban wastewater. Environmental waters are designated as sensitive areas where they are in need of protection through the provision of tertiary treatment at sewage treatment plants whose discharges adversely impact the waters. There are various types of sensitive areas, and their type will influence the form of tertiary treatment provided: For example, bathing and SFWs sensitive

areas will be protected by UV treatment and waters adversely affected by nutrients in discharges will receive phosphorus and/or nitrogen reduction.

8.5.59. Within the study area there are three other UWWTD Sensitive Areas in addition to the designated Cruden Bay Bathing Water, as presented in Table 8-18 and Figure 8-5.

Table 8-18 UWWTD Sensitive Areas within the MW&SQ study area

UWWTD Sensitive Area	Current Classification		
	Water of Cruden downstream (d/s) Hatton WWTP	**River Ugie – North/South confluence to tidal limit**	**Black Water – d/s St Fergus**
Waterbody ID	23200	23215	23062
Waterbody type	River	River	River
Waterbody size	5.2 km	9.3 km	1.3 km
Catchment	Buchan Coastal	River Ugie	Buchan Coastal
Overall Condition	Moderate Ecological Potential	Poor	Good
Water Quality	Moderate	Moderate	Good
Physical Condition	Moderate Ecological Potential	Good	High
Pressures	Diffuse source, point source discharges, modifications to bed, banks and shores	Diffuse source	N/A

8.5.60. The designated UWWTD sensitive rivers, despite being riverine in origin, do not extend past the MHWS and therefore do not form part of the marine environment and consequently the MW&SQ study area. The Proposed Development has no potential impact pathway to adversely affect designated areas landward of MHWS.

SHELLFISH WATER PROTECTED AREAS

8.5.61. Shellfish water protected areas (SWPAs) are areas of water designated to support the sustainable growth of the shellfish sector. There are 84 SWPAs in the Scotland River Basin District. Environmental objectives can be set to improve or protect those areas within Scotland's river basin management planning process.

8.5.62. The nearest SWPAs are within the Moray Firth, namely Cromarty Bay and Dornoch Firth. However, both areas are located within the Inner Moray Firth, approximately 200 km to the west of the Proposed Development and subsequently outside of the study area. Therefore, there are no identified pathways for significant effects on the Moray Firth's SWPAs.

NUTRIENT VULNERABLE ZONES

8.5.63. The Nitrates Directive 91/676/ECC transposed into Scottish law via Action Programme for Nitrate Vulnerable Zones (Scotland) Regulations 2008 (as amended) (Table 8-1) aims to protect water quality across Europe and prevent nitrates from polluting the water environment. Areas where the concentrations of nitrate in water exceed, or are likely to exceed, the levels set in the Directive are designated as NVZs and mandatory rules, set out in Action Programmes, must be enforced to reduce nitrate loss from agricultural land and to protect human health and resources from water pollution. Of the five NVZs in Scotland, one falls in the MW&SQ study area, referred to as the Moray, Aberdeenshire/Banff and Buchanan NVZ. This means that farms in the NVZ must comply with the Action Programme for Nitrate Vulnerable Zones (Scotland) Regulations 2008. The Proposed Development will have limited

interaction with the NVZ with crossover only at landfall and is not anticipated to effect or be affected by the NVZ due to the proposed use of trenchless landfall techniques. Moreover, the coastal and transitional waterbodies along the MW&SQ study area an overall classification of 'Good Ecological Potential' or 'Excellent' indicating a high capacity to accommodate change (Table 8-16).

FUTURE BASELINE CONDITIONS

8.5.64. In line with the EIA regulations, this EIAR requires a "*description of the relevant aspects of the current state of the environment (baseline scenario) and an outline of the likely evolution thereof without implementation of the project as far as natural changes from the baseline scenario can be assessed with reasonable effort, on the basis of the availability of environmental information and scientific knowledge*". This reflects how the baseline relevant to MW&SQ is expected to evolve without the proposed development.

8.5.65. The baseline conditions relating to MW&SQ are not stationary and will adapt regardless of the Proposed Development being constructed. Despite being subject to ongoing research many predictions expect future increases in SPM levels causing reduced water clarity (Thewes *et al.*, 2022, Wilson and Heath, 2019). This is attributed to various marine factors including changing tidal ellipses from sea level rise and bed shear stress increases alongside terrestrial adaptations including increased land-based precipitation and subsequent run-off (Opdal *et al.*, 2019).

8.5.66. Contaminant levels within the sediments and biota of the North Sea have generally been shown to be reducing (OSPAR Commission, 2022). Contaminant release into the North Sea from both land-based sources and the Oil and Gas Industry has been observed to reduce since 2010; this is expected to continue due to improved regulation and diffuse pollution control initiatives (OSPAR Commission, 2017).

8.5.67. Seawater chemistry is a major component of MW&SQ impacts and climate models predict continued changes to pH, salinity and DO to occur in the future. Salinity is anticipated to reduce in Scottish waters by the end of this century (Dye *et al.*, 2020) due to changes in Atlantic Ocean circulation. Changes to pH are also predicted to reduce with future climate change. The global ocean will continue to uptake the excess atmospheric carbon dioxide resulting in a lower pH and increased ocean acidification with areas of seasonal stratification like the northern North Sea experiencing widespread occurrences of aragonite and calcite undersaturation by the end of the century (Humphreys *et al.*, 2020). Increases to temperature leading to extended stratification periods (Mahaffey *et al.*, 2020) are predicted to result in a reduction of DO.

8.5.68. Bacterial load is projected to improve through reduced anthropogenic inputs from wastewater treatment however the evolution of diffuse sources such as agricultural runoff is uncertain.

CLIMATE CHANGE EFFECTS

8.5.69. All the identified MW&SQ receptors could theoretically be impacted by climate change over the Proposed Developments operational lifespan. This section assesses the following aspects regarding climate change:

- The effect of climate change on the local environment in which the Proposed Development will take place; and
- The effect of climate change and the project together in combination on the local environment.

EFFECT OF CLIMATE CHANGE ON THE LOCAL ENVIRONMENT

8.5.70. The main climate trends associated with the identified MW&SQ receptors are as follows:

- Annual precipitation rates;
- Dissolved Oxygen;
- Sea Surface Temperature;
- Sea Surface Salinity;
- Increasing number of harmful algal blooms; and
- pH Levels.

8.5.71. Changing precipitation rates could influence inputs to the marine environment, particularly in coastal areas. Increases in precipitation could result in run-off increasing the nutrient inputs into coastal environments and reducing the local water quality.

8.5.72. Climate change is likely to result in ocean warming which in turn has a wealth of effects on the marine environment including, increased risk of harmful algal blooms and the intensity, duration and geolocation of phytoplankton blooms (Climate Exchange, 2016). Warming sea temperatures are likely to facilitate a northerly expansion of warm water species (Hallegraeff, 2010).

8.5.73. Sediment bound contaminants partition into the dissolved phase at differing rates based on water temperature, although changes in contaminant concentrations within the water column are likely to be minimal. Increase of 1°C between 2000 and 2040 and 1.6°C between 2000 and 2060 is predicted under Representative Concentration Pathway 8.5[7] (RCP) condition (NOAA, 2024).

8.5.74. Sea surface salinity is anticipated to reduce by 0.4 ppt between 2000 and 2040 and a further 0.4 ppt by 2060 as predicted under RCP-8.5 condition in the North Sea (NOAA, 2024).

8.5.75. Decreases to pH levels are well documented and the shelf bottom waters around the UK (depth <200 m) are projected to experience faster rates of decline in pH. This is due to the seasonal processes that influence the carbonate chemistry at depth that can exacerbate the global ocean acidification signal. For example, the average trends of pH in bottom waters in the Greater North Sea are -0.0040 yr^{-1} (RCP8.5) which is 15% more rapid than at surface. This difference is particularly evident in the central and northern part of the North Sea where stratification is more important (Findlay *et al.*,2022).

EFFECT OF CLIMATE CHANGE AND THE PROJECT ON THE LOCAL ENVIRONMENT

8.5.76. The proposed operational phase commencement (2034) of the Proposed Development would enable the use of renewable electricity which would result in a positive greenhouse gas impact, resulting in a beneficial effect for the lifespan of the Project (estimated to be approximately 35 years as per Volume 1, Chapter 3 (Project Description)).

8.5.77. The Proposed Development is not predicted to contribute to adverse impacts of climate change in the local area to any significant extent with regards to MW&SQ.

[7] RCP 8.5 is the highest baseline emissions scenario used in global climate models, assuming the greatest fossil fuel use and projects the highest amount of CO_2 emissions throughout this century. This high-emissions scenario is frequently referred to as "business as usual", suggesting that is a likely outcome if society does not make concerted efforts to cut greenhouse gas emissions.

CONCLUSION

8.5.78. The changes described above could theoretically cause measurable change in the study area baseline conditions over the operational lifespan of the Proposed Development however, the Proposed Development will not contribute to the impacts of climate change in the local area to a significant extent. Consequently, climate change does not alter the existing baseline or conclusions of the assessments made in relation to MW&SQ. In the absence of the Proposed Development being constructed, the evolution of the existing baseline is anticipated to continue.

DATA LIMITATIONS AND ASSUMPTIONS

8.5.79. Whilst many of the baseline characteristics are well understood, in some instances, data sources or assumptions are less well studied and/or quantified for the study area. This section seeks to identify areas of uncertainty and potential data gaps. Where possible, this assessment has been based on conservative assumptions, such as maximum design parameters and modelling options, in order to add additional precaution into its findings.

8.5.80. Several surveys undertaking grab samples have been conducted in the area which show good validation against the BGS predictive substrate model, including the project specific sediment sampling campaign (BGS, 2020, Figure 8-4). Therefore, the available data are considered sufficient to characterise the study (and wider) area. The seabed in the study (and wider) area is well studied and surveyed. As such, the available evidence base is sufficiently robust to underpin the assessment presented here and an overall high confidence is placed the characterisation of the baseline.

8.5.81. Uncertainty exists with regards to characterisation of the future baseline, including the potential changes in seawater chemistry which may occur. The current predictions model a range of climate projection scenarios via RCP 1.9 to RCP 8.5. However, it is not possible to accurately predict every factor capable of impacting the marine environment leading to potential inaccuracies. As the future baseline is characterised in regard to RCP 8.5, the worst-case climate scenario, the available evidence is considered sufficient for this MW&SQ chapter.

8.5.82. In addition to the uncertainty described above with the future baseline, there is some uncertainty associated with the assessment of sediment plumes and accompanying changes to bed levels due to construction related activities. This arises due to uncertainty regarding how the seabed geology will respond to drilling and jetting. The exact volume of material entrained into the water column will be dependent upon a number of factors including the type of drilling/ cable installation equipment used and the mechanical properties of the geological units. In the absence of detailed installation and construction methodologies from the appointed contractor, a series of potential release options have been considered. Together, these options capture the worst-case impacts in terms of the highest concentration suspended sediment plumes, the most persistent suspended sediment plumes, the maximum changes in bed level elevation and the greatest spatial extent of change in bed level. Therefore, no effects will arise which are worse than those presented in this chapter.

8.5.83. Where this activity occurs within one model cell, this process can be considered to occur at a sub-grid scale, with no meaningful interpretation for the size of the dispersal plume. Therefore, this has been supplemented with information based on expert judgement and analogous projects to allow meaningful interpretation.

8.5.84. The availability of data relevant for the characterisation and assessment of MW&SQ is such that, despite some data limitations, it is considered that a thorough and meaningful characterisation for the purposes of EIA can be undertaken. As such, the available evidence base is sufficiently robust to underpin the assessment presented here and an overall high confidence is placed on the assessment.

8.6. MW&SQ ASSESSMENT METHODOLOGY

8.6.1. Assessment of effects in this Chapter will follow the general approach outlined in Volume 1, Chapter 6 (Environmental Impact Assessment Methodology) of the EIAR.

8.6.2. MW&SQ specific assessment criteria and recognised guidance on assessing MW&SQ are provided below.

GUIDANCE

8.6.3. In addition to the general approach and guidance outlined in Volume 1, Chapter 6 (Environmental Impact Assessment Methodology), the MW&SQ assessment also considers the guidance documents presented in paragraph 8.3.3.

CRITERIA FOR ASSESSMENT

8.6.4. The process for determining the significance of effects is a two-stage process that involves defining the magnitude of the potential impacts and the sensitivity of the receptors. This section describes the criteria applied in this chapter to assign values to the magnitude of potential impacts and the sensitivity of the receptors.

8.6.5. The terms used to define impact magnitude and receptor sensitivity for MW&SQ are based on those described in further detail in Volume 1, Chapter 6 (Environmental Impact Assessment Methodology) of the EIAR.

MAGNITUDE

8.6.6. The magnitude criteria for MW&SQ are provided in Table 8-19. In determining magnitude, each assessment considered the spatial extent, duration, frequency, and reversibility of impact and these are outlined within the magnitude section of each assessment of impact (e.g., a duration of hours or days would be considered for most receptors to be of short-term duration, which is likely to result in a low magnitude of impact).

Table 8-19 Impact Magnitude Criteria for MW&SQ

Magnitude Value	Description
Negligible	Although there may be some impact upon water quality status, activities are predicted to occur over a short period. Any change to water quality status will be quickly reversed once activity ceases.
Low	Noticeable but not considered to be substantial changes to the water quality status of the receiving water feature. Activity is not likely to alter local status to the extent that water quality characteristics change considerably and/ or EQS become compromised.
Medium	Medium scale change to key characteristics of the water quality status of the receiving water feature. Water quality status is likely to take considerable time (e.g., a change in the annual average turbidity classification (UKTAG, 2014)) to recover to baseline conditions. Ability to meet EQS becomes compromised.
High	Large scale change to key characteristics of the water quality status of the receiving water feature. Water quality status degraded to the extent that a permanent or long-term change (i.e., a WFD reporting cycle) occurs. Inability to meet Environmental Quality Standard(s) (EQS) as a result of the proposed activities.

SENSITIVITY

8.6.7. Various designated waterbodies were identified within the MW&SQ study area. The quality of such waterbodies are designated in regard to the baseline environment and have varying requirements and sensitivity in relation to MW&SQ impacts. The MW&SQ receptors considered in this chapter include:

- Designated Bathing Waters;
- Designated coastal and transitional waterbodies;
- The wider marine environment.

8.6.8. The description of the baseline environment identified additional designated waters that will not be considered further in this assessment. Shellfish water protected areas, whilst important in relation to MW&SQ, are not considered due to the expansive distance from the study area (~200 km) and therefore have no impact-receptor pathway via MW&SQ.

8.6.9. Whilst NVZs do extend out to the coastal marine environment, the designations are concerned with nitrate pollution from agricultural sources. The Proposed Development's offshore construction, operation and decommissioning works are not anticipated to result in the introduction, release or disturbance of nitrates resulting in no LSE to MW&SQ.

8.6.10. Sensitive areas designated under the UWWTD, such as NVZs, extend out to the coastal marine environment and are designated in relation to wastewater and agricultural diffuse and point source discharges. As such it is considered that the Proposed Development will not result in LSE in relation to MW&SQ. The Cruden Bay sensitive area is considered further due to its concurrent designation as a Bathing Water.

8.6.11. The sensitivity criteria for MW&SQ receptors are provided in Table 8-20. The sensitivity of a receptor is a function of its capacity to accommodate change and reflects its ability to recover if it is affected. As such, it is quantified via a consideration of adaptability, tolerance, recoverability and value.

Table 8-20 Receptor Sensitivity Criteria for MW&SQ

Sensitivity Value	Description
Negligible	Specific water quality conditions of the receptor are likely to be able to tolerate change with very little or no impact upon the baseline conditions detectable.
Low	The water quality of the receptor supports or contributes towards the designation of an internationally or nationally important feature and has a high capacity to accommodate the proposed form of change to current water quality status. The proposed change to the receptor would be undetectable within one tidal cycle of the activity.
Medium	The water quality of the receptor supports or contributes towards the designation of an internationally or nationally important feature and has a moderate to low capacity to accommodate the proposed form of change to current water quality status.
High	The water quality of the receptor supports or contributes towards the designation of an internationally or nationally important feature and/ or has a very low capacity to accommodate any change to current water quality status.

8.6.12. By assigning and combining magnitude and sensitivity criteria, overall effect significance upon MW&SQ receptors can be determined (Table 8-21).

Table 8-21 Matrix Used for the Assessment of Significance of the Effect

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

8.6.13. A level of effect of moderate or more will be considered a 'significant' effect for the purpose 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.

8.6.14. With respect to assessment of effects to protected features in a Nature Conservation Marine Protected Area (NC MPA), a dedicated MPA assessment has been conducted for the Proposed Development, see Volume 3, Appendix 9.2 (Marine Protected Area Assessment Report). Specific consideration of MPAs is required for consent under Section 83 of the Marine (Scotland) Act 2010. The objective of the MPA assessment is to determine if the Proposed Development may result in significant effects on an MPA, and/or any ecological or geomorphological process on which the conservation of any protected feature in an MPA relies.

EMBEDDED COMMITMENTS

8.6.15. As part of the project design process, several designed-in measures have been proposed to reduce the potential for impacts on environmental receptors. As there is a commitment to implementing these measures, they are considered inherently part of the design of the Proposed Development and have therefore been considered in the assessment (i.e., the determination of magnitude and therefore significance assumes implementation of these measures). These measures are considered standard industry practice for this type of development. The embedded commitments relevant to MW&SQ are presented in Table 8-22. Volume 3, Appendix 6.1 (Commitments Register), provides additional information on how these commitments are secured.

8.6.16. The embedded commitments (C-01, C-02, C-03, C-05, C-06, C-08, C-09) collectively aim to mitigate the impact of offshore infrastructure on MW&SQ. Scour protection (C-01) helps reduce the erosion of sediment surrounding the Proposed Development's infrastructure. Adherence to the Cable Plan (CaP) (C-02), Development Specification and Layout Plan (DSLP) (C-03), Construction Method Statement (C-05) and Construction Programme (CoP) (C-06) ensures that installation, routing, and construction are optimised to minimise disruption to the sediment and quality of the surrounding waters. Setting out an Environmental Management Plan (EMP) (C-08) and a Decommissioning Programme (DP) (C-09) will mitigate against pollution during and in the long term of Proposed Development ensuring preservation of MW&SQ.

Table 8-22 Embedded Commitment Measures of relevance to MW&SQ

Code	Commitment	Type (Primary, Secondary or Tertiary)	How Commitment Secured
C-01	Scour protection or other appropriate mitigation to be employed around seabed infrastructure where there is the potential risk for significant scour to develop.	Tertiary	CaP Construction Method Statement (CMS)
C-02	Development of and adherence to a CaP. The CaP will confirm planned cable routing, installation methods, cable specifications and any additional protection and any post-installation monitoring.	Tertiary	CaP
C-03	Development of and adherence to a DSLP. The DSLP will confirm layout and relevant design parameters.	Tertiary	DSLP
C-04	The infrastructure will be designed in such a way to minimise the impacts and will be within the key parameters set out in the EIA Project Description and EIAR.	Primary	DSLP
C-05	Development of a CMS. This will detail the construction procedures (including piling), good working practices for constructing the works, and how the construction-related mitigation steps are to be delivered.	Tertiary	CMS
C-06	Development of and adherence to a Construction Programme (CoP). This will detail the timeline and duration of the primary construction and commissioning activities.	Tertiary	CoP
C-08	Development of and adherence to an EMP. This will set out mitigation measures and procedures relevant to environmental management, including but not limited to chemical usage, invasive and non-native species, pollution prevention and waste management.	Tertiary	EMP
C-09	Development of and adherence to a DP. The DP will outline measures for the decommissioning of the Proposed Development.	Tertiary	DP

IMPACTS SCOPED OUT OF THE ASSESSMENT

8.6.17. The impacts that have been scoped out of this MW&SQ assessment are presented in Table 8-23.

8.6.18. The decision to scope out impacts from further consideration for MW&SQ is informed by relevant stakeholder consultation conducted for the scoping report (see Section 8.4). The Offshore Scoping Report (Volume 3, Appendix 5.1 (Offshore Scoping Report)), the Muir Mhòr Offshore Wind Farm Offshore Scoping Opinion (Volume 3, Appendix 5.2 (Offshore Scoping Opinion)), along with understanding of the worst case design scenarios and environmental baseline conditions have informed the decision to scope these impacts out for further consideration in the EIA for MW&SQ.

Table 8-23 Impacts Scoped out of the MW&SQ assessment.

Impact Scoped Out	Justification
Construction	
Accidental releases or spills of materials or chemicals.	There is potential for some substances (such as grease, oil, fuel, grouting materials, anti-fouling paints, etc.) to be accidentally released/spilt into the marine environment. There are no discharges (either continuous or intermittent) of construction materials or chemicals which may be toxic or persistent in the environment proposed during the construction phase of the Proposed Development. Still, impacts are likely to be localised and short-lived. In the event of an accidental chemical or oil spill, hydrocarbons released would be rapidly dispersed or diluted. All vessels working on the proposed development will be required to adhere to strict environmental controls set out in Volume 4, Appendix 2 (Outline Environmental Management Plan) which will minimise the risks and set out provisions for responding to spills. Due to the implementation of control measures, and small quantities of chemical and hydrocarbons, it is proposed to scope this impact out of further consideration within the EIA. The Scottish Ministers agreed with the impacts scoped in and out of the EIAR and were content with the approach taken and provided no further comment (Volume 3, Appendix 5.2 (Offshore Scoping Opinion); Table 8-3).
Operation and Maintenance (O&M)	
Deterioration in water quality due to re-suspension and deposit of sediments from scour.	There is potential for elevated SSC resulting from scour around infrastructure, including foundations and cable protection. Considering that the volume of suspended sediment released during operation via scour would be far lower than then released during construction or repair activities, it is proposed for this impact to be scoped out from further consideration within the EIA. Moreover, the effects will be highly localised and associated volumes of mobile sediments are considered within the range of natural variability. The Scottish Ministers agreed with the impacts scoped in and out of the EIAR and were content with the approach taken and provided no further comment (Volume 3, Appendix 5.2 (Offshore Scoping Opinion); Table 8-3).
Changes in water and sediment quality associated with the cleaning of infrastructure.	Some routine maintenance activities on infrastructure (such as removal/cleaning of biofouling) have potential to result in reduced water and sediment quality in the immediate vicinity of the activity. These operational cleaning activities may release some substances, such as anti-fouling paint into the marine environment. Any potential impacts from these activities are expected to be highly localised, small scale, temporary, and short-lived. Risks will be managed through the embedded commitment measures presented (specifically C-08 in Volume 3, Appendix 6.1 (Commitments Register)). The Scottish Ministers agreed with the impacts scoped in and out of the EIAR and were content with the approach taken and provided no further comment (Volume 3, Appendix 5.2 (Offshore Scoping Opinion); Table 8-3).
Accidental release or spills of materials or chemicals.	There is potential for accidental spills or release of materials/chemicals during maintenance works from associated vessels during the O&M phase. However, impacts are anticipated as being short-lived and highly localised. In the event of an accidental spillage, hydrocarbons would be rapidly dispersed or diluted. Moreover, vessels associated with the proposed development will be required to comply with strict environmental controls set out in Volume 4, Appendix 2 (Outline Environmental Management Plan), which will minimise risk and set out

Impact Scoped Out	Justification
	provisions for responses to spills during O&M activities. Due to the implementation measures, and small quantities of chemical and hydrocarbons, it is proposed to scope this impact out of further consideration within the EIA. The Scottish Ministers agreed with the impacts scoped in and out of the EIAR and were content with the approach taken and provided no further comment (Volume 3, Appendix 5.2 (Offshore Scoping Opinion); Table 8-3).
Decommissioning	
Accidental releases or spills of materials or chemicals.	There is potential for some substances (such as grease, oil, fuel, grouting materials, anti-fouling paints, etc.) to be accidentally released/spilt into the marine environment. There are no discharges (either continuous or intermittent) of construction materials or chemicals which may be toxic or persistent in the environment proposed during the construction phase of the Proposed Development. Still, impacts are likely to be localised and short-lived. In the event of an accidental chemical or oil spill, hydrocarbons released would be rapidly dispersed or diluted. All vessels working on the proposed development will be required to adhere to strict environmental controls set out in Volume 4, Appendix 2 (Outline Environmental Management Plan) which will minimise the risks and set out provisions for responding to spills. Due to the implementation of control measures, and small quantities of chemical and hydrocarbons, it is proposed to scope this impact out of further consideration within the EIA. The Scottish Ministers agreed with the impacts scoped in and out of the EIAR and were content with the approach taken and provided no further comment (Volume 3, Appendix 5.2 (Offshore Scoping Opinion); Table 8-3).

WORST CASE DESIGN SCENARIO

8.6.19. The Developer has adopted a design envelope approach to impact assessment (also known as a 'Rochdale Envelope'). In line with guidance from the Scottish Government (2022), the design envelope approach offers flexibility in the EIA process by enabling impact assessment to be carried out against several potential design options.

8.6.20. The assessment of MW&SQ impacts has been undertaken with respect to the details provided in Volume 1, Chapter 3 (Project Description). A 'worst case' design scenario has been selected for each impact which would lead to the greatest impact for all receptors or receptor groups, when selected from a range of values. Effects of greater adverse significance are not predicted to arise should any other development scenario, based on details within Volume 1, Chapter 3 (Project Description) (e.g., different infrastructure layout), to that assessed here, be taken forward in the final design scheme.

8.6.21. The worst-case design scenario for each impact associated with the LSE assessment on MW&SQ, along with justification is provided in Table 8-24.

Table 8-24 Worst Case Design Scenarios with respect to the MW&SQ Assessment.

Impact	Embedded Commitment	Worst Case Design Scenario	Justification
Construction			
Impact 1: Deterioration in water quality due to re-suspension of sediments. Impact 2: Release of sediment bound contaminants from disturbed sediments. Impact 3: Deterioration in Bathing Water Quality (parameters relating to nearshore ECC and landfall only). Impact 4: Deterioration in status of WFD coastal and/ or transitional waterbodies (parameters relating to nearshore ECC and landfall only).	C-01, C-02, C-05, C-09	**Total SSC released because of construction activities = 12,718,023 m^3** **Foundation installation (without drilling) = 6,030,000 m^3** *WTGs:* • Maximum sediment disturbance volume from 67 floating WTGs using drag embedded anchors with nine anchors per foundation (603 anchors total * 200m drag * 50 m target box = 6,030,000 m^2 **Foundation with drilling = 478,782 m^3** *WTGs:* • Anchor piles with a maximum diameter of 4 m to be drilled to a depth of 60 m below the seabed = 754 m^3 of drill arisings per pile • Maximum volume of drill arisings from 67 floating WTGs using piled anchors with nine anchors per foundation (603 anchors total) = 454,662 m^3 *OEP(s):* • Piled foundations for two jacket foundation OEP(s) with a maximum pile diameter of 4 m to be drilled to a depth of 80 m below the seabed = 1,005 m^3 of drill arisings per pile • Maximum volume of drill arisings from two OEPs with piled foundations for each OEP having 2 piles per jacket leg and 6 jacket legs 12 piles total per OEP = 24,120 m^3 **Cable Installation = 1,432,800 m^3** *Inter-array cables* • Inter-array cable installation method = Jetting • Total IAC length on seabed = 250 km • IAC cable seabed width = 3 m • IAC cable burial depth = 2 m • IAC trench cross sectional area = 6 m^2 • Assuming 30% of material is forced into suspension in the water column • Maximum sediment disturbance volume = 250,000 m x 6 m^2 = 1,500,000 m^2 x 0.3 (spill factor) = 450,000 m^3 • Assumed maximum installation rate of up to 700 m/hr *OEP Interconnector Cable* • Interconnector cable installation method = Jetting • Total length of Interconnector cable 3 km • Interconnector cable seabed width = 3 m • Interconnector cable burial depth = 4 m (excludes burial in sandwaves of up to 20 m) • Interconnector cable trench cross sectional area = 12 m^2 • Assuming 30% of material is forced into suspension in the water column • Maximum sediment disturbance volume = 3 ,000 m x 12 m^2 x 0.3 (spill factor) = 10,800 m^3 • Assumed maximum installation rate of up to 700 m/hr *Export cables* • Export cable installation method = Jetting • Total length of three export cables = 270 km, each up to 90 km in length from array area to landfall • Export cable seabed width = 3 m	Defining the Worst-Case Design Scenario for sediment disturbance activities is highly complex as the disturbance will be temporally and spatially variable (depending upon the metocean conditions at the time). For sediment plumes, the Worst-Case Design Scenario is intended to be representative in terms of peak concentration, plume extent and plume duration but will not correspond to a single sediment disturbance activity. The same applies for sediment deposition at the bed, where the Worst-Case Design Scenario is a representation of maximum deposit thickness, maximum footprint extent or likely duration. **Seabed preparation prior to foundation installation** Seabed preparation works, including boulder clearance, would be required prior to installation of certain foundation types. **Foundation installation (without drilling)** The installation of certain anchoring options will result in the release of disturbed sediments. The greatest sediment release is anticipated to be from the installation of drag-embedded anchors, although the impact of potential sediment plumes is expected to be of relatively short duration and in close proximity to the bed. **Drilling as part of foundation installation** Of the anchoring options under consideration, the greatest sediment release is anticipated to be from the drilling of anchor piles. While some of the other options could result in the release of large sediment volumes (for example drag embedded anchors), the impact of these is expected to be of relatively short duration and in close proximity to the bed. Drilling has the potential to release larger volumes of relatively finer sediment because of the site geology. The worst-case assumption of the drill arisings being release at the surface of the water column

Impact	Embedded Commitment	Worst Case Design Scenario	Justification
		• Export cable burial depth = 4 m (excludes burial in sandwaves of up to 20 m) • Export cable trench cross sectional area = 12 m^2 • Assuming 30% of material is forced into suspension in the water column • Maximum sediment disturbance volume = 270 km x 12 m^2 x 0.3 (spill factor) = 972,000 m^3 • Assumed maximum installation rate of up to 700 m/hr **Seabed preparation for cable installation = 4,776,000 m^3** *Inter-array cables* • Seabed preparation method = PLGR • Total length inter-array cables = 250 km, up to 100% of which require seabed preparation • Maximum area of seabed affected = 250,000 m (100 % of total inter-array cable length) x 3 m (maximum width of disturbance) = 750,000 m^2 • Maximum sediment disturbance volume = 750,000 m (area affected) x 2 m depth = 1,500,000 m^3 OEP Interconnector Cable • Seabed preparation method = PLGR • Total length of up to three export cables = 3 km, up to 100 % of which require seabed preparation • Maximum area of seabed affected = 3,000 m (100 % of total interconnector cable length) x 3 m (maximum width of disturbance) = 9,000 m^2 • Maximum sediment disturbance volume = 9,000 m^2 (area affected) x 4 m depth = 36,000 m^3 *Export cables* • Seabed preparation method = PLGR • Total length of up to three export cables = 270 km, up to 100 % of which require seabed preparation • Maximum area of seabed affected = 270,000 m (100 % of total export cable length) x 3 m (maximum width of disturbance) = 810,000 m^2 • Maximum sediment disturbance volume = 810,000 m^2 (area affected) x 4 m depth = 3,240,000 m^3 **Horizontal Directional Drilling (HDD) drilling fluid release = 441 m^3** • 3 offshore HDD conduits and exit pits • Maximum volume of drilling fluid loss per conduit = 25 m^3 • Total drilling fluid loss = 75 m^3 • 20% of the cut volume would be released per conduit • Max 122 m^3 per conduit • Total other sediment lost = 366 m^3	has been adopted. **Cable Installation** Cable installation may require some combination of (e.g.) jetting, ploughing, trenching and/or cutting type installation techniques. The realistic worst-case option is represented using jetting, having the greatest potential to fluidise and suspend fine sediments and therefore resulting in the largest amount of displaced sediment in the water column, with a realistic trenching rate of 500 m/hr and maximum trenching rate of 700 m/hr representing the highest release rate of sediments, and operating in locations with the largest contribution of fine sediments. **HDD Operations** Although other trenchless installation technologies are available, HDD is the established solution and has therefore been identified as the realistic worst-case option. HDD operations are expected to have localised and short-term effects on SSC concentrations due to the potential release of bentonite (or drilling mud) during the punch-out in the nearshore exit pit. Accordingly, the total drilling fluid loss = 75 m^3 (3 conduits, 25 m^3 per conduit).
Impact 5: Deterioration in water clarity due to release of drilling fluid. (also Impacts 3 and 4 above)	C-02, C-08	**HDD drilling fluid and sediment release** • 3 offshore HDD conduits and exit pits • Maximum volume of drilling fluid loss per conduit = 25 m^3 • Total drilling fluid loss = 75 m^3 • 20% of the cut volume would be released per conduit • Max 122 m^3 per conduit • Total other sediment lost = 366 m^3	**HDD Operations** Although other trenchless installation technologies are available, HDD is the established solution and has therefore been identified as the realistic worst-case option. HDD operations are expected to have localised and short-term effects on SSC concentrations due to the potential release of bentonite (or drilling mud) during the punch-out in the nearshore exit pit. This scenario represents the maximum

Impact	Embedded Commitment	Worst Case Design Scenario	Justification
			volumes of drilling mud discharges into the marine environment. The worst-case scenario assumes that no drilling fluid will be captured and prevented from entering the marine environment.
Operation and Maintenance			
Impact 6: Deterioration in water quality due to re-suspension of sediments from O&M activities Impact 7: Deterioration in Bathing Water Quality (parameters relating to nearshore ECC and landfall only) Impact 8: Deterioration in status of WFD coastal and/ or transitional waterbodies (parameters relating to nearshore ECC and landfall only)	C-01, C-02	**Greatest potential for seabed disturbance and sediment resuspension:** Cable activities: Inter-array cable • Maximum cable length on seabed: 250,000 m^2 • Disturbance width 3 m • Maximum seabed disturbance area: 750,000 m^2 • Up to seven inter-array cable failures assumed throughout the lifetime of the wind farm, with 7,000 m (length) x 5 m (width) = 35,000 m^2 disrupted per repair, for a total impacted area of 245,000 m^2 over the lifetime of the Proposed Development (approximately 35 years). Export Cables • Maximum cable length on seabed: 270,000 m^2 • Disturbance width 3 m • Maximum seabed disturbance area: 810,000 m^2 • 1 repair per cable every 5 years, 7 repairs per cable over lifetime of the windfarm (35 years) x 3 export cables = 21 repairs in total. • Area per repair = 1,000 m length x * 50 m width (omega configuration) = 50,000 m^2 per repair • Total = 21 x 50,000 m^2 = 1,050,000 m^2 Interconnector cable • One repair every five years. O&M: • JUV Operations for WTGs are N/A for the Array Area, applies to nearshore port location only. • JUV footprint for WTGs and OEP(s) = 1800 m^2 • 5 JUV trips per year = 175 trips over 35 year project lifetime • Total = 1800 m^2 * 175 = 315,000 m^2	These activities identify the scenarios which represent the realistic worst-case option in terms of the greatest sediment volumes being disturbed and suspended into the water column.
Decommissioning			
Impact 9: Deterioration in water quality due to re-suspension of sediments Impact 10: Release of sediment bound contaminants from disturbed sediments Impact 11: Deterioration in Bathing Water Quality (parameters relating to nearshore ECC and landfall only) Impact 12: Deterioration in status of WFD coastal and/ or transitional waterbodies (parameters relating to nearshore ECC and landfall only)	C-01, C-08, C-09	• Removal of any structures is expected to be undertaken as an approximate reverse of the installation process; • Buried cables to be cut and left *in situ* (but to be determined in consultation with key stakeholders as part of the decommissioning programme and following best practice at the time); • Scour and cable protection left *in situ*; and • Decommissioning activities lasting approximately three years for both onshore and offshore works.	When removing seabed infrastructure, the greatest disturbance will be associated with the layout containing the greatest number of seabed structure.

8.7. ASSESSMENT OF POTENTIAL EFFECTS

8.7.1. Assessment of LSE on MW&SQ has been undertaken for all phases of the Proposed Development. A detailed description of each impact, informed by Volume 1, Chapter 3 (Project Description), baseline information and various analytical methods including modelling is provided below. A full blue carbon assessment is presented within Annex A of this Chapter.

CONSTRUCTION PHASE

IMPACT 1: DETERIORATION IN WATER QUALITY DUE TO RE-SUSPENSION OF SEDIMENTS

8.7.2. Offshore construction activities associated with the Proposed Development have the potential to increase SSC in the marine environment through the generation of sediment plumes from seabed disturbance. Seabed disturbance will occur as a result of:

- Seabed preparation including pre-lay grapnel runs (PLGR);
- Anchor foundation installation for WTGs;
- OEP foundation installation; and
- Cable installation.

8.7.3. Increases in SSC and consequently turbidity resulting from increased suspension of sediment may result in a decrease in the depth to which natural light can penetrate the water column. This in turn may result in a reduction in primary productivity and/or an increase in bacterial growth. The disturbance of the seabed sediments may also result in the release of additional nutrients which were sediment bound, therefore increasing their concentrations in the water column.

8.7.4. Fish and many other organisms need dissolved oxygen in the water to survive. Dissolved oxygen levels can decrease due to various factors, including rapid changes in temperature and salinity, as well as from the respiration of organic matter. Dissolved oxygen levels can also decrease as a reaction to nutrient inputs. When nutrient loading is too high, phytoplankton and/or seaweed can bloom and then die. Bacteria and other decomposer organisms then use oxygen to break down the available organic matter.

MAGNITUDE OF IMPACT

8.7.5. As presented in Volume 2, Chapter 7 (Marine and Coastal Processes), increases in SSC concentration resulting from cable installation activities such as trenching and burial in exceedance of 50 mg/l are anticipated to be short lived occurring for less than 7.2 hours. Increases above 10 mg/l would occur for less than six days. Following the end of the seabed disturbance, SSC quickly reduces to background concentrations with no increases in background concentrations within six days of the end of the installation activity. SPM background concentrations are typically low in the Array Area, with surface concentrations of up to 5 mg/l recorded between the period 1998 to 2015 (Figure 8-3; Cefas, 2016).

8.7.6. Increases in SSC resulting from anchor foundation installation with drilling was predicted to result in a low concentration sediment plume, with increases in SSC of more than 2 mg/l constrained to the drilling site and increases of more than 1 mg/l extending up to 12 km to the southwest occur for more than 7.2 hours. Volume 3, Appendix 7.2 (Marine Processes Modelling Report) assessed the drilling of anchor piles to have the greatest sediment release due to the large numbers of anchors and potential height of subsequent sediment plumes in comparison with drag embedment anchors. The maximum volume of drill arisings from the

two OEPs was calculated as 24,128 m^3 in comparison to the 454,662 m^3 from WTGs (Table 8-24). The maximum volume of disturbed sediment of seabed preparation for cable installation via PLGR was calculated at 4,619,400 m^3. Volume 3, Appendix 7.2 (Marine Processes Modelling Report) assessed the impacts of cable installation (inter-array and export cables) with peak SSC of more than 50 mg/l highly localised to the activity area occurring for less than 7.2 hours and 5 mg/l for less than six days for export cables. In comparison inter-array cables had peak SSC of more than 50 mg/l highly localised to the activity area occurring for less than 7.2 hours and 10 mg/l for less than six days.

8.7.7. Activities associated with the Proposed Development are not anticipated to affect phytoplankton or DO, as no nutrients are anticipated to be released in concentrations from the seabed beyond typical storm conditions (for a characterisation of the metocean regime the reader is referred to Volume 2, Chapter 7 (Marine and Coastal Processes)). The effects are also anticipated to be temporary due to the short-term nature of the proposed construction activities. In addition to the anticipated absence of significant nutrient releases there will not be any outfalls or discharges associated with the Proposed Development and as such the proposed activities are not expected to cause a reduction in the DO in the water column.

8.7.8. Bacterial mortality, including *E. coli* and IE, within the water column is strongly influenced by the amount of ultraviolet (UV) light penetrating the water column. Under higher UV scenarios, the mortality of bacteria is higher. Therefore, reduced water clarity due to cable installation works in the coastal waters (landfall works are assessed in Impact 5 (paragraph 8.7.52 *et seq*) could result in temporary increases in bacterial counts within the water column due to decreased bacterial mortality and UV light penetration within the water column, and potential release of sediment bound bacteria (including *E. coli* and IE). These elevated bacterial counts could potentially cause a water quality deterioration and should this occur at the identified Bathing Waters during the designated bathing season, it may cause a deterioration in their performance classification.

8.7.9. A deterioration in water quality due to sediment suspension is expected to be localised to the 15 km extent of the tidal ellipses in the study area and short-term due to the temporary nature of the Proposed Development activities. Following dispersion of the sediment plumes and subsequent increase in UV light penetration, the bacterial counts will return to baseline conditions. However, timescales are highly dependent on localised factors such as light radiation and oxidative stress (Rozen and Belkin, 2001). Available evidence, both from the dredging industry (Pennekamp, 1996) and offshore wind industry (Department for Business, Enterprise and Regulatory Reform ((BERR), 2008) would suggest that any SSC increases are temporary, comparative to increases due to storm events away from the disturbance point, and with elevated concentrations rapidly reducing following cessation of activities. The relative absence of fines and predominance of sands and gravels within the Array Area and offshore ECC is such that any suspended material is expected to rapidly return to the seabed, thus allowing the turbidity and inherently the water quality to return to baseline conditions. Further information on potential sediment mobility is available in Volume 3, Appendix 7.1 (Marine and Coastal Processes Technical Report). Therefore, it is considered that the magnitude of impact is likely to be low.

SENSITIVITY OF RECEPTOR

8.7.10. Receptors regarding MW&SQ have been split into three categories to accurately classify their sensitivity (designated Bathing Waters, designated coastal and transitional waters and local non-designated waters in the wider marine environment). Each category of receptors is assessed on an individual basis due to the varying classifications of each designated water in relation to their EQS.

8.7.11. The sensitivity of the identified Bathing Waters is considered to be low, for potential increased bacterial counts following prior increases to SSC. Both Cruden Bay and Peterhead (Lido) were designated 'Excellent' in the most recent 2023 classification (Table 8-17) and are therefore considered to possess a high capacity to accommodate the changes within natural variation.

8.7.12. The sensitivity of the coastal and transitional waterbodies is considered low, with respect to deteriorations in water quality. All designated coastal waterbodies were classified as 'High' or 'Good Ecological Potential' in the case of the HMWB Ugie Estuary to Buchan Ness (Peterhead). The transitional waterbody is also currently classified as 'High' under the WFD classifications (Table 8-16). The classifications indicate stable, healthy, and resilient baseline conditions with a high capacity to adapt to change and potential effects have been identified as temporary.

8.7.13. The sensitivity of the wider marine environments non-designated waters, such as those within the Array Area, are considered to be negligible to short-term and discrete reductions in water clarity, arising from the proposed construction activities. These waters do not contribute towards the designation of internationally or nationally important features and are able to tolerate change with very little impact upon the baseline conditions. There is no applicable quality status which may be affected by these works.

SIGNIFICANCE OF EFFECT

8.7.14. As with the sensitivity of receptors, the significance of effects has been separated into three categories due to the variation in classification and successive significance calculation.

8.7.15. The designated Bathing Waters of Cruden Bay and Peterhead (Lido) were classified as low sensitivity and, when applied to the low magnitude of impact result in a negligible significance of effect (not significant in EIA terms) in regard to deterioration in water quality due to re-suspension of sediments.

8.7.16. The designated coastal and transitional waterbodies were classified as low sensitivity and when applied to the low magnitude of impact results in a negligible significance of effect (not significant in EIA terms) in regard to deterioration in water quality due to re-suspension of sediments.

8.7.17. The wider marine environment is classified as having negligible sensitivity as a receptor and when applied to the low magnitude of impact results in a negligible significance of effect (not significant in EIA terms) in regard to deterioration in water quality due to re-suspension of sediments.

8.7.18. A summary of the impact magnitude, receptor sensitivity and significance of effect for MW&SQ receptors is presented in Table 8-25.

Table 8-25 Significance of Impact 1: Deterioration in water quality due to re-suspension of sediments

Receptor/Location	Magnitude	Sensitivity	Significance
Peterhead (Lido) Bathing Water	Low	Low	Negligible
Cruden Bay Bathing Water	Low	Low	Negligible
Ugie Estuary to Buchan Ness (Peterhead) Coastal Waterbody	Low	Low	Negligible
Cairnbulg Point to Ugie Estuary Coastal Waterbody	Low	Low	Negligible

Receptor/Location	Magnitude	Sensitivity	Significance
Ugie Estuary Transitional Waterbody	Low	Low	Negligible
Cruden Bay Coastal Waterbody	Low	Low	Negligible
Buchan Ness to Cruden Bay Coastal Waterbody	Low	Low	Negligible
Wider marine environment	Low	Negligible	Negligible

SECONDARY MITIGATION AND RESIDUAL EFFECT

8.7.19. No additional MW&SQ mitigation is considered necessary because the likely effect in the absence of further mitigation (beyond the embedded commitments outlined in Section 8.6) is not significant in EIA terms.

8.7.20. Although significant effects on MW&SQ receptors are not expected and hence no further mitigation is required, significant effects on breeding herring were identified as a result of the assessment of the potential for resettlement of SSC during the herring breeding season. As such, additional mitigation is presented in Volume 2, Chapter 10 (Fish and Shellfish Ecology) for that receptor and in Volume 4, Appendix 10 (In Principle Fish Mitigation Plan).

IMPACT 2: RELEASE OF SEDIMENT BOUND CONTAMINANTS FROM DISTURBED SEDIMENTS

8.7.21. As described in Impact 1 (paragraph 8.7.2 *et seq*), the construction of the Proposed Development has the potential to increase SSC in the marine environment through the generation of sediment plumes. Sediment disturbance will occur as a result of:

- Seabed preparation including PLGR ;
- Anchor foundation installation for WTGs;
- OEP foundation installation; and
- Cable installation.

8.7.22. Disturbed sediments from construction activities such as cable trenching and burial have the potential, whilst in suspension for sediment bound contaminants, such as metals, hydrocarbons and organic pollutants, to be released into the water column and lead to an adverse effect on water quality receptors. The outcome of such impact depends upon the existing volume and nature of contaminants present within the sediment with increased magnitude of impact likely in correlation with higher contamination levels. Further details of the potential disturbance to sediments during construction (including seabed preparation, WTGs and OEP(s) foundation installation and cable installation is presented in Impact 1 (paragraph 8.7.2 *et seq*).

MAGNITUDE OF IMPACT

8.7.23. The sediment bound contaminates within the Array Area and offshore ECC are defined in Section 8.5 utilising data from site-specific surveys (EGS, 2023). These surveys indicated that contamination levels are very low across the Array Area and offshore ECC, with only one slight exceedance of the defined ALs (Cefas, 2016) for Arsenic within the offshore ECC. As such, none of the contaminants are present in concentrations that would significantly affect surrounding environment. Therefore, regardless of the sediment disturbance volume, the low levels of contaminants limits their potential to become released following sediment disturbance.

8.7.24. Furthermore, under normal circumstances, very small concentrations of contaminants are expected to enter the dissolved phase, with the vast majority adhering to the sediment particles when temporarily entering suspension in the water column. Partition coefficients may be applied to estimate the concentration of the contaminants entering the dissolved phase which typically result in a reduction of several orders of magnitude than the concentrations associated with suspended sediments. As such, it is considered highly unlikely that the MAC EQS threshold will be exceeded for any of the substances as a result of disturbing sediment from the proposed activities. Given the low contamination concentrations and short-term nature of the works and presence of the sediment plumes, any small uplift in the water concentrations of contaminant substances would be anticipated to return to background levels very quickly.

8.7.25. The magnitude of this potential impact is considered to be low as a result of the short-term nature of the impact and low concentrations of identified contaminants. Furthermore, it is not anticipated that disturbance of any sediment bound contaminants would affect the marine environment as the potential impacts will be temporary in nature.

SENSITIVITY OF RECEPTOR

8.7.26. The sensitivity of the identified Bathing Waters is considered to be low, for potential increased contaminant levels from disturbed sediments as the qualifying features of designated Bathing Waters are not influenced by sediment contamination. Both Cruden Bay and Peterhead (Lido) were also designated 'Excellent' in the most recent 2023 classification (Table 8-17) and are therefore considered to possess a high capacity to accommodate changes in sediment contaminant concentrations within natural variation.

8.7.27. The sensitivity of the coastal and transitional waterbodies is considered low, with respect to increased contaminant levels from disturbed sediments. All designated coastal waterbodies were classified as 'High' or 'Good Ecological Potential' in the case of the HMWB Ugie Estuary to Buchan Ness (Peterhead). The transitional waterbody is also currently classified as 'High' under the WFD classifications (Table 8-16) indicating stable, healthy, and resilient baseline conditions with a high capacity to adapt to change and potential effects have been identified as temporary.

8.7.28. The sensitivity of the wider marine environments non-designated waters, such as those within the Array Area, are considered to be negligible to short term, discrete disturbances of sediments releasing sediment bound contaminants arising from the proposed construction activities. These waters do not contribute towards the designation of internationally or nationally important features and are able to tolerate change with very little impact upon the baseline conditions. There is no applicable quality status which may be affected by these works.

SIGNIFICANCE OF EFFECT

8.7.29. The designated Bathing Waters of Cruden Bay and Peterhead (Lido) were classified as low sensitivity and, when applied to the low magnitude of impact result in a negligible significance of effect (not significant in EIA terms) in regard to release of sediment bound contaminants from disturbed sediments.

8.7.30. The designated coastal and transitional waterbodies were classified as low sensitivity and when applied to the low magnitude of impact results in a negligible significance of effect (not significant in EIA terms) in regard to release of sediment bound contaminants from disturbed sediments.

8.7.31. The wider marine environment is classified as having negligible sensitivity as a receptor and when applied to the low magnitude of impact results in a negligible significance of effect (not

significant in EIA terms) in regard to release of sediment bound contaminants from disturbed sediments.

8.7.32. A summary of the impact magnitude, receptor sensitivity and significance of effect for MW&SQ receptors is presented in Table 8-26.

Table 8-26 Significance of Impact 2: Release of sediment bound contaminants from disturbed sediments

Receptor/Location	Magnitude	Sensitivity	Significance
Peterhead (Lido) Bathing Water	Low	Low	Negligible
Cruden Bay Bathing Water	Low	Low	Negligible
Ugie Estuary to Buchan Ness (Peterhead) Coastal Waterbody	Low	Low	Negligible
Cairnbulg Point to Ugie Estuary Coastal Waterbody	Low	Low	Negligible
Ugie Estuary Transitional Waterbody	Low	Low	Negligible
Cruden Bay Coastal Waterbody	Low	Low	Negligible
Buchan Ness to Cruden Bay Coastal Waterbody	Low	Low	Negligible
Wider marine environment	Low	Negligible	Negligible

SECONDARY MITIGATION AND RESIDUAL EFFECT

8.7.33. No additional MW&SQ mitigation is considered necessary because the likely effect in the absence of further mitigation (beyond the embedded commitments outlined in Section 8.6) is not significant in EIA terms.

IMPACT 3: DETERIORATION IN BATHING WATER QUALITY (PARAMETERS RELATING TO NEARSHORE ECC AND LANDFALL ONLY)

8.7.34. Deterioration in Bathing Water quality, specifically from nearshore and landfall parameters, would be restricted to sediment plume generation from cable installation and HDD operations as described in the worst case design scenario. Such activities have the potential to deteriorate Bathing Water quality via increased SPM causing subsequent bacterial mortality decreases as described in Impact 1 (paragraph 8.7.2 *et seq*), alongside disturbing sediment bound contaminants in the nearshore ECC as described in Impact 2 (paragraph 8.7.21 *et seq*).

MAGNITUDE OF IMPACT

8.7.35. As described in detail for Impact 1 (paragraph 8.7.2 *et seq*), deterioration in Bathing Water quality due to re-suspension of sediments is expected to be localised to the 15 km extent of tidal ellipses in the study area and short-term due to the temporary nature of the Proposed Development installation activities. Following dispersion of the sediment plumes and subsequent increase in UV light penetration, the bacterial counts will return to baseline levels. Available evidence would suggest that any increases in SSC are temporary, comparative to increases due to storm events away from the disturbance point, and with elevated

concentrations rapidly reducing following the cessation of activities. This is supported by the sediment modelling indicating that the export cable installation activities would result in SSC:

- Above 50 mg/l for less than 7.2 hours, highly localised to the point of disturbance; and
- 5 mg/l for less than six days.

8.7.36. Further, for HDD installation activities, concentrations SSC levels do not exceed 10 mg/l.

8.7.37. The closest Bathing Water is Peterhead (Lido) however, this is within the breakwaters across the entrance to Peterhead and the plume does not disperse into this region. The Bathing Water of Cruden Bay lies more than 10 km to the south of Peterhead, SSC above 0.5 mg/l is constrained to an area extending, approximately, 6 km to the north and south of the release point south as presented within Volume 3, Appendix 7.2 (Marine Processes Modelling Report).

8.7.38. The sediment bound contaminants within the offshore ECC are defined in Section 8.5 utilising data from site-specific surveys (EGS, 2023). These surveys indicate that contamination levels are very low across the offshore ECC with only one slight exceedance of the defined ALs (Cefas, 2016) for Arsenic within the offshore ECC. This exceedance was identified in the subtidal rather than intertidal area indicating this will not affect Peterhead (Lido) or Cruden Bay Bathing Waters. Based on the available evidence, it is therefore concluded that none of the contaminants were present in concentrations that would significantly affect the surrounding environment.

8.7.39. The relative absence of fines and predominance of sands and gravels is such that any suspended material is expected to rapidly, within the order of minutes, return to the seabed, thus allowing the turbidity (and therefore contaminants) and inherently the water quality to return to baseline conditions. Therefore, it is considered that the magnitude of impact is low.

SENSITIVITY OF RECEPTOR

8.7.40. The sensitivity of the identified Bathing Waters is considered to be low, in regard to the deterioration of Bathing Water quality due to potential source-receptor pathways from sediment plumes. Whilst unlikely to persist for long periods of time, due to the nature of the cable installation works, sediment plumes have the potential to reduce the excellent classification of the designated Bathing Waters (Table 8-17) of Cruden Bay and Peterhead (Lido) through decreased bacterial mortality. Therefore, Bathing Waters are considered to possess a high capacity to accommodate changes in water quality due to landfall and nearshore ECC works including HDD and cable installation.

SIGNIFICANCE OF EFFECT

8.7.41. The designated Bathing Waters of Cruden Bay and Peterhead (Lido) were classified as low sensitivity and, when applied to the low magnitude of impact result in a negligible significance of effect (not significant in EIA terms) in regard to deteriorations in Bathing Water quality.

8.7.42. A summary of the impact magnitude, receptor sensitivity and significance of effect for MW&SQ receptors is presented in Table 8-27

Table 8-27 Significance of Impact 3: Deterioration in Bathing Water quality (parameters relating to nearshore ECC and landfall only)

Receptor/Location	Magnitude	Sensitivity	Significance
Cruden Bay	Low	Low	Negligible
Peterhead (Lido)	Low	Low	Negligible

SECONDARY MITIGATION AND RESIDUAL EFFECT

8.7.43. No additional MW&SQ mitigation is considered necessary because the likely effect in the absence of further mitigation (beyond the embedded commitments outlined in Section 8.6) is not significant in EIA terms.

IMPACT 4: DETERIORATION IN STATUS OF WFD COASTAL AND/ OR TRANSITIONAL WATERBODIES (PARAMETERS RELATING TO NEARSHORE ECC AND LANDFALL ONLY)

8.7.44. Coastal and transitional waterbodies designated by the WFD are classified based on a variety of criteria including biological, chemical and hydromorphological elements. The same pathway of effects exist for deterioration in WFD status as Impact 3 (paragraph 8.7.34 *et seq*). Cable installation, including HDD fluid releases can cause sediment plumes and resuspension of sediment bound contaminants described in further detail in Impacts 1 and 2 (paragraphs 8.7.2 *et seq* and 8.7.21 *et seq*).

MAGNITUDE OF IMPACT

8.7.45. As described in detail for Impact 1 (paragraph 8.7.2 *et seq*), deterioration in WFD status due to re-suspension of sediments is expected to be localised to the 15 km extent of tidal ellipses in the study area and short-term due to the temporary nature of the proposed development activities. Following dispersion of the sediment plumes and subsequent increase in UV light penetration, the bacterial counts will return to baseline levels. Available evidence would suggest that any increases in SSC are temporary, comparative to increases due to storm events away from the disturbance point, and with elevated concentrations rapidly reducing following cessation of activities. As presented within Volume 3, Appendix 7.2 (Marine Processes Modelling Report) export cable installation activities would result in SSC above 50 mg/l for less than 7.2 hours highly localised to the area where the activity was being undertaken and more than 5 mg/l for less than six days. Inter-array cable installation would result in increases of more than 50 mg/l occurring for less than 7.2 hours and increases of more than 10 mg/l occurring for less than six days. Increases to SSC for HDD do not exceed 10 mg/l for drilling fluid release with increases above 0.5 mg/l extending approximately 6 km north and south of the release point.

8.7.46. The sediment bound contaminants within the nearshore ECC are defined in Section 8.5 utilising data from site-specific surveys (EGS, 2023). These surveys indicated that contamination levels are very low across the offshore ECC with only one slight exceedance of the defined ALs (Cefas., 2016) for arsenic within the offshore ECC. This exceedance was identified in the subtidal rather than intertidal area therefore it can be concluded that none of the contaminants were present in concentrations that would significantly affect the surrounding environment.

8.7.47. The relative absence of fines and predominance of sands and gravels is such that any suspended material is expected to rapidly, within the order of minutes, return to the seabed, thus allowing the turbidity (and therefore contaminants) and water quality to return to baseline conditions. In light of this, it is considered that the magnitude of impact is likely to be low.

SENSITIVITY OF RECEPTOR

8.7.48. The sensitivity of the coastal and transitional waterbodies is considered low (not significant in EIA terms), with respect to deteriorations in WFD status. All designated coastal and transitional waterbodies were classified as 'High' or 'Good Ecological Potential' in the case of the HMWB Ugie Estuary to Buchan Ness (Peterhead) under the WFD classifications (Table 8-16). Potential effects have been identified as temporary and the current and historical

classifications indicate stable, healthy, and resilient baseline conditions with a high capacity to adapt to change.

SIGNIFICANCE OF EFFECT

8.7.49. The designated coastal and transitional waterbodies were classified as low sensitivity to changes in WFD status and when applied to the low magnitude of impact results in a negligible significance of effect in regard to deterioration in WFD status.

8.7.50. A summary of the impact magnitude, receptor sensitivity and significance of effect for MW&SQ receptors is presented in Table 8-28

Table 8-28 Significance of Impact 4: Deterioration in status of WFD coastal and/ or transitional waterbodies (parameters relating to nearshore ECC and landfall only)

Receptor/Location	Magnitude	Sensitivity	Significance
Ugie Estuary to Buchan Ness (Peterhead) Coastal Waterbody	Low	Low	Negligible
Cairnbulg Point to Ugie Estuary Coastal Waterbody	Low	Low	Negligible
Ugie Estuary Transitional Waterbody	Low	Low	Negligible
Cruden Bay Coastal Waterbody	Low	Low	Negligible
Buchan Ness to Cruden Bay Coastal Waterbody	Low	Low	Negligible

SECONDARY MITIGATION AND RESIDUAL EFFECT

8.7.51. No additional MW&SQ mitigation is considered necessary because the likely effect in the absence of further mitigation (beyond the embedded commitments outlined in Section 8.6) is not significant in EIA terms.

IMPACT 5: DETERIORATION IN WATER CLARITY DUE TO RELEASE OF DRILLING FLUID

8.7.52. There is a requirement to use drilling mud, such as bentonite (or another inert mud), in order to undertake HDD and make landfall. Deterioration in water clarity will occur during the release of drilling mud within the intertidal area at the punch out point under the worst case design scenario.

8.7.53. Bentonite is a non-toxic, inert, natural clay mineral (<63 µm particle diameter). It is included in the 'List of Notified Chemicals' approved for use and discharge into the marine environment and is classified as a Group E substance under the Offshore Chemical Notification Scheme. Substances in Group E are defined as the group least likely to cause environmental harm and are "readily biodegradable and non-bioaccumulative". This is further supported by bentonite being included on the OSPAR List of Substances Used and Discharged Offshore which are considered to Pose Little or No Risk to the Environment (PLONOR).

8.7.54. This assessment has been based on the maximum bentonite volume which could be released into the environment, equivalent to 25 m^3 per cut for three cuts. Further representation of the numerical modelling results is given within Volume 3, Appendix 7.2 (Marine Processes Modelling Report) and Table 8-24 and presented in Figure 8-6. The principal issue for MW&SQ receptors relating to bentonite release into the water column is the potential for an

increase in SSC (and so turbidity) within the water column and potential reduction in bacterial mortality, as detailed in Impact 1 (paragraph 8.7.2 *et seq*). With the exception of the potential for increased turbidity from the release of bentonite, no other potential deterioration in water or sediment quality, such as the introduction of contaminants or nutrients, is anticipated.

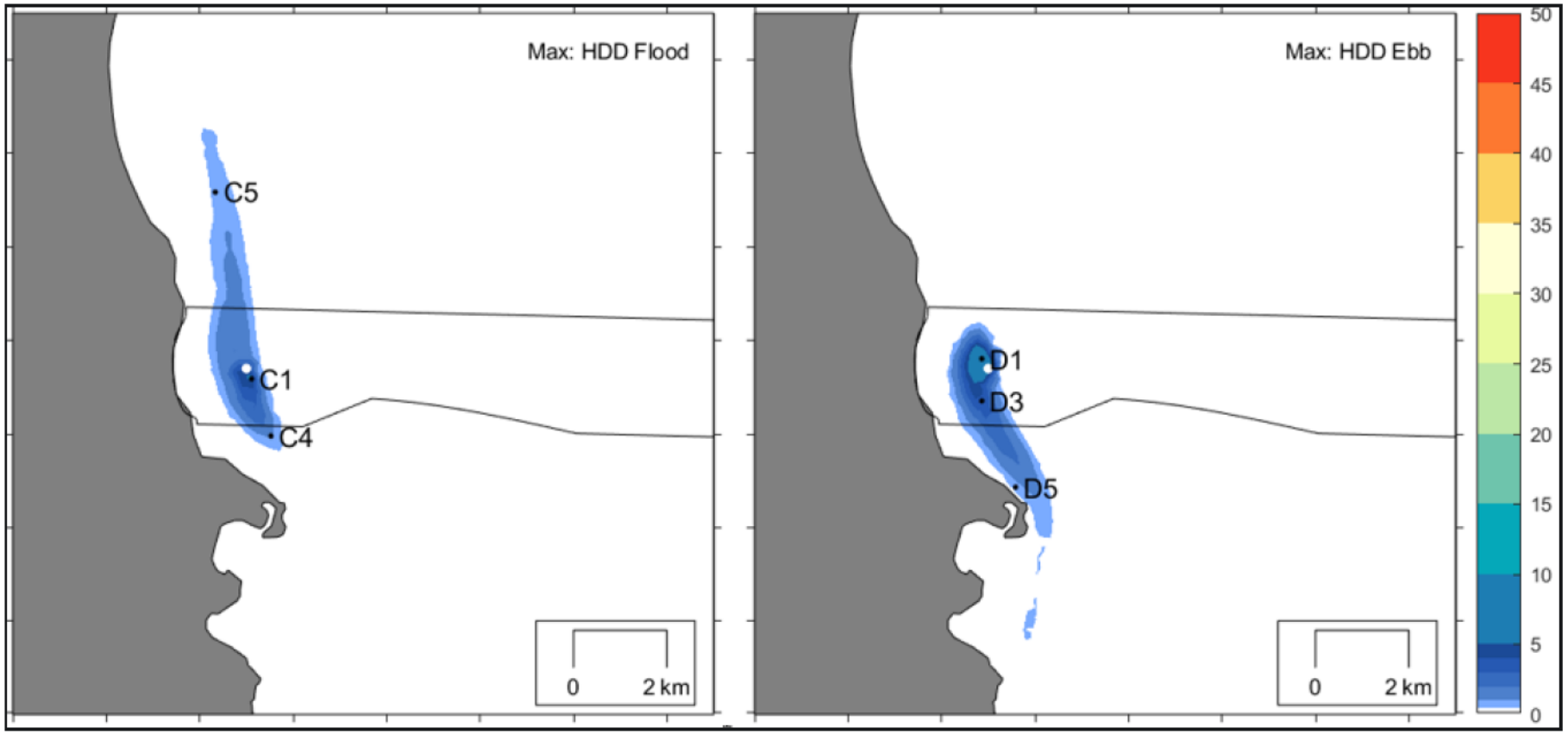


Figure 8-6 Modelled maximum SSC from the PT model simulation for HDD flood (left) and ebb (right) tide scenario.

MAGNITUDE OF IMPACT

8.7.55. Bentonite is a clay-based substance and as such may persist in suspension for hours to days (depending on the wave and tidal conditions) following its release, becoming diluted to very low concentrations (indistinguishable from natural background levels and variability). The majority of the plume will be advected in the direction of the ambient tidal currents, which are aligned as a north-south pattern as presented in Volume 2, Chapter 7 (Marine and Coastal Processes). The transport direction will depend upon the tidal state (flood/ ebb) during release, and it is expected that the plume would be dispersed to relatively low concentrations within hours of release and to background concentrations within a few tidal cycles. Project specific modelling was used to simulate the maximum SSC over a 15 day period is presented within Volume 3, Appendix 7.2 (Marine Processes Modelling Report). In summary, the modelling output showed that elevated SSC will be localised and temporary in extent with plume concentrations not exceeding 10 mg/l. Increased SSC greater than 0.5 mg/l is constrained to extending approximately 6 km north and south of the punch out point and therefore encompassed within the study area (Figure 8-6).

8.7.56. Background SSC concentrations are typically low within the offshore ECC, with surface concentrations of up to 5 mg/l recorded between the period 1998 to 2015 (Figure 8-3, Cefas, 2016).

8.7.57. As described in Impact 1 (paragraph 8.7.2 *et seq*), there is a relationship between increased turbidity and decreased bacterial mortality within the water column. However, given the predicted levels of dilution, the temporary nature of the activities, and dispersion from tidal currents of the SSC, it is expected that any increases in bacteria in the water column would be in the order of days. Following the dispersion of the bentonite plumes, and subsequent increases in UV light, the bacterial counts in the water column will return to “do-nothing” baseline conditions. The resultant decrease in water clarity would be analogous to storm events therefore these potential changes are considered to remain within the natural variation of the marine environment in the study area.

8.7.58. The elevation in SSC and potential decrease in bacterial mortality as a consequence of the release of inert drilling mud, such as bentonite, would likely be localised, within the range of natural variability and temporary. The magnitude of these elevated concentrations and potential bacterial counts on water quality receptors are considered to be low.

SENSITIVITY OF RECEPTOR

8.7.59. The sensitivity of the identified Bathing Waters is considered to below, for potential increased bacterial counts following prior increases to SSC from drilling fluid releases. Both Cruden Bay and Peterhead (Lido) were designated 'Excellent' in the most recent 2023 classification (Table 8-17) and are therefore considered to possess a high capacity to accommodate the changes within natural variation.

8.7.60. The sensitivity of all the coastal and transitional waterbodies is considered low, for deterioration in water clarity due to release of drilling fluid. All designated coastal waterbodies were classified as 'High' or 'Good Ecological Potential' in the case of the HMWB Ugie Estuary to Buchan Ness (Peterhead). The transitional waterbody is also currently classified as 'High' under the WFD classifications (Table 8-16). The classifications indicate stable, healthy, and resilient baseline conditions with a high capacity to adapt to change and potential effects have been identified as temporary.

8.7.61. The sensitivity of the wider marine environments non-designated waters, such as those within the Array Area are considered to be negligible to deterioration in water clarity due to release of drilling fluid. There is no applicable quality status which may be affected arising from the proposed construction activities and these waters do not contribute towards the designation

of internationally or nationally important features and are able to tolerate change with very little impact upon the baseline conditions.

SIGNIFICANCE OF EFFECT

8.7.62. The designated Bathing Waters of Cruden Bay and Peterhead (Lido) were classified as having low sensitivity and, when applied to the low magnitude of impact result in a negligible significance of effect (not significant in EIA terms) in regard to deterioration in water quality due to re-suspension of sediments.

8.7.63. The designated coastal and transitional waterbodies were classified as low sensitivity and when applied to the low magnitude of impact results in a negligible significance of effect (not significant in EIA terms) in regard to deterioration in water quality due to re-suspension of sediments.

8.7.64. The wider marine environment is classified as having negligible sensitivity as a receptor and when applied to the low magnitude of impact results in a negligible significance of effect (not significant in EIA terms) in regard to deterioration in water quality due to re-suspension of sediments.

8.7.65. A summary of the impact magnitude, receptor sensitivity and significance of effect for MW&SQ receptors is presented in Table 8-29.

Table 8-29 Significance of Impact 5: Deterioration in water clarity due to release of drilling fluid

Receptor/Location	Magnitude	Sensitivity	Significance
Peterhead (Lido) Bathing Water	Low	Low	Negligible
Cruden Bay Bathing Water	Low	Low	Negligible
Ugie Estuary to Buchan Ness (Peterhead) Coastal Waterbody	Low	Low	Negligible
Cairnbulg Point to Ugie Estuary Coastal Waterbody	Low	Low	Negligible
Ugie Estuary Transitional Waterbody	Low	Low	Negligible
Cruden Bay Coastal Waterbody	Low	Low	Negligible
Buchan Ness to Cruden Bay Coastal Waterbody	Low	Low	Negligible
Wider marine environment	Low	Negligible	Negligible

SECONDARY MITIGATION AND RESIDUAL EFFECT

8.7.66. No additional MW&SQ mitigation is considered necessary because the likely effect in the absence of further mitigation (beyond the embedded commitments outlined in Section 8.6) is not significant in EIA terms.

OPERATION AND MAINTENANCE

IMPACT 6: DETERIORATION IN WATER QUALITY DUE TO RE-SUSPENSION OF SEDIMENTS FROM O&M ACTIVITIES

8.7.67. As outlined in full for Impact 1 (paragraph 8.7.2 *et seq*), the re-suspension of sediments can result in the deterioration of water quality via sediment plumes and subsequent decreases to UV penetration and bacterial mortality. The same processes are applied to O&M activities resulting in seabed disturbance during the Proposed Development's operational lifetime.

MAGNITUDE OF IMPACT

8.7.68. The worst case design scenario quantifies the amount of seabed disturbance which will result in sediment suspension/resuspension during construction the magnitude of which is assessed in full for Impact 1 (paragraph 8.7.2 *et seq*). The Proposed Development activities resulting in re-suspension of sediments during O&M include:

- Cable repair/replacement;
- Cable reburial
- JUVs; and
- Catenary mooring chains

8.7.69. Cable maintenance will result in sediment disturbance across the of Array Area and offshore ECC however due to irregular nature of the work potential impacts would likely be more localised and occur over a shorter duration than those considered during the construction phase. Up to seven inter-array cable failures are anticipated during the approximately 35 year lifespan resulting in a maximum area of 245,000 m^2 of seabed affected in comparison to the maximum impacted area (750,000 m^2) from the construction phase (Table 8-24).

8.7.70. Catenary mooring chains may interact with the seabed sediments during operation during storm events in particular. Sediment may be re-suspended due to the drag effect of such chains however as described in Section 8.5 surficial sediments in the study area include a large fraction of sand and gravel and small proportions of fines. Large sediments are likely to return to the seabed rapidly and fines would remain in suspension for a limited period. Depending on the final design parameters this impact may be reduced if semi-taut, taut or tension mooring systems are favoured over catenary mooring. Further details on mooring systems are presented in Volume 1 Chapter 3. (Project Description) Although this will be an ongoing impact during the O&M phase of the Proposed Development, it is anticipated that the impacts will remain localised to the point of seabed disturbance.

8.7.71. The magnitude of the impacts on water quality resulting from O&M activities would be no greater than those assessed during construction (Impact 1 (paragraph 8.7.2 *et seq*)). Therefore, the magnitude of the impact is considered to be low for the potential changes in water quality due to re-suspension of sediments.

SENSITIVITY OF RECEPTOR

8.7.72. The sensitivity of the identified Bathing Waters is considered to be low, for potential increased bacterial counts following prior increases to SSC. Both Cruden Bay and Peterhead (Lido) were designated 'Excellent' in the most recent 2023 classification and are therefore considered to possess a high capacity to accommodate the changes within natural variation.

8.7.73. The sensitivity of the coastal and transitional waterbodies is considered low, with respect to deteriorations in water quality. All designated coastal waterbodies were classified as 'High' or 'Good Ecological Potential' in the case of the HMWB Ugie Estuary to Buchan Ness

(Peterhead). The transitional waterbody is also currently classified as 'High' under the WFD classifications (Table 8-16). The classifications indicate stable, healthy, and resilient baseline conditions with a high capacity to adapt to change and potential effects have been identified as temporary.

8.7.74. The sensitivity of the wider marine environments non-designated waters, such as those within the Array Area are considered to be low, due to the localised reductions in water quality from catenary mooring chains during O&M activities. These waters do not contribute towards the designation of internationally or nationally important features and are able to tolerate change with very little impact upon the baseline conditions. There is no applicable quality status which may be affected by these works.

SIGNIFICANCE OF EFFECT

8.7.75. The designated Bathing Waters of Cruden Bay and Peterhead (Lido) were classified as low sensitivity and, when applied to the low magnitude of impact result in a low significance of effect (not significant in EIA terms) in regard to deterioration in water quality due to re-suspension of sediments.

8.7.76. The designated coastal and transitional waterbodies were classified as low sensitivity and when applied to the low magnitude of impact results in a negligible significance of effect (not significant in EIA terms) in regard to deterioration in water quality due to re-suspension of sediments.

8.7.77. The wider marine environment is classified as having negligible sensitivity as a receptor and when applied to the low magnitude of impact results in a negligible significance of effect (not significant in EIA terms) in regard to deterioration in water quality due to re-suspension of sediments.

8.7.78. A summary of the impact magnitude, receptor sensitivity and significance of effect for MW&SQ receptors is presented in Table 8-30.

Table 8-30 Significance of Impact 6: Deterioration in water quality due to re-suspension of sediments from O&M activities

Receptor/Location	Magnitude	Sensitivity	Significance
Peterhead (Lido) Bathing Water	Low	Low	Negligible
Cruden Bay Bathing Water	Low	Low	Negligible
Ugie Estuary to Buchan Ness (Peterhead) Coastal Waterbody	Low	Low	Negligible
Cairnbulg Point to Ugie Estuary Coastal Waterbody	Low	Low	Negligible
Ugie Estuary Transitional Waterbody	Low	Low	Negligible
Cruden Bay Coastal Waterbody	Low	Low	Negligible
Buchan Ness to Cruden Bay Coastal Waterbody	Low	Low	Negligible
Wider marine environment	Low	Low	Negligible

SECONDARY MITIGATION AND RESIDUAL EFFECT

8.7.79. No additional MW&SQ mitigation is considered necessary because the likely effect in the absence of further mitigation (beyond the embedded commitments outlined in Section 8.6) is not significant in EIA terms.

IMPACT 7: DETERIORATION IN BATHING WATER QUALITY (PARAMETERS RELATING TO NEARSHORE ECC AND LANDFALL ONLY)

8.7.80. As detailed for Impact 3 (paragraph 8.7.34 *et seq*), sediment re-suspension can result in the deterioration of water quality via sediment plumes and subsequent decreases to UV penetration and bacterial mortality. The same processes are applied to O&M activities resulting in seabed disturbance (i.e. during the Proposed Development's operational lifetime).

MAGNITUDE OF IMPACT

8.7.81. Cable maintenance will result in sediment disturbance across the nearshore ECC however, due to irregular nature of the work potential impacts would likely be more localised and occur over a shorter duration than those considered during the construction phase. Given the tidal ellipses are orientated north-south (As described in Volume 2, Chapter 7 (Marine and Coastal Processes)), only O&M work in the intertidal offshore ECC could cause likely effect to either designated Bathing Water.

8.7.82. The magnitude of the effects on Bathing Water quality resulting from O&M activities would be less frequent and no greater than those assessed during construction (Impact 1 (paragraph 8.7.2 *et seq*)). Therefore, the magnitude of the impact is considered to be low for the potential changes in Bathing Water quality due to re-suspension of sediments and subsequent bacterial increases potentially effecting classification.

SENSITIVITY OF RECEPTOR

8.7.83. The sensitivity of the identified Bathing Waters is considered to be low, in regard to deterioration of Bathing Water quality due to potential source-receptor pathways from sediment plumes from cable maintenance activity. Whilst unlikely to persist for long periods of time due to the nature of the cable repair works, the potential to reduce the excellent classification of the designated Bathing Waters of Cruden Bay and Peterhead (Lido) through decreased bacterial mortality exists. Therefore, Bathing Waters are considered to possess a high capacity to accommodate changes in water quality within natural variation.

SIGNIFICANCE OF EFFECT

8.7.84. The designated Bathing Waters of Cruden Bay and Peterhead (Lido) were classified as low sensitivity and, when applied to the low magnitude of impact result in a negligible significance of effect (not significant in EIA terms) in regard to deteriorations in Bathing Water quality.

8.7.85. A summary of the impact magnitude, receptor sensitivity and significance of effect for MW&SQ receptors is presented in Table 8-31.

Table 8-31 Significance of Impact 7: Deterioration in Bathing Water quality (parameters relating to nearshore ECC and landfall only)

Receptor/Location	Magnitude	Sensitivity	Significance
Cruden Bay	Low	Low	Negligible
Peterhead (Lido)	Low	Low	Negligible

SECONDARY MITIGATION AND RESIDUAL EFFECT

8.7.86. No additional MW&SQ mitigation is considered necessary because the likely effect in the absence of further mitigation (beyond the embedded commitments outlined in Section 8.6) is not significant in EIA terms.

IMPACT 8: DETERIORATION IN STATUS OF WFD COASTAL AND/ OR TRANSITIONAL WATERBODIES (PARAMETERS RELATING TO NEARSHORE ECC AND LANDFALL ONLY)

8.7.87. Coastal and transitional waterbodies designated by the WFD are classified based on a variety of criteria including biological, chemical and hydromorphological elements. The same pathway of effects exists for deterioration in WFD status during O&M as Impact 4 (paragraph 8.7.44 *et seq*). Cable maintenance can cause sediment plumes and resuspension of sediment bound contaminants as described in further detail in Impacts 1 and 2 (paragraphs 8.7.2 *et seq* and 8.7.21 *et seq*).

MAGNITUDE OF IMPACT

8.7.88. As described in detail for Impact 1 (paragraph 8.7.2 *et seq*), a deterioration in WFD status due to re-suspension of sediments is expected to be localised to the 15 km extent of tidal ellipses in the study area and short-term due to the temporary nature of the proposed development activities. Following dispersion of the sediment plumes and subsequent increase in UV light penetration, the bacterial counts will return to baseline levels. Available evidence would suggest that any increases in SSC are temporary, comparative to increases due to storm events away from the disturbance point, and with elevated concentrations rapidly reducing following cessation of activities.

8.7.89. The sediment bound contaminants within the nearshore ECC are defined in Section 8.5 utilising data from site-specific surveys (EGS, 2023). These surveys indicated that contamination levels are very low across the offshore ECC with only one slight exceedance of the defined ALs (Cefas, 2016) for Arsenic within the offshore ECC. This exceedance was identified in the subtidal rather than intertidal area therefore it can be concluded that none of the contaminants were present in concentrations that would significantly affect the surrounding environment.

8.7.90. The relative absence of fines and predominance of sands and gravels is such that any suspended material is expected to rapidly, within the order of minutes, return to the seabed, thus allowing the turbidity (and therefore contaminants) and water quality to return to baseline conditions. In light of this, it is considered that the magnitude of impact is likely to be low.

SENSITIVITY OF RECEPTOR

8.7.91. The sensitivity of the coastal and transitional waterbodies is considered low, with respect to deteriorations in WFD status. All designated coastal and transitional waterbodies were classified as 'High' or 'Good Ecological Potential' in the case of the HMWB Ugie Estuary to Buchan Ness (Peterhead) under the WFD classifications (Table 8-16). Potential effects have been identified as temporary and the current and historical classifications indicate stable, healthy, and resilient baseline conditions with a high capacity to adapt to change.

SIGNIFICANCE OF EFFECT

8.7.92. The designated coastal and transitional waterbodies were classified as low sensitivity to changes in WFD status and when applied to the low magnitude of impact results in a negligible significance of effect (not significant in EIA terms) in regard to deterioration in WFD status.

8.7.93. A summary of the impact magnitude, receptor sensitivity and significance of effect for MW&SQ receptors is presented in Table 8-32.

Table 8-32 Significance of Impact 8: Deterioration in status of WFD coastal and/ or transitional waterbodies (parameters relating to nearshore ECC and landfall only)

Receptor/Location	Magnitude	Sensitivity	Significance
Ugie Estuary to Buchan Ness (Peterhead) Coastal Waterbody	Low	Low	Negligible
Cairnbulg Point to Ugie Estuary Coastal Waterbody	Low	Low	Negligible
Ugie Estuary Transitional Waterbody	Low	Low	Negligible
Cruden Bay Coastal Waterbody	Low	Low	Negligible
Buchan Ness to Cruden Bay Coastal Waterbody	Low	Low	Negligible

SECONDARY MITIGATION AND RESIDUAL EFFECT

8.7.94. No additional MW&SQ mitigation is considered necessary because the likely effect in the absence of further mitigation (beyond the embedded commitments outlined in Section 8.6) is not significant in EIA terms.

DECOMMISSIONING

IMPACT 9: DETERIORATION IN WATER QUALITY DUE TO RE-SUSPENSION OF SEDIMENTS

8.7.95. The Proposed Development infrastructure will be decommissioned in accordance with the Decommissioning Plan. Structures are proposed to be removed in reverse order of the installation procedure however aspects, in particular inter-array, interconnector and export cables, may be left *in situ* to minimise disturbance to the seabed. Removal of infrastructure may result in deterioration in water quality due to resuspension of sediments. Sediment plumes from decommissioning works are anticipated to act analogous to construction as described in Impact 1 (paragraph 8.7.2 *et seq*).

MAGNITUDE OF IMPACT

8.7.96. Impacts arising from decommissioning activities are considered to be similar, or less, than those which occur during construction. Therefore, the magnitude of the impact is considered to be low for potential changes in water quality due to the re-suspension of sediments.

SENSITIVITY OF RECEPTOR

8.7.97. The sensitivity of the identified Bathing Waters is considered to be low, for potential increased bacterial counts following prior increases to SSC. Both Cruden Bay and Peterhead (Lido) were designated 'Excellent' in the most recent 2023 classification and are therefore considered to possess a moderate capacity to accommodate the changes within natural variation.

8.7.98. The sensitivity of the coastal and transitional waterbodies is considered low, with respect to deteriorations in water quality. All designated coastal waterbodies were classified as 'High' or 'Good Ecological Potential' in the case of the HMWB Ugie Estuary to Buchan Ness

(Peterhead). The transitional waterbody is also currently classified as 'High' under the WFD classifications (Table 8-16). The classifications indicate stable, healthy, and resilient baseline conditions with a high capacity to adapt to change and potential effects have been identified as temporary.

8.7.99. The sensitivity of the wider marine environments non-designated waters, such as those within the Array Area are considered to be negligible, due to the localised reductions in water quality from decommissioning activities. There is no applicable quality status which may be affected by these works and these waters do not contribute towards the designation of internationally or nationally important features and are able to tolerate change with very little impact upon the baseline conditions.

SIGNIFICANCE OF EFFECT

8.7.100. The designated Bathing Waters of Cruden Bay and Peterhead (Lido) were classified as low sensitivity and, when applied to the low magnitude of impact result in a negligible significance of effect (not significant in EIA terms) in regard to deterioration in water quality due to re-suspension of sediments.

8.7.101. The designated coastal and transitional waterbodies were classified as low sensitivity and when applied to the low magnitude of impact results in a negligible significance of effect (not significant in EIA terms) in regard to deterioration in water quality due to re-suspension of sediments.

8.7.102. The wider marine environment is classified as having negligible sensitivity as a receptor and when applied to the low magnitude of impact results in a negligible significance of effect (not significant in EIA terms) in regard to deterioration in water quality due to re-suspension of sediments.

8.7.103. A summary of the impact magnitude, receptor sensitivity and significance of effect for MW&SQ receptors is presented in Table 8-33.

Table 8-33 Significance of Impact 9: Deterioration in water quality due to re-suspension of sediments

Receptor/Location	Magnitude	Sensitivity	Significance
Peterhead (Lido) Bathing Water	Low	Low	Negligible
Cruden Bay Bathing Water	Low	Low	Negligible
Ugie Estuary to Buchan Ness (Peterhead) Coastal Waterbody	Low	Low	Negligible
Cairnbulg Point to Ugie Estuary Coastal Waterbody	Low	Low	Negligible
Ugie Estuary Transitional Waterbody	Low	Low	Negligible
Cruden Bay Coastal Waterbody	Low	Low	Negligible
Buchan Ness to Cruden Bay Coastal Waterbody	Low	Low	Negligible
Wider marine environment	Low	Negligible	Negligible

SECONDARY MITIGATION AND RESIDUAL EFFECT

8.7.104. No additional MW&SQ mitigation is considered necessary because the likely effect in the absence of further mitigation (beyond the embedded commitments outlined in Section 8.6) is not significant in EIA terms.

IMPACT 10: RELEASE OF SEDIMENT BOUND CONTAMINANTS FROM DISTURBED SEDIMENTS

8.7.105. The Proposed Development infrastructure will be decommissioned in accordance with the decommissioning plan. Structures are proposed to be removed in reverse order of the installation procedure however aspects, in particular inter-array and export cables, may be left in situ to minimise disturbance to the seabed. Sediment plumes and subsequent release of contaminates into the water column from decommissioning works are anticipated to act analogous to construction as described in Impact 1 (paragraph 8.7.2 *et seq*) and Impact 2 (paragraph 8.7.21 *et seq*).

MAGNITUDE OF IMPACT

8.7.106. Impacts arising from decommissioning activities are considered to be similar, or less, than those which occur during construction (Impact 2 (paragraph 8.7.21 *et seq*)). Therefore, the magnitude of the impact is considered to be low for potential changes in water quality due to the re-suspension of sediments.

SENSITIVITY OF RECEPTOR

8.7.107. The sensitivity of the identified Bathing Waters is considered to be low, for potential increased contaminant levels from disturbed sediments as the qualifying features of designated Bathing Waters are not influenced by sediment contamination. Both Cruden Bay and Peterhead (Lido) were also designated 'Excellent' in the most recent 2023 classification and are therefore considered to possess a high capacity to accommodate changes in sediment contaminant concentrations within natural variation.

8.7.108. The sensitivity of the coastal and transitional waterbodies is considered low, with respect to increased contaminant levels from disturbed sediments. All designated coastal waterbodies were classified as 'High' or 'Good Ecological Potential' in the case of the HMWB Ugie Estuary to Buchan Ness (Peterhead). The transitional waterbody is also currently classified as 'High' under the WFD classifications (Table 8-16) indicating stable, healthy, and resilient baseline conditions with a high capacity to adapt to change and potential effects have been identified as temporary.

8.7.109. The sensitivity of the wider marine environments non-designated waters, such as those within the Array Area, are considered to be negligible to short term, discrete disturbances of sediments releasing sediment bound contaminants arising from the proposed decommissioning activities. These waters do not contribute towards the designation of internationally or nationally important features and are able to tolerate change with very little impact upon the baseline conditions and there is no applicable quality status which may be affected by these works.

SIGNIFICANCE OF EFFECT

8.7.110. The designated Bathing Waters of Cruden Bay and Peterhead (Lido) were classified as low sensitivity and, when applied to the low magnitude of impact result in a negligible significance of effect (not significant in EIA terms) in regard to release of sediment bound contaminants from disturbed sediments.

8.7.111. The designated coastal and transitional waterbodies were classified as low sensitivity and when applied to the low magnitude of impact results in a negligible significance of effect (not significant in EIA terms) in regard to release of sediment bound contaminants from disturbed sediments.

8.7.112. The wider marine environment is classified as having negligible sensitivity as a receptor and when applied to the low magnitude of impact results in a negligible significance of effect (not significant in EIA terms) in regard to release of sediment bound contaminants from disturbed sediments.

8.7.113. A summary of the impact magnitude, receptor sensitivity and significance of effect for MW&SQ receptors is presented in Table 8-34.

Table 8-34 Significance of impact 10: Release of sediment bound contaminants from disturbed sediments

Receptor/Location	Magnitude	Sensitivity	Significance
Peterhead (Lido) Bathing Water	Low	Low	Negligible
Cruden Bay Bathing Water	Low	Low	Negligible
Ugie Estuary to Buchan Ness (Peterhead) Coastal Waterbody	Low	Low	Negligible
Cairnbulg Point to Ugie Estuary Coastal Waterbody	Low	Low	Negligible
Ugie Estuary Transitional Waterbody	Low	Low	Negligible
Cruden Bay Coastal Waterbody	Low	Low	Negligible
Buchan Ness to Cruden Bay Coastal Waterbody	Low	Low	Negligible
Wider marine environment	Low	Negligible	Negligible

SECONDARY MITIGATION AND RESIDUAL EFFECT

8.7.114. No additional MW&SQ mitigation is considered necessary because the likely effect in the absence of further mitigation (beyond the embedded commitments outlined in Section 8.6) is not significant in EIA terms.

IMPACT 11: DETERIORATION IN BATHING WATER QUALITY (PARAMETERS RELATING TO NEARSHORE ECC AND LANDFALL ONLY)

8.7.115. Deterioration in Bathing Water quality, specifically from nearshore and landfall parameters, would be restricted to sediment plume generation from removal of structures as described in the worst case design scenario and decommissioning plan. Such activities have the potential to deteriorate Bathing Water quality via increased SPM causing subsequent bacterial mortality decreases as described in Impact 1 (paragraph 8.7.2 *et seq*), alongside disturbing sediment bound contaminants in the nearshore ECC as described in Impact 2 (paragraph 8.7.21 *et seq*).

MAGNITUDE OF IMPACT

8.7.116. The magnitude of impact, as described in detail for Impacts 1 and 3 (paragraphs 8.7.2 *et seq* and 8.7.34 *et seq*), at decommissioning will be equal to or less than that of construction, due to the potential for aspects of the Proposed Development's infrastructure to remain *in situ* as opposed to full removal taking place. In light of this, it is considered that the magnitude of impact is likely to be Low.

SENSITIVITY OF RECEPTOR

8.7.117. The sensitivity of the identified Bathing Waters is considered to be low, in relation to deterioration of Bathing Water quality due to potential source-receptor pathways from sediment plumes. Whilst unlikely to persist for long periods of time due to the nature of the cable installation works have the potential to reduce the excellent classification of the designated Bathing Waters of Cruden Bay and Peterhead (Lido) through decreased bacterial mortality. Therefore, Bathing Waters are considered to possess a high capacity to accommodate changes in water quality within natural variation.

SIGNIFICANCE OF EFFECT

8.7.118. The designated Bathing Waters of Cruden Bay and Peterhead (Lido) were classified as low sensitivity and, when applied to the low magnitude of impact result in a negligible significance of effect (not significant in EIA terms) in relation to deteriorations in Bathing Water quality.

8.7.119. A summary of the impact magnitude, receptor sensitivity and significance of effect for MW&SQ receptors is presented in Table 8-35.

Table 8-35 Significance of Impact 11: Deterioration in Bathing Water quality (parameters relating to nearshore ECC and landfall only)

Receptor/Location	Magnitude	Sensitivity	Significance
Cruden Bay	Low	Low	Negligible
Peterhead (Lido)	Low	Low	Negligible

SECONDARY MITIGATION AND RESIDUAL EFFECT

8.7.120. No additional MW&SQ mitigation is considered necessary because the likely effect in the absence of further mitigation (beyond the embedded commitments outlined in Section 8.6) is not significant in EIA terms.

IMPACT 12: DETERIORATION IN STATUS OF WFD COASTAL AND/ OR TRANSITIONAL WATERBODIES (PARAMETERS RELATING TO NEARSHORE ECC AND LANDFALL ONLY)

8.7.121. Coastal and transitional waterbodies designated by the WFD are classified based on a variety of criteria including biological, chemical and hydromorphological elements. The same pathway of effects exist for deterioration in WFD status during decommissioning as Impact 4 (paragraph 8.7.44 *et seq*). Removal of infrastructure can cause sediment plumes and resuspension of sediment bound contaminants less than or equivalent to construction as described in further detail in Impacts 1, 2 and 4 (paragraph 8.7.2 *et seq*, paragraph 8.7.21 *et seq,* and paragraph 8.7.44 *et seq*).

MAGNITUDE OF IMPACT

8.7.122. The magnitude of impact, as described in detail for Impacts 1 and 4 (paragraph 8.7.2 *et seq* and paragraph 8.7.44 *et seq*) at decommissioning will be equal to or less than that of construction, in light of this, it is considered that the magnitude of impact is likely to be low.

SENSITIVITY OF RECEPTOR

8.7.123. The sensitivity of the coastal and transitional waterbodies is considered low, with respect to deteriorations in WFD status. All designated coastal and transitional waterbodies were classified as 'High' or 'Good Ecological Potential' in the case of the HMWB Ugie Estuary to Buchan Ness (Peterhead) under the WFD classifications (Table 8-16). Potential effects have been identified as temporary and the current and historical classifications indicate stable, healthy, and resilient baseline conditions with a high capacity to adapt to change.

SIGNIFICANCE OF EFFECT

8.7.124. The designated coastal and transitional waterbodies were classified as low sensitivity to changes in WFD status and when applied to the low magnitude of impact results in a negligible significance of effect in (not significant in EIA terms) regards to deterioration in WFD status.

8.7.125. A summary of the impact magnitude, receptor sensitivity and significance of effect for MW&SQ receptors is presented in Table 8-36.

Table 8-36 Significance of Impact 12: Deterioration in status of WFD coastal and/ or transitional waterbodies (parameters relating to nearshore ECC and landfall only)

Receptor/Location	Magnitude	Sensitivity	Significance
Ugie Estuary to Buchan Ness (Peterhead) Coastal Waterbody	Low	Low	Negligible
Cairnbulg Point to Ugie Estuary Coastal Waterbody	Low	Low	Negligible
Ugie Estuary Transitional Waterbody	Low	Low	Negligible
Cruden Bay Coastal Waterbody	Low	Low	Negligible
Buchan Ness to Cruden Bay Coastal Waterbody	Low	Low	Negligible

SECONDARY MITIGATION AND RESIDUAL EFFECT

8.7.126. No additional MW&SQ mitigation is considered necessary because the likely effect in the absence of further mitigation (beyond the embedded commitments outlined in Section 8.6) is not significant in EIA terms.

PROPOSED MONITORING

8.7.127. No marine water and sediment quality monitoring is proposed to test the predictions made within the assessment of likely significant effects on marine water and sediment quality receptors as no likely significant effects were predicted during construction, O&M and decommissioning phases of the Proposed Development.

8.8. WHOLE PROJECT ASSESSMENT

8.8.1. The Proposed Development's infrastructure and activities are the focus of this EIAR. However, where the potential exists for onshore elements of the Project (the onshore infrastructure landward of MLWS) to impact the offshore receptors, these have been identified and assessed below in the Whole Project Assessment (WPA).

8.8.2. A separate onshore EIAR is being prepared which will provide a description of the onshore elements of the Project landward of MLWS, and an assessment of the associated LSE.

8.8.3. The elements of the MW&SQ environment relevant to the WPA are restricted to the near shore receptors due to the potential of additive or synergistic effects from onshore and offshore elements acting in combination. In this regard the following MW&SQ receptors will be assessed further:

- Peterhead (Lido) designated Bathing Water;
- Cruden Bay designated Bathing Water;
- Ugie Estuary to Buchan Ness (Peterhead) Coastal Waterbody;
- Cairnbulg Point to Ugie Estuary Coastal Waterbody;
- Cruden Bay Coastal Waterbody;
- Buchan Ness to Cruden Bay Coastal Waterbody; and
- Ugie Estuary Transitional Waterbody.

8.8.4. The wider marine environment is not considered in the WPA due to the lack of impact receptor pathways from onshore to offshore seaward of the coastal waterbodies.

CONSTRUCTION

ONSHORE

8.8.5. The onshore elements of the Project have the potential to overlap with the offshore elements due to construction activities occurring in the Scottish river basin district, specifically the Buchan Coastal and River Ugie catchments. A decrease in water quality from construction onshore in the aforementioned areas could theoretically reduce the EQS of the Cairnbulg Point to the Ugie Estuary and the Ugie Estuary to Buchan Ness (Peterhead) coastal waterbodies (Figure 8-5). The Buchan Coastal and River Ugie catchments drain into Cairnbulg Point to the Ugie Estuary and the Ugie Estuary to Buchan Ness (Peterhead) coastal waterbodies and, whilst no significant impacts in EIAR terms are predicted from offshore elements alone the potential for in combination effects of onshore and offshore elements exists.

8.8.6. The Ugie Estuary and Black Water – d/s St Fergus are classified as High and Good for overall status, respectively as presented in Table 8-18. These surface water classifications could be affected from onshore impacts and subsequently the status of the coastal waterbodies they discharge into. Embedded commitments and ensuring local and national regulations such as the Controlled Activities (Scotland) Regulations 2005 (CAR) are meticulously adhered to will act to reduce impacts on these waterbodies. The construction activities that have the potential to influence MW&SQ receptors are primarily HDD and cable installation. The implementation of HDD (assessed within Section 8.7) contributes to reducing environmental impacts from onshore activities in the marine environment as the majority of drilling fluid will be captured prior to release into the marine environment. Onshore cabling activities have the potential to impact the marine environment if contaminants, such as nitrates, are released into the watercourse. Following the CaP and best practice guidance, in combination with MW&SQ

receptors having a high capacity to adapt to change (Section 8.7), reduces the likelihood of this effect.

8.8.7. Given the measures to be adopted during construction, as presented above, it is not anticipated that there will be any significant effects from the onshore elements of the Project on MW&SQ receptors as all other activities from the onshore Proposed Development are fully terrestrial. Consequently, the potential for additive effects between the onshore and offshore activities on MW&SQ receptors is expected to be negligible and no significant effects in EIA terms are anticipated.

OPERATION AND MAINTENANCE

ONSHORE

8.8.8. No continuous deposits or releases from onshore aspects of the Project into the marine environment are anticipated during the O&M phase of the Proposed Development.

8.8.9. The potential for additive effects between the onshore and offshore activities on MW&SQ receptors is expected to be negligible and no significant effects in EIA terms are anticipated.

DECOMMISSIONING

ONSHORE

8.8.10. The Proposed Development infrastructure will be decommissioned in accordance with the DP. Structures are proposed to be removed as per best practice and relevant guidance documents. Aspects of the Project may be left *in situ* to minimise disturbance to the environment. The environmental impacts from onshore decommissioning works are anticipated to act analogous to construction.

8.8.11. Impacts arising from decommissioning activities are considered to be similar, or less, than those which occur during construction. Therefore, the impact for the potential for additive effects between the onshore and offshore activities on MW&SQ receptors is expected to be minor and no significant effects in EIA terms are anticipated.

8.9. CUMULATIVE EFFECTS ASSESSMENT

CEA METHODOLOGY

8.9.1. Effects of the Proposed Development alone are generally spatially restricted to being near the Array Area and offshore ECC. However, certain impacts have the potential to be observed over a wider area. These cumulative effects result from the Proposed Development, combined with the effects from other projects, on the same receptor or group of receptors.

8.9.2. Volume 1, Chapter 6 (Environmental Impact Assessment Methodology) details how potential cumulative effects will be assessed for the Proposed Development through a Cumulative Effects Assessment (CEA). A CEA screening process has identified the relevant other plans, projects, and activities which are to be included in the assessment. Those plans/projects relevant to the CEA for MW&SQ are illustrated in Figure 8-7. Information on each tiered project is given in Table 8-37.

8.9.3. For each of these relevant plans/projects, the most up-to-date publicly available project parameters have been used to inform the CEA.

8.9.4. These other plans or projects may present different levels of potential cumulative effect when combined with the Proposed Development, informed by each other plan/project's readiness and likelihood for actual operation. A tiered approach to the CEA is therefore applied here, allowing weighted assessment of cumulative effects.

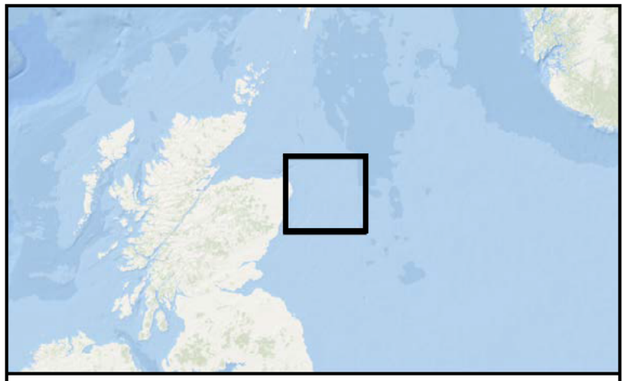
- **Tier 1** – The whole project (both onshore and offshore elements), combined with plans/projects which have become operational since the baseline characterisation of the Proposed Development, operational projects that have an ongoing impact, plus those that are consented and are yet to be constructed or under construction;
- **Tier 2** – All plans/projects assessed under Tier 1, plus those projects that have submitted a Scoping Report or those pending determination following a submitted application; and
- **Tier 3** – All plans/projects assessed under Tier 2, plus those projects that are not currently in the planning system but are likely to enter the planning system in the near future (e.g., Agreement for Lease (AfL) or projects at feasibility / early design stages) where information is available to inform the cumulative assessment and there is sufficient data confidence.

8.9.5. This CEA for MW&SQ has considered the worst-case design scenario for each of the projects, plans and activities in line with the methodology outlined in Volume 1, Chapter 6 (Environmental Impact Assessment Methodology). For potential effects on MW&SQ receptors, planned projects were screened into the assessment based on a screening range that encapsulates the Proposed Development temporally and spatially as defined by the construction/decommissioning dates and study area. The screening distance is based upon the expected maximum distance that suspended sediment could theoretically be transport by a single peak spring tide (15 km). Other plans/projects assessed to have a low level of data confidence were screened out of the CEA regardless of proximity to the Proposed Development. This screening criteria therefore encompasses the extent of cumulative impacts to MW&SQ associated with the Proposed Development's timeframes.

8.9.6. Assessment of potential cumulative impacts on MW&SQ receptors has been informed by project-specific modelling, and other analytic approaches.

600000
650000
6400000
6350000

36" GAS BRENT A - ST. FERGUS (FLAGS)
HFC TO ST. FERGUS SOUTH
SAGE PIPELINE
NORTH CONNECT
BRITANNIA TO ST FERGUS
BUZZARD (P) TO FORTIES HOT TAP
20/11a
20/12a
TAMPNET CNS FIBRE OPTIC
FORTIES C TO CRUDEN BAY (PL8) & (PL721)
Salamander
20" GAS FULMAR A - ST. FERGUS
HYWIND CABLES
Hywind
BUCHAN OIL FIELD (POWER FROM SHORE)
PETERHEAD TO DRAX HVDC (E4D3)
PETERHEAD TO SOUTH HUMBER (E4L5)



Legend:

- Array Area
- Offshore Export Cable Corridor
- MW&SQ Study Area
- Offshore Wind Farm Sites
- Green Volt Consented Offshore ECC
- Salamander Application Offshore ECC
- Open Disposal Sites
- Oil and Gas Licensed Blocks
- Oil and Gas Pipelines
- Subsea Cables
- Subsea Structures

Project:	Report:
Muir Mhòr	Environmental Impact Assessment Report

Other Plans/Projects Relevant to the MW&SQ Cumulative Effects Assessment

Figure: 8-7	Drawing No: GoBe-0146		
Revision:	Date:	Drawn:	Checked:
01	14/11/24	[Redacted]	

Map scale 1:450,000 @ A3

0 5 10 km

N

Co-ordinate system: ETRS 1989 UTM Zone 30N **EPSG:** 25830

MUIR MHÒR OFFSHORE WIND FARM
A joint venture between Fred. Olsen Seawind & Vattenfall

Table 8-37 Other Plans/Projects included in the MW&SQ CEA.

Plan/Project	Summary	Status	Distance from Array Area (km)	Distance from ECC (km)	Construction dates (if relevant)	Operational by (if relevant)	Summary of interaction with Proposed Development
Tier 1							
Offshore Energy							
Hywind Array	Floating offshore wind farm	Operational	35.56	0.06	N/A	2024	Potential for temporal overlap with Proposed Development construction, O&M and decommissioning phases. Overlap with study area.
Aggregate and Disposal Sites							
North Buchan Ness	Open sea disposal site	Active	59.85	0.98	N/A	2024	Operational phase interacts with O&M and construction phase of Proposed Development. Overlap with study area.
Peterhead Harbour	Open sea disposal site	Active	63.68	1.13	N/A	2024	Operational phase interacts with O&M and construction phase of Proposed Development. Overlap with study area.
Fraserburgh	Open sea disposal site	Active	72.62	13.52	N/A	2024	Operational phase interacts with O&M and construction phase of Proposed Development. Overlap with study area.
Cables and Pipelines							
Tampnet CNS Fibre Optic	Telecom	Operational	10.75	Intersects ECC	N/A	2024	Operational phase interacts with O&M and construction phase of Proposed Development. Overlap with study area.
FORTIES C to Cruden Bay	Pipeline - Water	Operational	10.82	Intersects ECC	N/A	2024	Operational phase interacts with O&M and construction phase of Proposed Development. Overlap with study area.
Hywind Cables	Power	Operational	36.61	Intersects ECC	N/A	2024	Operational phase interacts with O&M and construction phase of Proposed Development. Overlap with study area.
Green Volt Export Cables	Power	Consented	29.40	Intersects ECC	2025-2027	2028	Operational phase interacts with O&M and construction phase of Proposed Development. Overlap with study area.
NorthConnect	Scottish offshore wind cable	Consented	43.96	Intersects ECC	N/A	2024	Operational phase interacts with O&M and construction phase of Proposed Development. Overlap with study area.
Peterhead to Drax HVDC (E4D3)	Power cable	Consented	47.69	Intersects ECC	2024	2025	Operational phase interacts with O&M and

Plan/Project	Summary	Status	Distance from Array Area (km)	Distance from ECC (km)	Construction dates (if relevant)	Operational by (if relevant)	Summary of interaction with Proposed Development
							construction phase of the Proposed Development. Overlap with study area.
Peterhead to South Humber (E4L5)	Power	Construction	47.69	Intersects ECC	2024-2028	2029	Operational phase interacts with O&M and construction phase of the Proposed Development. Overlap with study area.
20" Gas Fulmar A – St Fergus	Pipeline - Chemical	Operational	1.46	0.45	N/A	2024	Operational phase interacts with O&M and construction phase of Proposed Development. Overlap with study area.
32 in MCP01 Bypass Bundle to St Fergus Gas Plant	Pipeline - Oil	Operational	50.03	1.58	N/A	2024	Operational phase interacts with O&M and construction phase of Proposed Development. Overlap with study area.
HFC to St Fergus South	Umbilical Hydraulic	Operational	50.10	1.60	N/A	2024	Operational phase interacts with O&M and construction phase of Proposed Development. Overlap with study area.
36" Gas Brent A – St Fergus (Flags)	Pipeline - Oil	Operational	55.14	1.72	N/A	2024	Operational phase interacts with O&M and construction phase of Proposed Development. Overlap with study area.
Britannia to St Fergus	Umbilical - Oil	Operational	27.69	2.66	N/A	2024	Operational phase interacts with O&M and construction phase of Proposed Development. Overlap with study area.
Sage Pipeline	Pipeline - Gas	Operational	40.36	2.71	N/A	2024	Operational phase interacts with O&M and construction phase of Proposed Development. Overlap with study area.
PL2074 FHT SPOOL	Pipeline - Gas	Operational	13.95	7.11	N/A	2024	Operational phase interacts with O&M and construction phase of Proposed Development. Overlap with study area.
Buzzard (P) TO Forties Hot Tap	Pipeline - Gas	Operational	13.96	7.17	N/A	2024	Operational phase interacts with O&M and construction phase of Proposed Development. Overlap with study area.
Oil and Gas							
Pierce SDS Manifold	Gas Manifold	Operational	52.91	4.66	N/A	2024	Operational phase interacts with O&M and construction phase of Proposed Development. Overlap with study area.

Plan/Project	Summary	Status	Distance from Array Area (km)	Distance from ECC (km)	Construction dates (if relevant)	Operational by (if relevant)	Summary of interaction with Proposed Development
Stella MDC Manifold	Gas Manifold	Operational	51.63	4.94	N/A	2024	Operational phase interacts with O&M and construction phase of Proposed Development. Overlap with study area
Machar Production Manifold	Gas Manifold	Operational	13.95	7.18	N/A	2024	Operational phase interacts with O&M and construction phase of Proposed Development. Overlap with study area
Shipping and Navigation							
Peterhead Port	Port	Operational	63.86	0.95	N/A	2024	Operational phase interacts with O&M and construction phase of Proposed Development. Overlap with study area.
Tier 2							
Offshore Energy[8]							
Salamander	Floating offshore wind farm	Awaiting determination	28.37	9.10	2028-2030	2031	Construction phase overlaps with the construction phase of the Proposed Development. Overlap with study area.
Cables and Pipelines							
Salamander Export Cables	Power	Awaiting determination	20.88	Intersects ECC	2026-2030	2031	
Tier 3							
No projects identified within spatial and temporal range or for which sufficient data is available to carry out assessment.							

[8] Despite the proximity (12.56 km) to the Proposed Development Campion Wind OWF was not considered within the CEA as it was assessed to have low data confidence.

WORST CASE DESIGN SCENARIO CEA

8.9.7. The MW&SQ CEA has been undertaken with respect to the details provided in Volume 1, Chapter 3 (Project Description). A 'worst case' design scenario has been selected for each cumulative impact which would lead to the greatest impact for all receptors or receptor groups, when selected from a range of values. Effects of greater adverse significance are not predicted to arise should any other development scenario, based on details within Volume 1, Chapter 3 (Project Description) (e.g., different infrastructure layout), to that assessed here, be taken forward in the final design scheme.

8.9.8. The worst-case design scenario for each cumulative impact associated with the MW&SQ CEA, along with justification, is provided in Table 8-38.

Table 8-38 Worst Case Design Scenarios with respect to the MW&SQ CEA

Cumulative Impact	Tier	Worst Case Design Scenario
Construction		
Cumulative effects resulting in deterioration in water quality due to re-suspension of sediments	**Tier 1** **Offshore Energy** • Hywind **Aggregates and Disposal** • North Buchan Ness • Peterhead Harbour • Fraserburgh **Cables and Pipelines** • Tampnet CNS fibre optic • Forties C to Cruden bay • Hywind Export Cables • Green Volt Export Cables • NorthConnect • Peterhead to Drax HVDC (E4D3) • Peterhead to South Humber (E4L5) • 20" Gas Fulmar A – St Fergus • 32 in MCP01 Bypass Bundle to St Fergus Gas Plant • HFC to St Fergus South • 36" Gas Brent A – St Fergus (Flags) • Britannia to St Fergus • Sage Pipeline • PL2074 FHT spool • Buzzard (P) to Forties hot tap **Oil and Gas** • Pierce SDS Manifold • Stella MDC Manifold • Machar Production Manifold **Shipping** • Peterhead	If the construction or operation (intermittent) activities overlap temporally with the construction of the Proposed Development, there is potential for cumulative increases to SSC.
Cumulative effects resulting in release of sediment bound contaminants from disturbed sediments		If the construction or operational (intermittent) activities overlap temporally with the construction of the Proposed Development, there is potential for cumulative increases to previously sediment bound contaminants in the water column.

Cumulative Impact	Tier	Worst Case Design Scenario
	Tier 2 **Offshore Energy** • Salamander **Cables and Pipelines** • Salamander Export Cables	
Operation and Maintenance		
Cumulative effects resulting in deterioration in water quality due to re-suspension of sediments	**Tier 1** **Offshore Energy** • Hywind **Aggregates and Disposal** • North Buchan Ness • Peterhead Harbour • Fraserburgh **Cables and Pipelines** • Tampnet CNS fibre optic • Forties C to Cruden bay • Hywind Export Cables • NorthConnect • Peterhead to Drax HVDC (E4D3) • Peterhead to South Humber (E4L5) • 20" Gas Fulmar A – St Fergus • 32 in MCP01 Bypass Bundle to St Fergus Gas Plant • HFC to St Fergus South • 36" Gas Brent A – St Fergus (Flags) • Britannia to St Fergus • Sage Pipeline • PL2074 FHT spool • Buzzard (P) to Forties hot tap **Oil and Gas** • Pierce SDS Manifold • Stella MDC Manifold • Machar Production Manifold **Shipping** • Peterhead **Tier 2** **Offshore Energy** • Salamander **Cables and Pipelines** • Salamander Export Cables	If the operational (intermittent) activities overlap temporally with the O&M of the Proposed Development, there is potential for cumulative increases to SSC.
Decommissioning		
Cumulative effects resulting in deterioration in water quality due to re-suspension of sediments	**Tier 1** **Offshore Energy** • Hywind	If the operational (intermittent) activities overlap temporally with the decommissioning of the Proposed Development, there is potential for

Cumulative Impact	Tier	Worst Case Design Scenario
	Aggregates and Disposal • North Buchan Ness • Peterhead Harbour • Fraserburgh **Cables and Pipelines** • Tampnet CNS fibre optic • Forties C to Cruden bay • Hywind Export Cables • NorthConnect • Peterhead to Drax HVDC (E4D3) • Peterhead to South Humber (E4L5) • 20" Gas Fulmar A – St Fergus • 32 in MCP01 Bypass Bundle to St Fergus Gas Plant • HFC to St Fergus South • 36" Gas Brent A – St Fergus (Flags) • Britannia to St Fergus • Sage Pipeline • PL2074 FHT spool • Buzzard (P) to Forties hot tap **Oil and Gas** • Pierce SDS Manifold • Stella MDC Manifold • Machar Production Manifold **Shipping** • Peterhead **Tier 2** **Offshore Energy** • Salamander **Cables and Pipelines** • Salamander Export Cables	cumulative increases to SSC.
Cumulative effects resulting in release of sediment bound contaminants from disturbed sediments		If the operational (intermittent) activities overlap temporally with either the decommissioning of the Proposed Development, there is potential for cumulative increases to previously sediment bound contaminants in the water column.

8.9.9. Due to the uncertainty associated with the exact timings of other projects and activities, there is insufficient data on which to undertake a quantitative or semi-quantitative assessment. As such, the discussion presented here is qualitative. Whilst each of the identified projects may undertake maintenance works such as asset reburial or repairs, these are likely to be infrequent occurrences during the lifetime of the respective projects.

8.9.10. Sediment plumes from O&M activities are generally short-lived, with major maintenance works infrequent. Any impacts from operational offshore windfarm export cables, pipelines, and O&G activities are therefore likely to be short-lived and of localised extent, with limited opportunity to overlap with the Proposed Development's activities. The likely cumulative impacts of the developments identified in Table 8-38, with respect to SSC and contamination, are considered below. Sediment plume modelling, presented in Volume 3, Appendix 7.2 (Marine Processes Modelling Report), provide evidence that sediment plumes may be advected from the Project infrastructure up to 15 km. This means that, should construction related activities connected to the Proposed Development be occurring at the same time as construction of Salamander OWF, there is the potential for cumulative changes in SSC.

CONSTRUCTION CEA

IMPACT 13 – CUMULATIVE EFFECTS RESULTING IN DETERIORATION IN WATER QUALITY DUE TO RE-SUSPENSION OF SEDIMENTS

8.9.11. Dredging and disposal, seabed preparation works, foundation and cable installation and maintenance works from other projects can cause temporary increases in SSC. Increases in SSC have the potential to cause a reduction of water quality through decreases to UV light penetration and subsequently bacterial mortality. This impact is associated primarily with construction and decommissioning phases of other projects due to the increased likelihood of sediment plume generation. The likely significant cumulative effects of Tier 1 and 2 projects, as a result of simultaneous sediment disturbance with the Proposed Development, are presented in the following sections.

TIER 1

8.9.12. Of the Tier 1 projects there is a potential for cumulative effects to occur through interactions between sediment plumes of individual projects within the MW&SQ study area due to the temporal and spatial crossover. A variety of projects have been identified within the study area and overlap of impact pathways known to disturb sediment can vary between the type of project/plan being considered. The following section will discuss the pathway in which each project may overlap to fully understand the cumulative magnitude of impact.

8.9.13. There is an overlap between the Proposed Development study area and several projects listed in Table 8-37 which have the ability to cause potential MW&SQ cumulative effects predominantly through sediment plume dispersion. The vast majority of Tier 1 projects are currently operational with Peterhead to South Humber (E4L5) and Green Volt Cables due to be operational prior to the commencement of the construction phase for the Proposed Development. Operational aspects of identified projects (excluding sea disposal sites) are considered highly unlikely to undertake routine maintenance work, in particular asset reburial or repairs, as these are infrequent occurrences during the lifetime of developments.

8.9.14. Both the Peterhead to South Humber (E4L5) and Green Volt Export Cables are due to make landfall within the vicinity of the Proposed Developments landfall. The construction period of the Proposed Development commences in 2029 (Volume 1, Chapter 3 (Project Description)) with the Green Volt construction phase identified as 2025 to 2027 and Peterhead to South Humber (E4L5) as 2024 to 2028. Of note, Green Volt (2024) concluded that no cumulative impacts were to occur due to temporal variations in construction programmes. Once constructed, despite the spatial overlap, these projects are not anticipated to cause ongoing SSC increases throughout the construction period of the Proposed Development.

8.9.15. Sea disposal sites can have various impacts on SSC in surrounding waters. For example, the depositing of material (i.e. dredged sediments or spoil) can result in sediment plumes of increased SSC of varying magnitude depending on the type of sediment deposited (e.g. coarse versus fine sediments). Generally, during spoil disposal, sediments will be discharged as a highly turbid dynamic plume, with the coarser sediment fraction falling quickly to the seabed with limited opportunity to be advected away by tidal currents. However, finer sediments found in the spoil will remain in suspension for longer, forming a plume that will likely be advected by tidal currents. Any resultant plume may have potential to impact water quality (e.g. reduction in light penetration and reduced bacterial mortality). Three open sea disposal sites (North Buchan Ness, Peterhead Harbour, Fraserburgh) were identified within the MW&SQ study area. Sediment plumes from sea disposal sites are considered to act in a similar manner to sediment plumes generated solely from Proposed Developments and spatial overlaps of sediment plumes from dredging or sea disposal activities will not occur frequently. As shown by modelling (Volume 3, Appendix 7.2 (Marine Processes Modelling

Report)), typically sediment plumes are rapidly indistinguishable from background levels within six days of cessation of activities. Therefore, no additive effect towards water quality deterioration from disturbed sediment is expected from sea disposal sites within the MW&SQ's study area.

TIER 2

8.9.16. The construction and O&M of Salamander OWF and Export Cables is expected to closely resemble the impacts caused by the Proposed Development due to the similarities in both design, timeframes and location. The construction dates for the Salamander development are expected to be 2028 to 2030 in comparison to the Proposed Development's 2029 to 2033. Similarities in surficial sediments shown in publicly available datasets further support the assumption that effects from re-suspended sediments will behave in the same way as from the Proposed Development. Increased SSC quickly dissipates following the cessation of activities with no increases in background concentrations within six days of the installation end. As such, it is not expected for there to be any additive process to increase SSC within the water column due to the Salamander project. Therefore, deterioration of water quality from disturbed sediments, when considered cumulatively, is still anticipated to be within the natural variation of the MW&SQ study area.

MAGNITUDE OF CUMULATIVE IMPACT

8.9.17. Due to uncertainties associated with the exact (day/month) timings of other plans and projects, there is insufficient data on either project scale or timings on which to undertake a quantitative or semi-quantitative assessment. As such, the discussion presented here is qualitative. It is considered highly unlikely that each of the identified operational projects (Table 8-37) would be undertaking routine maintenance work, in particular asset reburial or repairs, as these are infrequent occurrences during the lifetime of developments. Although there is a possibility of temporal overlap with the construction of Salamander, the exact dates remain uncertain. It should be noted that two concurrent sediment plumes would not travel towards each other as they are advected by the tide (predominantly north-south orientated). Given the low levels of sediment dispersion, as demonstrated by project-specific sediment modelling (Volume 3, Appendix 7.2 (Marine Processes Modelling Report)) increased SSC is restricted to the near-field only due to low current speeds and near seabed release point. There is not expected to be a notable spatial overlap with concentrated sediment plumes created during the construction of the Salamander project.

8.9.18. This comprehensive qualitative assessment of all identified projects[9] has determined that it is unlikely that a cumulative increase of SSC, or subsequent degradation of water quality, will occur. Moreover, when evaluating all projects cumulatively with the Proposed Development, they are not expected to generate additive SSC within the MW&SQ study area beyond those observed during natural storm events (Volume 2, Chapter 7 (Marine and Coastal Processes)). This can be explained by modelling results (Volume 3, Appendix 7.2 (Marine Processes Modelling Report)) which shows that in almost all cases, sediment plumes are indistinguishable from background levels within six days and restricted to the near-field area. Consequently, the likelihood of multiple sediment-disturbance activities occurring simultaneously and in close enough proximity that the tidal excursions and resultant sediment plumes overlap resulting in an additive effect is considered highly unlikely. Given the short-lived nature of sediment plumes and their highly localised behaviour, alongside the location of other infrastructure, there is not anticipated to be a notable overlap with concentrated sediment plumes created from other industry activities.

[9] encompassing sea disposal sites, ports, OWFs and their associated cables, subsea cables and pipelines, and O&G infrastructure

8.9.19. The potential increases in SSC, when considered cumulatively, are still anticipated to be within the natural variation of the MW&SQ study area, where no additive effect is expected to water clarity or bacterial mortality. Hence, even with the additional potential sediment disturbances introduced by other projects, the magnitude of the impact is considered to stay the same as the assessment of the Proposed Development alone. Therefore, when assessed cumulatively with Tier 1 projects, the magnitude of impact for Tier 2 is considered to be low.

SENSITIVITY OF RECEPTOR

8.9.20. As outlined in Impact 1 (paragraph 8.7.2 *et seq*), temporary increases in SSC could potentially result in a reduction in water clarity, primary production, bacterial mortality and DO concentrations and increased nutrients within the water column.

8.9.21. The sensitivity of MW&SQ receptors to cumulative effects resulting in deterioration in water quality due to re-suspension of sediments are the same as outlined in Impact 1. In summary, the sensitivity of Bathing Waters and coastal and transitional waterbodies are classified as low, and the wider marine environment is classified as negligible.

SIGNIFICANCE OF CUMULATIVE EFFECT

8.9.22. Taking the low sensitivity of both Peterhead (Lido) and Cruden Bay Bathing Waters and the low magnitude of impact into account, cumulative effects resulting in deterioration in water quality due to re-suspension of sediments during construction is considered to be negligible and not significant in EIA terms.

8.9.23. Taking the low sensitivity of all designated coastal and transitional waterbodies and the low magnitude of impact into account, cumulative effects resulting in deterioration in water quality due to re-suspension of sediments during construction is considered to be negligible and not significant in EIA terms.

8.9.24. Taking the negligible sensitivity of the wider marine environment and the low magnitude of impact into account, cumulative effects resulting in deterioration in water quality due to re-suspension of sediments during construction is considered to be negligible and not significant in EIA terms.

8.9.25. A summary of the cumulative impact magnitude, receptor sensitivity and significance of effect for MW&SQ receptors is presented in Table 8-39.

Table 8-39 Significance of Impact 13: Cumulative effects resulting in deterioration in water quality due to re-suspension of sediments

Receptor/Location	Magnitude	Sensitivity	Significance
Peterhead (Lido) Bathing Water	Low	Low	Negligible
Cruden Bay Bathing Water	Low	Low	Negligible
Ugie Estuary to Buchan Ness (Peterhead) Coastal Waterbody	Low	Low	Negligible
Cairnbulg Point to Ugie Estuary Coastal Waterbody	Low	Low	Negligible
Ugie Estuary Transitional Waterbody	Low	Low	Negligible
Cruden Bay Coastal Waterbody	Low	Low	Negligible
Buchan Ness to Cruden Bay Coastal Waterbody	Low	Low	Negligible
Wider marine environment	Low	Negligible	Negligible

SECONDARY MITIGATION AND RESIDUAL CUMULATIVE EFFECTS

8.9.26. No additional MW&SQ mitigation is considered necessary because the likely cumulative effect in the absence of further mitigation (beyond the embedded commitments outlined in Section 8.6) is not significant in EIA terms.

IMPACT 14 - CUMULATIVE EFFECTS RESULTING IN RELEASE OF SEDIMENT BOUND CONTAMINANTS FROM DISTURBED SEDIMENTS

8.9.27. The construction of the Proposed Development has the potential to increase contaminant levels in the marine environment through the generation of sediment plumes. Sediment disturbance will occur as a result of seabed preparation, foundation drilling and cable installation.

8.9.28. Whilst in suspension, there is the potential for sediment bound contaminants, such as metals, hydrocarbons and organic pollutants, to be released into the water column and lead to an adverse effect on water quality receptors. The outcome of such impact depends upon the existing volume and nature of contaminants present within the sediment with increased magnitude of impact likely in correlation with higher contamination levels. Further details of the potential disturbance to sediments during construction is presented in Impact 2 (paragraph 8.7.21 *et seq*).

8.9.29. As described in Section 8.5, the sediment bound contaminants across the Proposed Development were determined to be low concentration with only one exceedance of AL1 for Arsenic (EGS, 2023b) recorded in the area and was subsequently assessed to be insignificant in EIA terms.

TIER 1

8.9.30. If multiple sediment plumes were to occur cumulatively there is potential for previously low contaminant concentrations to become bioavailable at high enough concentrations in the water column to cause deterioration to MW&SQ receptors. As described in Impact 13 (paragraph 8.9.11 *et seq)*, the other projects of concern are sea disposal sites, the Green Volt development and Peterhead to South Humber (E4L5) due to the increased frequency of sediment disturbance. Both the Peterhead to South Humber (E4L5) and Green Volt Export Cables overlap spatially with the Proposed Development at landfall. The construction period of the Proposed Development commences in 2029 with the Green Volt construction phase identified as 2025 to 2027 and Peterhead to South Humber (E4L5) as 2024 to 2028. Of note, Green Volt (2024) concluded that no deterioration in water quality from sediment bound contaminants would occur. Once constructed, despite the spatial overlap, these projects are not anticipated to cause ongoing seabed disturbance that could additively contribute to contamination concentrations throughout the construction period of the Proposed Development.

8.9.31. North Buchan Ness, Peterhead Harbour and Fraserburgh sea disposal sites are required to assess dredged material for contaminants prior to disposal in order to reduce environmental impacts. Due to this embedded mitigation, sediment plumes from such sites are not anticipated to cause significant releases of sediment bound contaminants alone or when considered cumulatively due to the advection of tidal ellipses and dispersion rates in the region.

8.9.32. Operational aspects of identified cable projects are considered highly unlikely to undertake routine maintenance work within the MW&SQ study area, in particular asset reburial or repairs, as these are infrequent occurrences during the lifetime of developments. Sediment plumes from these projects are not anticipated to cause significant releases of sediment bound contaminants alone or when considered cumulatively due to the low proportion of contaminants, advection of tidal ellipses and dispersion rates in the region.

TIER 2

8.9.33. Impacts arising from the construction and O&M of the Salamander OWF and Export Cables are anticipated to be analogous with those of the Proposed Development due to the proposed location and type of activities. The construction dates for the Salamander development are expected to be 2028 to 2030 in comparison to the Proposed Developments 2029 to 2033. Despite the temporal and spatial overlap of the construction phases additive impacts of sediment contaminants are not anticipated due to the initial low concentrations and the likelihood of both export cables being constructed simultaneously. Salamander Offshore Wind Farm (2024) states *'The offshore export cables and inter-array cables may be installed in either the first or second year of offshore construction'* further reducing the likelihood of temporal overlap. In the unlikely event that both export cables are installed at the same time, vessel communication and management plans will limit the potential for sediment resuspension to be elevated beyond the project alone assessment. Furthermore, sediments in suspension are considered likely to act similarly to that of the Proposed Development alone when considered cumulatively due to the advection of tidal ellipses and dispersion rates in the region.

MAGNITUDE OF CUMULATIVE IMPACT

8.9.34. Typically, low concentrations of sediment bound contaminants enter to the dissolved phase within the water column, whilst the vast majority remain adhered to the sediment particles when temporarily entering suspension in the water column. Similar to the assessment of the Proposed Development alone, the sediment (and associated contaminants) from construction activities is expected to rapidly disperse with tidal currents. Therefore, any increase in contaminant bioavailability that could lead to deterioration in MW&SQ receptors is not expected. When assessed cumulatively with the Proposed Development and Tier 1 projects, the magnitude of the impact is considered to be low.

SENSITIVITY OF RECEPTOR

8.9.35. The sensitivity of the identified Bathing Waters is considered to be low, for potential increased contaminant levels from disturbed sediments as the qualifying features of designated Bathing Waters are not influenced by sediment contamination.

8.9.36. The sensitivity of the coastal and transitional waterbodies is considered low, with respect to cumulative increases contaminant levels from disturbed sediments.

8.9.37. The sensitivity of the wider marine environments non-designated waters, such as those within the Array Area, are considered to be negligible to short term, discrete disturbances of sediments resulting in cumulative release of sediment bound contaminants arising from the proposed construction activities due to the lack of applicable quality status which may be affected by these works.

SIGNIFICANCE OF CUMULATIVE EFFECT

8.9.38. Taking the low sensitivity of both Peterhead (Lido) and Cruden Bay Bathing Waters and the low magnitude of impact into account, cumulative effects resulting in deterioration in water quality due to re-suspension of sediments during construction is considered to be negligible and not significant in EIA terms.

8.9.39. Taking the negligible sensitivity of the wider marine environment and the low magnitude of impact into account, cumulative effects resulting in deterioration in water quality due to re-suspension of sediments during construction is considered to be negligible and not significant in EIA terms.

8.9.40. Taking the low sensitivity of all designated coastal and transitional waterbodies and the low magnitude of impact into account, cumulative effects resulting in deterioration in water quality

due to re-suspension of sediments during construction is considered to be negligible and not significant in EIA terms.

8.9.41. A summary of the cumulative impact magnitude, receptor sensitivity and significance of effect for MW&SQ receptors is presented in Table 8-40.

Table 8-40 Significance of Impact 14: Cumulative effects resulting in release of sediment bound contaminants from disturbed sediments

Receptor/Location	Magnitude	Sensitivity	Significance
Peterhead (Lido) Bathing Water	Low	Low	Negligible
Cruden Bay Bathing Water	Low	Low	Negligible
Ugie Estuary to Buchan Ness (Peterhead) Coastal Waterbody	Low	Low	Negligible
Cairnbulg Point to Ugie Estuary Coastal Waterbody	Low	Low	Negligible
Ugie Estuary Transitional Waterbody	Low	Low	Negligible
Cruden Bay Coastal Waterbody	Low	Low	Negligible
Buchan Ness to Cruden Bay Coastal Waterbody	Low	Low	Negligible
Wider marine environment	Low	Negligible	Negligible

SECONDARY MITIGATION AND RESIDUAL CUMULATIVE EFFECTS

8.9.42. No additional MW&SQ mitigation is considered necessary because the likely cumulative effect in the absence of further mitigation (beyond the embedded commitments outlined in Section 8.6) is not significant in EIA terms.

OPERATION AND MAINTENANCE CEA

IMPACT 15 - CUMULATIVE EFFECTS RESULTING IN DETERIORATION IN WATER QUALITY DUE TO RE-SUSPENSION OF SEDIMENTS

8.9.43. Activities associated with the O&M of the Proposed Development can cause sediment resuspension albeit less frequently than activities associated with construction or decommissioning. The processes associated with O&M activities resulting in deterioration of water quality are described in detail in Impact 6 (paragraph 8.7.67).

Tier 1

8.9.44. As discussed in Impact 13 (paragraph 8.9.11 *et seq*) for construction, operational Tier 1 projects MW&SQ impacts are anticipated to act in a similar manner to the Proposed Development when considered cumulatively due to the temporal and spatial similarities. As such no additive effects are expected due to the reduction in seabed disturbance and subsequent sediment plume generation from the construction to the operational phase of the Proposed Development.

TIER 2

8.9.45. As discussed in Impact 13 (paragraph 8.9.11 *et seq*) for construction impacts, O&M impacts arising from the Salamander project are anticipated to act analogously to the Proposed Development alone with no additive effects expected. The magnitude of the impacts on water quality resulting from O&M activities would be no greater than those assessed during construction. The overall probability of cumulative increases in SSC is substantially reduced compared to the potential overlaps assessed during the construction phase of the Proposed

Development. Therefore, the potential increases in SSC, when considered cumulatively, are still anticipated to be within the natural variation of the MW&SQ Study Area, where no additive effect is expected to water clarity or bacterial mortality

MAGNITUDE OF CUMULATIVE IMPACT

8.9.46. Sediment plumes generated by other projects considered here are anticipated to behave in a similar pattern as the sediments being disturbed for the Proposed Development due to expected similarities in operational design combined with a similar environmental setting and sediment characteristics. The potential increases in SSC, when considered cumulatively, are still anticipated to be within the natural variation within the MW&SQ study area. Therefore, the potential cumulative effects on water quality due to resuspended sediments are deemed to be comparable to the Proposed Development alone and as such are considered low (When considered cumulatively with Tier 1 projects).

SENSITIVITY OF RECEPTOR

8.9.47. The sensitivity of the identified Bathing Waters is considered to be low, for potential increased bacterial counts following prior increases to SSC. Both Cruden Bay and Peterhead (Lido) are therefore considered to possess a moderate capacity to accommodate the changes within natural variation.

8.9.48. The sensitivity of the identified coastal and transitional waterbodies is considered low, with respect to cumulative deteriorations in water quality. All designated coastal and transitional waterbodies were classified as 'High' or 'Good Ecological Potential' in the case of the HMWB Ugie Estuary to Buchan Ness (Peterhead) indicating a stable, healthy and resilient environment with a high capacity to adapt to change.

8.9.49. The sensitivity of the wider marine environments non-designated waters, such as those within the Array Area are considered to be low, due to the localised reductions in water quality from catenary mooring chains during O&M activities. There is no applicable quality status which may be affected by these works.

SIGNIFICANCE OF CUMULATIVE EFFECT

8.9.50. The designated Bathing Waters of Cruden Bay and Peterhead (Lido) were classified as low sensitivity and, when applied to the low magnitude of impact result in a negligible significance of effect in regard to cumulative effects resulting in deterioration in water quality due to re-suspension of sediments.

8.9.51. The designated coastal and transitional waterbodies were classified as low sensitivity and when applied to the low magnitude of impact results in a negligible significance of effect in regard to cumulative effects resulting in deterioration in water quality due to re-suspension of sediments.

8.9.52. The wider marine environment is classified as having negligible sensitivity as a receptor and when applied to the low magnitude of impact results in a negligible significance of effect in regard to cumulative effects resulting in deterioration in water quality due to re-suspension of sediments.

8.9.53. A summary of the cumulative impact magnitude, receptor sensitivity and significance of effect for MW&SQ receptors is presented in Table 8-41.

Table 8-41 Significance of Impacts 15: Cumulative effects resulting in deterioration in water quality due to re-suspension of sediments

Receptor/Location	Magnitude	Sensitivity	Significance
Peterhead (Lido) Bathing Water	Low	Low	Negligible
Cruden Bay Bathing Water	Low	Low	Negligible
Ugie Estuary to Buchan Ness (Peterhead) Coastal Waterbody	Low	Low	Negligible
Cairnbulg Point to Ugie Estuary Coastal Waterbody	Low	Low	Negligible
Ugie Estuary Transitional Waterbody	Low	Low	Negligible
Cruden Bay Coastal Waterbody	Low	Low	Negligible
Buchan Ness to Cruden Bay Coastal Waterbody	Low	Low	Negligible
Wider Marine Environment	Low	Low	Negligible

SECONDARY MITIGATION AND RESIDUAL CUMULATIVE EFFECTS

8.9.54. No additional MW&SQ mitigation is considered necessary because the likely cumulative effect in the absence of further mitigation (beyond the embedded commitments outlined in Section 8.6) is not significant in EIA terms.

DECOMMISSIONING CEA

IMPACT 16 - CUMULATIVE EFFECTS RESULTING IN DETERIORATION IN WATER QUALITY DUE TO RE-SUSPENSION OF SEDIMENTS

8.9.55. The Proposed Development infrastructure will be decommissioned in accordance with the decommissioning plan. Structures are proposed to be removed in reverse order of the installation procedure however aspects, in particular inter-array and export cables, may be left in situ to minimise disturbance to the seabed. Sediment plumes from decommissioning works are anticipated to act analogous to construction and therefore cumulative effects from resuspension of sediments are anticipated to be equal to or less than construction as described in Impact 12.

TIER 1

8.9.56. Tier 1 projects are currently operational, and resuspension of sediments are anticipated to occur infrequently, predominantly from repairs or reburial works as described in Impact 12. The decommissioning phase of the Proposed Development will result in less seabed disturbance than construction and consequently no additive effects are anticipated.

TIER 2

8.9.57. The Salamander project is expected to begin decommissioning prior to the Proposed Development based on the currently available proposed timescales. The impacts arising from decommissioning works are expected to be lower than that of construction (Impact 12) and

therefore additive effects when considering the projects cumulatively are not anticipated to be significant.

MAGNITUDE OF CUMULATIVE IMPACT

8.9.58. Impacts arising from decommissioning activities are considered to be similar, or less, than those which occur during construction. Therefore, cumulatively with Tier 1 projects, the magnitude of the impact is considered to be low for potential changes in water quality due to the re-suspension of sediments.

SENSITIVITY OF RECEPTOR

8.9.59. As outlined in Impact 1 (paragraph 8.7.2 *et seq*), temporary increases in SSC could potentially result in a reduction in water clarity, primary production, bacterial mortality and DO concentrations and increased nutrients within the water column.

8.9.60. The sensitivity of MW&SQ receptors to cumulative effects resulting in deterioration in water quality due to re-suspension of sediments are the same as outlined in Impact 1 (paragraph 8.7.2 *et seq*). In summary, the sensitivity of Bathing Waters and coastal and transitional waterbodies are classified as low whereas the wider marine environment is classified as negligible.

SIGNIFICANCE OF CUMULATIVE EFFECT

8.9.61. Taking the low sensitivity of both Peterhead (Lido) and Cruden Bay Bathing Waters and the low magnitude of impact into account, cumulative effects resulting in deterioration in water quality due to re-suspension of sediments during construction is considered to be negligible and not significant in EIA terms.

8.9.62. Taking the low sensitivity of all designated coastal and transitional waterbodies and the low magnitude of impact into account, cumulative effects resulting in deterioration in water quality due to re-suspension of sediments during construction is considered to be negligible and not significant in EIA terms.

8.9.63. Taking the negligible sensitivity of the wider marine environment and the low magnitude of impact into account, cumulative effects resulting in deterioration in water quality due to re-suspension of sediments during construction is considered to be negligible and not significant in EIA terms.

8.9.64. A summary of the cumulative impact magnitude, receptor sensitivity and significance of effect for MW&SQ receptors is presented in Table 8-42

Table 8-42 Significance of Impact 16: Cumulative effects resulting in deterioration in water quality due to re-suspension of sediments

Receptor/Location	Magnitude	Sensitivity	Significance
Peterhead (Lido) Bathing Water	Low	Low	Negligible
Cruden Bay Bathing Water	Low	Low	Negligible
Ugie Estuary to Buchan Ness (Peterhead) Coastal Waterbody	Low	Low	Negligible
Cairnbulg Point to Ugie Estuary Coastal Waterbody	Low	Low	Negligible
Ugie Estuary Transitional Waterbody	Low	Low	Negligible
Cruden Bay Coastal Waterbody	Low	Low	Negligible
Buchan Ness to Cruden Bay Coastal Waterbody	Low	Low	Negligible
Wider marine environment	Low	Negligible	Negligible

SECONDARY MITIGATION AND RESIDUAL CUMULATIVE EFFECTS

8.9.65. No additional MW&SQ mitigation is considered necessary because the likely cumulative effect in the absence of further mitigation (beyond the embedded commitments outlined in Section 8.6) is not significant in EIA terms.

IMPACT 17 – CUMULATIVE EFFECTS RESULTING IN RELEASE OF SEDIMENT BOUND CONTAMINANTS FROM DISTURBED SEDIMENTS

8.9.66. The Proposed Development infrastructure will be decommissioned in accordance with the decommissioning plan. Structures are proposed to be removed in reverse order of the installation procedure however aspects, in particular inter-array and export cables, may be left in situ to minimise disturbance to the seabed. Sediment plumes and subsequent release of contaminates into the water column from decommissioning works are anticipated to act analogous to construction as described in Impact 13.

TIER 1

8.9.67. Tier 1 projects are currently operational, and resuspension of sediments and subsequently increases to contaminant concentrations are anticipated to occur infrequently, predominantly from repairs or reburial works as described in Impact 12. The decommissioning phase of the Proposed Development will result in less seabed disturbance than construction and consequently no additive effects are anticipated.

TIER 2

8.9.68. The Salamander project is expected to begin decommissioning prior to the Proposed Development based on the currently available proposed timescales. The impacts arising from decommissioning works are expected to be lower than that of construction (Impact 12) and therefore additive effects of contaminants from disturbed sediments when considering the projects cumulatively are not anticipated to be significant.

MAGNITUDE OF CUMULATIVE IMPACT

8.9.69. Typically, low concentrations of sediment bound contaminants enter to the dissolved phase within the water column, whilst the vast majority remain adhered to the sediment particles when temporarily entering suspension in the water column. Similar to the assessment of the Proposed Development alone, the sediment (and associated contaminants) from construction activities is expected to rapidly disperse with tidal currents. Therefore, any increase in contaminant bioavailability that could lead to deterioration in MW&SQ receptors is not expected. When assessed cumulatively with the Proposed Development and Tier 1 projects, the magnitude of the Tier 2 impact is considered to be low.

SENSITIVITY OF RECEPTOR

8.9.70. The sensitivity of the identified Bathing Waters is considered to be low, for potential increased contaminant levels from disturbed sediments as the qualifying features of designated Bathing Waters are not influenced by sediment contamination.

8.9.71. The sensitivity of the coastal and transitional waterbodies is considered low, with respect to cumulative increases contaminant levels from disturbed sediments.

8.9.72. The sensitivity of the wider marine environments non-designated waters, such as those within the Array Area, are considered to be negligible to short term, discrete disturbances of sediments resulting in cumulative release of sediment bound contaminants arising from the proposed construction activities due to the lack of applicable quality status which may be affected by these works.

SIGNIFICANCE OF CUMULATIVE EFFECT

8.9.73. Taking the low sensitivity of both Peterhead (Lido) and Cruden Bay Bathing Waters and the low magnitude of impact into account, cumulative effects resulting in deterioration in water quality due to re-suspension of sediments during construction is considered to be negligible and not significant in EIA terms.

8.9.74. Taking the low sensitivity of all designated coastal and transitional waterbodies and the low magnitude of impact into account, cumulative effects resulting in deterioration in water quality due to re-suspension of sediments during construction is considered to be negligible and not significant in EIA terms.

8.9.75. Taking the negligible sensitivity of the wider marine environment and the low magnitude of impact into account, cumulative effects resulting in deterioration in water quality due to re-suspension of sediments during construction is considered to be negligible and not significant in EIA terms.

8.9.76. A summary of the cumulative impact magnitude, receptor sensitivity and significance of effect for MW&SQ receptors is presented in Table 8-43.

Table 8-43 Significance of Impact 17: Cumulative effects resulting in release of sediment bound contaminants from disturbed sediments

Receptor/Location	Magnitude	Sensitivity	Significance
Peterhead (Lido) Bathing Water	Low	Low	Negligible
Cruden Bay Bathing Water	Low	Low	Negligible
Ugie Estuary to Buchan Ness (Peterhead) Coastal Waterbody	Low	Low	Negligible
Cairnbulg Point to Ugie Estuary Coastal Waterbody	Low	Low	Negligible
Ugie Estuary Transitional Waterbody	Low	Low	Negligible
Cruden Bay Coastal Waterbody	Low	Low	Negligible
Buchan Ness to Cruden Bay Coastal Waterbody	Low	Low	Negligible
Wider marine environment	Low	Negligible	Negligible

SECONDARY MITIGATION AND RESIDUAL CUMULATIVE EFFECTS

8.9.77. No additional MW&SQ mitigation is considered necessary because the likely cumulative effect in the absence of further mitigation (beyond the embedded commitments outlined in Section 8.6) is not significant in EIA terms.

PROPOSED MONITORING FOR CUMULATIVE EFFECTS

8.9.78. No marine water and sediment quality monitoring is proposed to test the predictions made within the assessment of cumulative effects on marine water and sediment quality receptors as no likely significant effects were predicted during construction, O&M and decommissioning phases of the Proposed Development.

8.10. TRANSBOUNDARY EFFECTS

8.10.1. A transboundary effect assessment assesses the potential MW&SQ effects from the Proposed Development upon the interests of European Economic Areas (EEA States).

8.10.2. Comment was provided by MD-LOT during the scoping phase (Table 8-3) that transboundary impacts on MW&SQ receptors can be scoped out of the EIA process. As the Proposed Development is not within 15 km of any other EEA States, there is no pathway for MW&SQ transboundary effects, and these will not be considered further.

8.11. INTER-RELATED EFFECTS

8.11.1. Inter-related effects may occur due to multiple impacts on a receptor or a group of receptors from the Proposed Development. This includes the following:

- **Project Lifecycle Effects** - Interactions between impacts across different phases of the Proposed Development i.e., interaction of impacts across construction, operation and maintenance and decommissioning; and
- **Inter-related Receptor Effects** - Interactions between impacts on a receptor or group of receptors within an offshore Project stage (Inter-related Receptor Effects).

8.11.2. Project Lifecycle and Receptor led inter-related effects from MW&SQ are presented in Table 8-44.

8.11.3. An assessment of ecosystem level effects for the Proposed Development is provided in Volume 3, Appendix 6.4 (Ecosystem Level Effects).

Table 8-44 Inter-Related Effects of MW&SQ

Impact	Significant Inter-Related Effects
Project lifecycle effects	
Impacts 1, 6, 9 Deterioration in water quality due to re-suspension of sediments	The activities resulting in the highest sediment disturbance will occur during the construction phase, with any effects being temporary. Due to this and the **negligible** to **low** sensitivity of MW&SQ receptors to this impact, the interaction of these impacts between the construction, operation and decommissioning of the Proposed Development is not predicted to result in any greater significance than those assessed in the individual project phases.
Impacts 2 and 10 Release of sediment bound contaminants from disturbed sediments.	The activities resulting in the highest sediment disturbance, and subsequent release of sediment bound contaminants, will occur during the construction phase. Any effects are deemed to be short-term in nature. Due to this and the Negligible to Low sensitivity of MW&SQ receptors to sediment bound contaminants release, the interaction of these impacts across the Proposed Development lifecycle is not predicted to result in an effect of any greater significance than those assessed in the individual project phases. This impact pathway is in relation to construction and decommissioning only. The modelling results indicate sediment will stay in suspension above background conditions for a maximum of six days meanwhile the construction and decommissioning phases will be approximately 35 years apart and therefore the interaction of these impacts across stages of the Proposed Development is not predicted.

Impact	Significant Inter-Related Effects
Impacts 3, 7 and 11 Deterioration in Bathing Water quality (parameters relating to nearshore ECC and landfall only)	The activities resulting in the highest sediment resuspension and disturbance of sediment bound contaminants of relevance to Bathing Waters will occur temporarily during the construction phase of the Proposed Development. Namely export cable installation. Deterioration in water quality due to re-suspension of sediments and release of sediment bound contaminants are assessed as having no significant inter-related effects due to the timescales associated with each stage of the Proposed Development outlasting any reductions in water quality. . Consequently, inter-related effects are not anticipated to result in an effect of any greater significance than those assessed in the individual project phases.
Impacts 4, 8 and 12 Deterioration in status of WFD coastal and/ or transitional waterbodies (parameters relating to nearshore ECC and landfall only)	The activities resulting in the highest sediment resuspension and disturbance of sediment bound contaminants of relevance to WFD waterbodies will occur temporarily during the construction phase of the Proposed Development. Namely export cable installation. Deterioration in water quality due to re-suspension of sediments and release of sediment bound contaminants are assessed as having no significant inter-related effects due to the timescales associated with each stage of the Proposed Development outlasting any reductions in water quality. Consequently, inter-related effects are not anticipated to result in an effect of any greater significance than those assessed in the individual project phases.
Impact 5 Deterioration in water clarity due to release of drilling fluid	This impact pathway is in relation to cable installation using trenchless techniques in the construction phase only. Due to this there is no pathway for potential interaction of impacts across the stages of the Proposed Development lifecycle.
Receptor Led Effects	
Benthic Subtidal and Intertidal Ecology	Sediment disturbance caused by the Proposed Development has the potential to reduce water quality. Higher SSC decreases the depth to which UV light can penetrate the water column and may result in a reduction of primary production, dissolved oxygen and bacterial mortality. This has the potential to cause secondary effects on benthic ecology during construction and decommissioning of minor significance to all identified receptors which is not significant in EIA terms Volume 2, Chapter 9 (Benthic Subtidal and Intertidal Ecology). The release of sediment bound contaminant from activities disturbing the sediment could lead to an increased contaminant bioavailability with the potential for ecotoxicological effects. However, due to the lack of contaminants found in the site-specific survey, it was considered unlikely that there would be any pathways on benthic communities. Therefore, the significance of effect was considered to be negligible which is not significant in EIA terms Volume 2, Chapter 9 (Benthic Subtidal and Intertidal Ecology).
Fish and Ecology	Sediment disturbance caused by the Proposed Development has the potential to reduce water quality. Higher SSC decreases the depth to which UV light can penetrate the water column and may result in a reduction of primary production, dissolved oxygen and bacterial mortality. This has the potential to cause secondary effects on fish and shellfish ecology during construction and decommissioning of minor significance to

Impact	Significant Inter-Related Effects
	demersal spawning (herring) and negligible to all other identified receptors which is not significant in EIA terms (Volume 2, Chapter 10 (Fish and Shellfish Ecology)). The release of sediment bound contaminant from activities disturbing the sediment could lead to an increased contaminant bioavailability with the potential for ecotoxicological effects. However, due to the lack of contaminants found in the site-specific survey, it was considered unlikely that there would be any pathways on fish and shellfish communities. Therefore, the significance of effect was considered to be minor to negligible which is not significant in EIA terms (Volume 2, Chapter 10 (Fish and Shellfish Ecology)).
Marine Mammals	The release of sediment bound contaminant from activities disturbing the sediment could lead to an increased contaminant bioavailability with the potential for ecotoxicological effects. However, due to the lack of contaminants found in the site-specific survey, it was considered unlikely that there would be any pathways on marine mammals including indirect effects from known food sources. Therefore, the significance of effect was considered to be negligible which is not significant in EIA terms (Volume 2, Chapter 12 (Marine Mammals)).

8.12. ASSESSMENT SUMMARY

8.12.1. A summary of the findings of the effects and cumulative effects assessments undertaken in Section 8.7 and Section 8.9 is provided in Table 8-45 and Table 8-46, respectively. This includes residual effect significance after any required secondary mitigation and proposed monitoring.

Table 8-45 Summary of Assessment of Effects on MW&SQ

Effect	Receptor	Magnitude of Impact	Receptor Sensitivity	Effect Significance	Secondary Mitigation	Residual Effect	Proposed Monitoring
Construction							
Impact 1: Deterioration in water quality due to re-suspension of sediments	Peterhead (Lido) Bathing Water	Low	Low	Negligible	None	No significant residual effect	None
	Cruden Bay Bathing Water	Low	Low	Negligible	None	No significant residual effect	None
	Ugie Estuary to Buchan Ness (Peterhead) Coastal Waterbody	Low	Low	Negligible	None	No significant residual effect	None
	Cairnbulg Point to Ugie Estuary Coastal Waterbody	Low	Low	Negligible	None	No significant residual effect	None
	Ugie Estuary Transitional Waterbody	Low	Low	Negligible	None	No significant residual effect	None
	Cruden Bay Coastal Waterbody	Low	Low	Negligible	None	No significant residual effect	None
	Buchan Ness to Cruden Bay Coastal Waterbody	Low	Low	Negligible	None	No significant residual effect	None
	Wider marine environment	Low	Negligible	Negligible	None	No significant residual effect	None
Impact 2: Release of sediment bound contaminants from disturbed sediments	Peterhead (Lido) Bathing Water	Low	Low	Negligible	None	No significant residual effect	None
	Cruden Bay Bathing Water	Low	Low	Negligible	None	No significant residual effect	None
	Ugie Estuary to Buchan Ness (Peterhead) Coastal Waterbody	Low	Low	Negligible	None	No significant residual effect	None
	Cairnbulg Point to Ugie Estuary Coastal Waterbody	Low	Low	Negligible	None	No significant residual effect	None
	Ugie Estuary Transitional Waterbody	Low	Low	Negligible	None	No significant residual effect	None
	Cruden Bay Coastal Waterbody	Low	Low	Negligible	None	No significant residual effect	None
	Buchan Ness to Cruden Bay Coastal Waterbody	Low	Low	Negligible	None	No significant residual effect	None
	Wider marine environment	Low	Negligible	Negligible	None	No significant residual effect	None
Impact 3: Deterioration in Bathing Water quality (parameters relating to nearshore ECC and landfall only)	Peterhead (Lido)	Low	Low	Negligible	None	No significant residual effect	None
	Cruden Bay	Low	Low	Negligible	None	No significant residual effect	None
Impact 4: Deterioration in status of WFD coastal and/ or transitional waterbodies (parameters relating to nearshore ECC and landfall only)	Ugie Estuary to Buchan Ness (Peterhead) Coastal Waterbody	Low	Low	Negligible	None	No significant residual effect	None
	Cairnbulg Point to Ugie Estuary Coastal Waterbody	Low	Low	Negligible	None	No significant residual effect	None
	Ugie Estuary Transitional Waterbody	Low	Low	Negligible	None	No significant residual effect	None
	Cruden Bay Coastal	Low	Low	Negligible	None	No significant residual effect	None

Effect	Receptor	Magnitude of Impact	Receptor Sensitivity	Effect Significance	Secondary Mitigation	Residual Effect	Proposed Monitoring
	Waterbody						
	Buchan Ness to Cruden Bay Coastal Waterbody	Low	Low	Negligible	None	No significant residual effect	None
Impact 5: Deterioration in water clarity due to release of drilling fluid	Peterhead (Lido) Bathing Water	Low	Low	Negligible	None	No significant residual effect	None
	Cruden Bay Bathing Water	Low	Medium	Minor	None	No significant residual effect	None
	Ugie Estuary to Buchan Ness (Peterhead) Coastal Waterbody	Low	Low	Negligible	None	No significant residual effect	None
	Cairnbulg Point to Ugie Estuary Coastal Waterbody	Low	Low	Negligible	None	No significant residual effect	None
	Ugie Estuary Transitional Waterbody	Low	Low	Negligible	None	No significant residual effect	None
	Cruden Bay Coastal Waterbody	Low	Low	Negligible	None	No significant residual effect	None
	Buchan Ness to Cruden Bay Coastal Waterbody	Low	Low	Negligible	None	No significant residual effect	None
	Wider marine environment	Low	Negligible	Negligible	None	No significant residual effect	None
O&M							
Impact 6: Deterioration in water quality due to re-suspension of sediments from O&M activities	Peterhead (Lido) Bathing Water	Low	Low	Negligible	None	No significant residual effect	None
	Cruden Bay Bathing Water	Low	Low	Negligible	None	No significant residual effect	None
	Ugie Estuary to Buchan Ness (Peterhead) Coastal Waterbody	Low	Low	Negligible	None	No significant residual effect	None
	Cairnbulg Point to Ugie Estuary Coastal Waterbody	Low	Low	Negligible	None	No significant residual effect	None
	Ugie Estuary Transitional Waterbody	Low	Low	Negligible	None	No significant residual effect	None
	Cruden Bay Coastal Waterbody	Low	Low	Negligible	None	No significant residual effect	None
	Buchan Ness to Cruden Bay Coastal Waterbody	Low	Low	Negligible	None	No significant residual effect	None
	Wider marine environment	Low	Low	Negligible	None	No significant residual effect	None
Impact 7: Deterioration in Bathing Water Quality (parameters relating to nearshore ECC and landfall only)	Cruden Bay	Low	Low	Negligible	None	No significant residual effect	None
	Peterhead (Lido)	Low	Low	Negligible	None	No significant residual effect	None
Impact 8: Deterioration in status of WFD coastal and/ or transitional waterbodies (parameters relating to nearshore ECC and landfall only)	Ugie Estuary to Buchan Ness (Peterhead) Coastal Waterbody	Low	Low	Negligible	None	No significant residual effect	None
	Cairnbulg Point to Ugie Estuary Coastal Waterbody	Low	Low	Negligible	None	No significant residual effect	None
	Ugie Estuary Transitional Waterbody	Low	Low	Negligible	None	No significant residual effect	None

Effect	Receptor	Magnitude of Impact	Receptor Sensitivity	Effect Significance	Secondary Mitigation	Residual Effect	Proposed Monitoring
	Cruden Bay Coastal Waterbody	Low	Low	Negligible	None	No significant residual effect	None
	Buchan Ness to Cruden Bay Coastal Waterbody	Low	Low	Negligible	None	No significant residual effect	None
Decommissioning							
Impact 9: Deterioration in water quality due to re-suspension of sediments	Peterhead (Lido) Bathing Water	Low	Low	Negligible	None	No significant residual effect	None
	Cruden Bay Bathing Water	Low	Low	Negligible	None	No significant residual effect	None
	Ugie Estuary to Buchan Ness (Peterhead) Coastal Waterbody	Low	Low	Negligible	None	No significant residual effect	None
	Cairnbulg Point to Ugie Estuary Coastal Waterbody	Low	Low	Negligible	None	No significant residual effect	None
	Ugie Estuary Transitional Waterbody	Low	Low	Negligible	None	No significant residual effect	None
	Cruden Bay Coastal Waterbody	Low	Low	Negligible	None	No significant residual effect	None
	Buchan Ness to Cruden Bay Coastal Waterbody	Low	Low	Negligible	None	No significant residual effect	None
	Wider marine environment	Low	Negligible	Negligible	None	No significant residual effect	None
Impact 10: Release of sediment bound contaminants from disturbed sediments	Peterhead (Lido) Bathing Water	Low	Low	Negligible	None	No significant residual effect	None
	Cruden Bay Bathing Water	Low	Low	Negligible	None	No significant residual effect	None
	Ugie Estuary to Buchan Ness (Peterhead) Coastal Waterbody	Low	Low	Negligible	None	No significant residual effect	None
	Cairnbulg Point to Ugie Estuary Coastal Waterbody	Low	Low	Negligible	None	No significant residual effect	None
	Ugie Estuary Transitional Waterbody	Low	Low	Negligible	None	No significant residual effect	None
	Cruden Bay Coastal Waterbody	Low	Low	Negligible	None	No significant residual effect	None
	Buchan Ness to Cruden Bay Coastal Waterbody	Low	Low	Negligible	None	No significant residual effect	None
Impact 11: Deterioration in Bathing Water Quality (parameters relating to nearshore ECC and landfall only)	Peterhead (Lido)	Low	Low	Negligible	None	No significant residual effect	None
	Cruden Bay	Low	Low	Negligible	None	No significant residual effect	None
Impact 12: Deterioration in status of WFD coastal and/ or transitional waterbodies (parameters relating to nearshore ECC and landfall only)	Ugie Estuary to Buchan Ness (Peterhead) Coastal Waterbody	Low	Low	Negligible	None	No significant residual effect	None
	Cairnbulg Point to Ugie Estuary Coastal Waterbody	Low	Low	Negligible	None	No significant residual effect	None
	Ugie Estuary Transitional Waterbody	Low	Low	Negligible	None	No significant residual effect	None

Effect	Receptor	Magnitude of Impact	Receptor Sensitivity	Effect Significance	Secondary Mitigation	Residual Effect	Proposed Monitoring
	Cruden Bay Coastal Waterbody	Low	Low	Negligible	None	No significant residual effect	None
	Buchan Ness to Cruden Bay Coastal Waterbody	Low	Low	Negligible	None	No significant residual effect	None

Table 8-46 Summary of Assessment of Cumulative Effects on MW&SQ

Effect	CEA Tier	Receptor	Magnitude of Cumulative Impact	Receptor Sensitivity	Cumulative Effect Significance	Secondary Mitigation	Residual Cumulative Effect	Proposed Monitoring
Construction								
Impact 13: Cumulative Effects Resulting in Deterioration in Water Quality Due to Re-Suspension of Sediments	1 and 2	Bathing Waters	Low	Low	Negligible	None	No significant residual effect	None
		Coastal and Transitional Waterbodies	Low	Low	Negligible	None	No significant residual effect	None
		Wider Marine Environment	Low	Negligible	Negligible	None	No significant residual effect	None
Impact 14: Cumulative Effects Resulting in Release of Sediment Bound Contaminants from Disturbed Sediments	1 and 2	Bathing Waters	Low	Low	Negligible	None	No significant residual effect	None
		Coastal and Transitional Waterbodies	Low	Low	Negligible	None	No significant residual effect	None
		Wider Marine Environment	Low	Negligible	Negligible	None	No significant residual effect	None
Operation and Maintenance								
Impact 15: Cumulative Effects Resulting in Deterioration in Water Quality Due to Re-Suspension of Sediments	1 and 2	Bathing Waters	Low	Low	Negligible	None	No significant residual effect	None
		Coastal and Transitional Waterbodies	Low	Low	Negligible	None	No significant residual effect	None
		Wider Marine Environment	Low	Low	Negligible	None	No significant residual effect	None
Decommissioning								
Effect 16: Cumulative Effects Resulting in Deterioration in Water Quality Due to Re-Suspension of Sediments	1 and 2	Bathing Waters	Low	Low	Negligible	None	No significant residual effect	None
		Coastal and Transitional Waterbodies	Low	Low	Negligible	None	No significant residual effect	None
		Wider Marine Environment	Low	Negligible	Negligible	None	No significant residual effect	None
Effect 17: Cumulative Effects Resulting in Release of Sediment Bound Contaminants from Disturbed Sediments	1 and 2	Bathing Waters	Low	Low	Negligible	None	No significant residual effect	None
		Coastal and Transitional Waterbodies	Low	Low	Negligible	None	No significant residual effect	None
		Wider Marine Environment	Low	Negligible	Negligible	None	No significant residual effect	None

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Annex A: Blue Carbon Assessment

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GLOSSARY

Term	Definition
Array Area	The area in which the generation infrastructure (including Wind Turbine Generators and associated foundations, and inter-array cables) and Offshore Electrical Platform(s) and an interconnector will be located.
Blue carbon	Blue carbon refers to carbon that is captured from the atmosphere and stored in marine and coastal ecosystems like seagrass meadows, mangroves, subtidal sediments and tidal marshes.
Developer	Muir Mhòr Offshore Wind Farm Limited
E2	The ScotWind Plan Option Area where the Proposed Development is located
Floating Foundations	The floating structures on which the Wind Turbine Generators are installed.
Foundation anchors	The structures which anchor the floating foundations to the seabed, connected to the foundation mooring.
Foundation mooring	The mooring structures which connect the Floating Foundations to the anchors.
Horizontal Directional Drilling (HDD)	A method of cable installation where the cable is drilled beneath a feature without the need for trenching.
Inorganic carbon	Inorganic carbon refers to carbon compounds that do not contain carbon-hydrogen bonds, such as carbon dioxide (CO^2) and carbonates. It is typically found in the atmosphere, oceans, and rocks.
Inter-array cables	Cables which link the Wind Turbines Generators to each other and the Offshore Electrical Platform(s).
Interconnector cable	Cable which links the Offshore Electrical Platform(s) to one another, allowing for power to be transferred between the platform(s).
Landfall	The area between Mean High Water Springs (MHWS) and Mean Low Water Springs (MLWS) where the offshore export cables are brought onshore.
Offshore Electrical Platform(s) (OEP)	Offshore platform consisting of High Voltage Alternating Current (HVAC) equipment, details depending on the final electrical set up of the Project.
Offshore Export Cable Corridor (ECC)	The area within which the offshore export cable(s) will be installed.
Offshore export cables	The subsea electricity cable circuits running from the Offshore Electrical Platform(s) to the landfall which will transmit the electricity generated by the offshore wind farm to the onshore export cable(s) for transmission onwards to the onshore substation and the national electrical transmission system along with auxiliary cables such as fibre optic cables
Offshore transmission infrastructure	The proposed transmission infrastructure comprising: Offshore Electrical Platform(s) and associated foundations and substructures; the offshore export cable(s); and the landfall area up to Mean High Water Springs (MHWS).
Organic carbon	Organic carbon refers to carbon compounds that contain carbon-hydrogen bonds, such as carbohydrates, lipids, proteins, and nucleic acids. Organic carbon is primarily found in living organisms, including plants, animals, and microorganisms.
Project	Muir Mhòr Offshore Wind Farm – comprises the wind farm and all associated offshore and onshore components.
Proposed Development	The offshore Muir Mhòr Offshore Wind Farm project elements to which this Offshore EIA Report relates.

Term	Definition
Carbon sequestration	The long-term storage of carbon in plants, soils, geologic formations, and the ocean.
Wind Turbine Generator (WTG)	The wind turbines that generate electricity consisting of tubular towers and blades attached to a nacelle housing mechanical and electrical generating equipment.

ACRONYMS

Term	Definition
BGS	British Geological Survey
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Emissions
DDV	Drop Down Video
ECC	Export Cable Corridor
EEZ	Exclusive Economic Zone
EIAR	Environmental Impact Assessment Report
HDD	Horizonal Directional Drilling
IAC	Inter-array Cable
IC	Inorganic Carbon
JUV	Jack-Up Vessel
MHWS	Mean High Water Springs
MLWS	Mean Low Water Springs
Mt	Million Tonnes
O&M	Operation and Maintenance
OC	Organic Carbon
OEP(s)	Offshore Electrical Platform(s)
OWF	Offshore Wind Farm
PLGR	Pre-Lay Grapnel Run
RSPB	Royal Society for the Protection of Birds
UXO	Unexploded Ordinance
WTG	Wind Turbine Generator
WWF	World Wide Fund for Nature

1. INTRODUCTION

1.1.1. Muir Mhòr Offshore Wind Farm Limited (hereafter referred to as 'the Developer') is proposing to develop the Muir Mhòr Offshore Wind Farm (hereafter 'the Project'). The Project is made up of both offshore and onshore components. The subject of this offshore Environmental Impact Assessment Report (EIAR) is the offshore infrastructure of the Project seaward of Mean High-Water Springs (MHWS) which is hereafter referred to as 'the Proposed Development'.

1.1.2. The Muir Mhòr Array Area covers an area of approximately 200 km^2 and is located approximately 63 km east of Peterhead on the east coast of Scotland. The offshore infrastructure of the Proposed Development includes Wind Turbine Generators (WTGs) and associated floating foundations, interconnector cable, Offshore Electrical Platform(s) (OEP(s)) and associated fixed foundations, inter-array cables, an interconnector cable, offshore export cables and landfall.

2. PURPOSE OF THE REPORT

2.1.1. This blue carbon assessment considers how the Proposed Development could affect carbon stored in the marine environment. Blue carbon is defined by the Scottish Blue Carbon Forum (2022) as follows:

"Blue carbon is the carbon captured and stored in marine and coastal ecosystems that accumulates over long timescales through natural processes. In Scotland, blue carbon habitats include saltmarshes, seagrasses, kelp beds, biogenic reefs and geological sedimentary stores, such as seafloor and sea loch sediments."

2.1.2. Globally, there are three blue carbon habitats that make up less than 0.5% of the total seafloor area but contribute an estimated 50% of the total burial of organic carbon in ocean sediments (Cunningham & Hunt 2023). These are mangroves, saltmarshes and seagrasses – none of which are present within the Proposed Development area. However, these represent relatively short-term carbon stores as the carbon is stored as living biomass. Other coastal and marine habitats also contribute to carbon cycling, sequestration, and storage but less is known about these systems and the long-term fate of the carbon they trap or store. This includes the seabed sediments within the Proposed Development area which are long-term carbon stores that can lock carbon away from atmospheric circulation for significant time periods (generally over 100 years) (Burrows *et al.*, 2024).

3. IMPACTS ASSESSED

3.1.1. When considering the impacts to long term carbon storage within the sediments of the Proposed Development area, the main pathways of effect will be related to any activities that disturb the top layer of sediment. The greatest impact is likely to be during construction, including seabed preparation (such as Pre-lay Grapnel Run (PLGR) and any Unexploded Ordinance (UXO) removal) and cable installation activities. Other activities that will cause temporary disturbance include Offshore Electrical Platform (OEP) foundations, anchoring for lidar, wave buoys, installation of cable protection (where required), anchoring operations for WTGs, Jack Up Vessels (JUV) and Horizonal Directional Drilling (HDD) installation. Operational impacts will include scour effects from mooring lines and dynamic inter-array cable movements. Maintenance activities also have the potential to cause temporary

disturbance to the seabed which may release carbon. This includes JUV operations, potential repairs to inter-array cables and export cable failures.

3.1.2. When sediments are disturbed and resuspended in the water column, carbon within the sediments becomes available for consumption by organisms that subsequently release the carbon as carbon dioxide (CO_2), which may, if not recaptured within the oceanic carbon cycle, become available for atmospheric circulation. Maintenance activities also have the potential to cause temporary disturbance to the seabed which may release carbon. This includes JUV operations, potential repairs to inter-array cables and export cable failures.

3.1.3. There are several evidence gaps regarding the fate of organic carbon in sediments when it is disturbed. For example, some will be oxidised (lost) in the water column; some of it will resettle and could potentially become reburied; and some of it may be transported laterally to a new area of seabed while the sediment is within the water column. Ultimately the impact that the Proposed Development may have on blue carbon will be influenced by external factors such as, but not limited to:

- Sediment type;
- Sedimentation and accumulation rates for the area (if these are low, then the impact is greater because recovery back to the original situation will take longer);
- Organic carbon density and reactivity;
- Benthic activity;
- Currents;
- Temperature; and
- Oxygenation.

3.1.4. These factors are mostly outside of the scope of the current assessment. However, the assessment does consider the different types of sediment present within the vicinity of the Proposed Development and the amount of carbon that could be released into atmospheric circulation as a result of the Proposed Development.

3.1.5. It should be noted that whilst there is some kelp habitat present at the landfall location (see Volume 2, Chapter 9 (Benthic Subtidal and Intertidal Ecology) for details), this habitat will not be impacted by cable laying at landfall as HDD will be used to pass the cable under the intertidal area and so this habitat has not been assessed here.

4. ASSESSMENT METHODOLOGY

4.1.1. The following data sets and literature have been used to inform the Blue Carbon Assessment (Table 4-1).

Table 4-1 Summary of Key Data Sets and Literature for Blue Carbon Assessment

Title	Source	Year	Author
The United Kingdom's Blue Carbon Inventory: Assessment of Marine Carbon Storage and Sequestration Potential in Scotland (Including Within Marine Protected Areas).	https://www.wildlifetrusts.org/sites/default/files/2024-09/Scotland%20-%20scientific%20report.pdf	2024	Burrows, M. T., Smeaton, C., Tillin, H., Grundy, S., Sugden, H., Moore, P., Fitzsimmons, C., Austin, W., O'Dell, A.
Sediment type and surficial sedimentary carbon stocks across the United Kingdom's Exclusive Economic Zone and the territorial waters of the Isle of Man and the Channel Islands.	https://data.marine.gov.scot/dataset/sediment-type-and-surficial-sedimentary-carbon-stocks-across-united-kingdom%E2%80%99s-exclusive	2021	Smeaton, C., Hunt, C.A., Turrell, W.R. and Austin, W.E.N.
Scottish Blue Carbon - a literature review of the current evidence for Scotland's blue carbon habitats.	https://www.nature.scot/doc/naturescot-research-report-1326-scottish-blue-carbon-literature-review-current-evidence-scotlands#:~:text=Authors:%20Cunningham,%20C.%20and%20Hunt,%20C.	2023	Cunningham, C. and Hunt, C.

4.1.2. This assessment follows the assessment methodology set out within the EIAR which includes Volume 1, Chapter 6 (Environmental Impact Assessment Methodology) and Volume 2, Chapter 9 (Benthic Subtidal and Intertidal Ecology).

4.1.3. Site-specific surveys were carried out by the Developer to provide an up-to-date characterisation of the habitats and species occurring within the boundary of the Proposed Development to inform the assessment of benthic subtidal and intertidal ecology. Geophysical surveys were undertaken which informed, and were followed by, a subtidal benthic ecology survey using grab sampling and Drop-Down Video (DDV). Intertidal surveys were conducted that combined a walkover and collection of sediment samples for biological and physicochemical analyses (Volume 3, Appendix 9.1 (Preliminary Geophysical & Environmental Survey 2023: OWF (LOT 1)); and Volume 3, Appendix 9.1 (Preliminary Geophysical & Environmental Survey 2023: ECC and Intertidal (LOT 2 & LOT 3)).

4.1.4. Information on the benthic subtidal and intertidal communities was also collected through a detailed desktop review of existing literature and available data sources. This data enabled

habitats to be classified throughout the Proposed Development area to inform the Blue Carbon Assessment.

5. BASELINE

5.1.1. An estimate of long-term marine carbon storage and sequestration potential was conducted for Scotland (Burrows *et al*., 2024). This estimate could only be conducted in areas that have been mapped for carbon which equates to an area of 437,883 km^2 that lies within Scotland's Exclusive Economic Zone (EEZ) which is 462,315 km^2. In total, 152.3 million tonnes (Mt) of Organic Carbon (OC) in long-term stores are found in the region. Of this, 99.7% is stored within seabed sediments. The remaining 0.3% is stored within coastal vegetated blue carbon habitats, which include kelp beds, coastal saltmarsh and seagrass beds.

5.1.2. A study by Smeaton *et al*. (2021a and 2021b) used historical British Geological Survey (BGS) sediment cores to estimate both the OC and Inorganic Carbon (IC) content of sediment in the top 10 cm of the seabed for the whole of the UK EEZ. Figure 5-1 shows the OC density in the top 10 cm of marine sediments in the vicinity of the Proposed Development. The highest OC density within the Array Area was 0.45 kg/m^2 and the lowest was 0.29 kg/m^2. Within the offshore Export Cable Corridor (ECC), the highest OC density was 0.43 kg/m^2 and the lowest was 0.018 kg/m^2. For context, the highest OC densities in the UK are found in the muddy sediments within fjords. The mud held within fjords has estimated OC densities of 2.44 ± 1.26 kg/m^2 (Smeaton *et al*., 2021b).

5.1.3. A similar illustration of IC density is shown in Figure 5-2. For IC, the highest density within the Array Area was 4.46 kg/m^2 and the lowest was 0.33 kg/m^2. Within the offshore ECC, the highest IC density was 5.87 kg/m^2 and the lowest was 0.58 kg/m^2.

5.1.4. The ability of sediment to hold carbon is dependent on the sediment type. Water is able to flow freely through coarse sandy sediments, allowing oxygen to penetrate. Carbon cycling in coarse sandy sediments is therefore rapid and so only low levels of carbon are stored (Alonso *et al*., 2012). Conversely, sediments with a high mud content store much higher levels of carbon. Coastal sediments also store much higher levels of carbon than equivalent habitats in the subtidal. For example, intertidal sand has been shown to store approximately 6,500 g/m^2 ±4,000 of carbon whereas subtidal sand has been recorded to store approximately 1,700 g/m^2 ±100 of carbon (Parker *et al*., 2021; Swaile *et al*., 2022).

5.1.5. Within the Array Area, sediments are composed of sands, gravelly sand and gravel ribbons. The offshore ECC seabed shifts from megarippled sand near the shore to sandy gravel further out, with a transition to predominantly sandy seabed around 22 km offshore. Coarse sediment patches are observed amidst sand, with some areas of coarser substrate. Sandwaves are present within the offshore ECC near the Array Area. Large boulders are present across the Array Area and the offshore ECC.

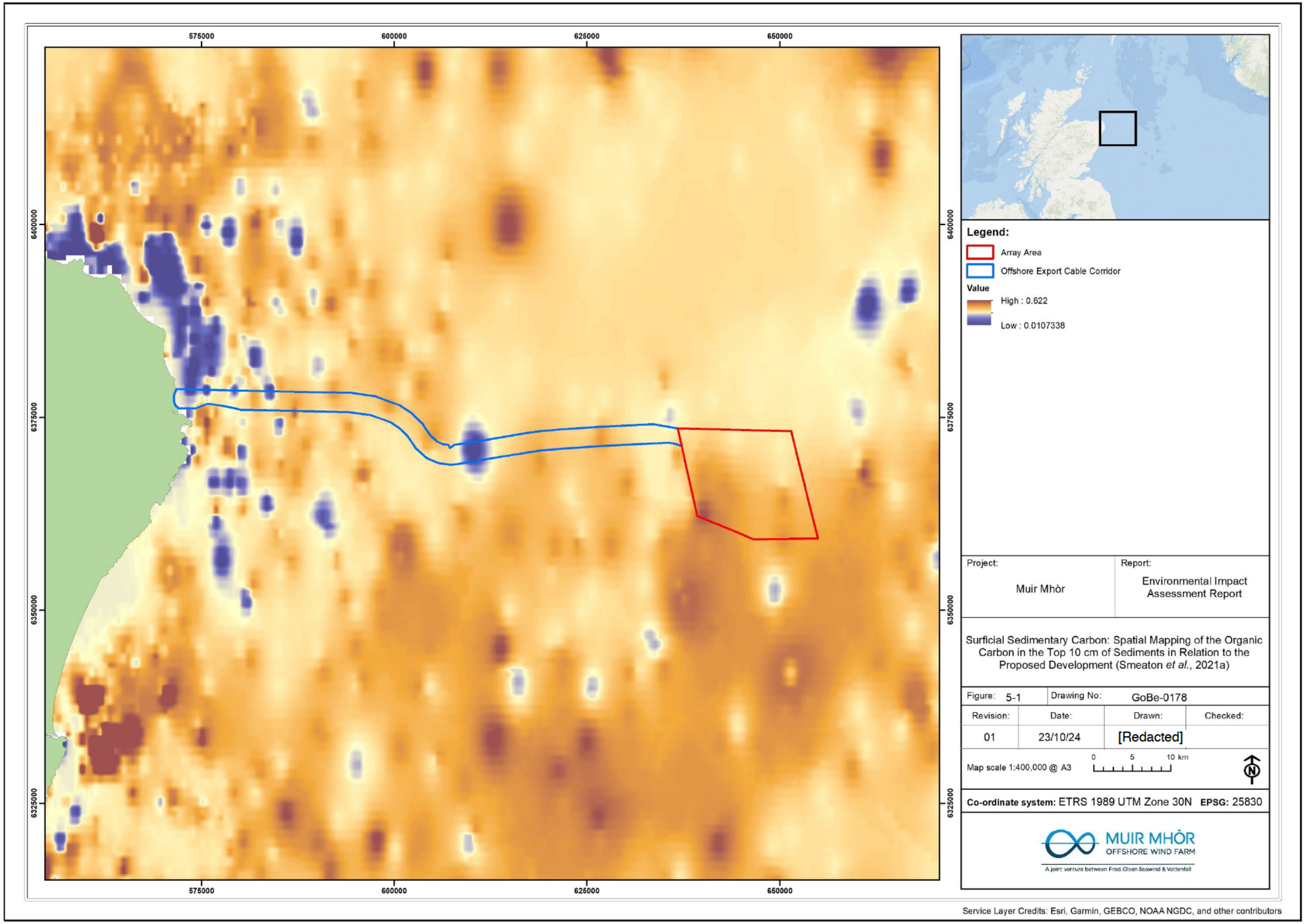

Figure 5-1 Surficial Sedimentary Carbon: Spatial Mapping of the Organic Carbon in the Top 10 cm of Sediments in Relation to the Proposed Development (Smeaton et al., 2021a)

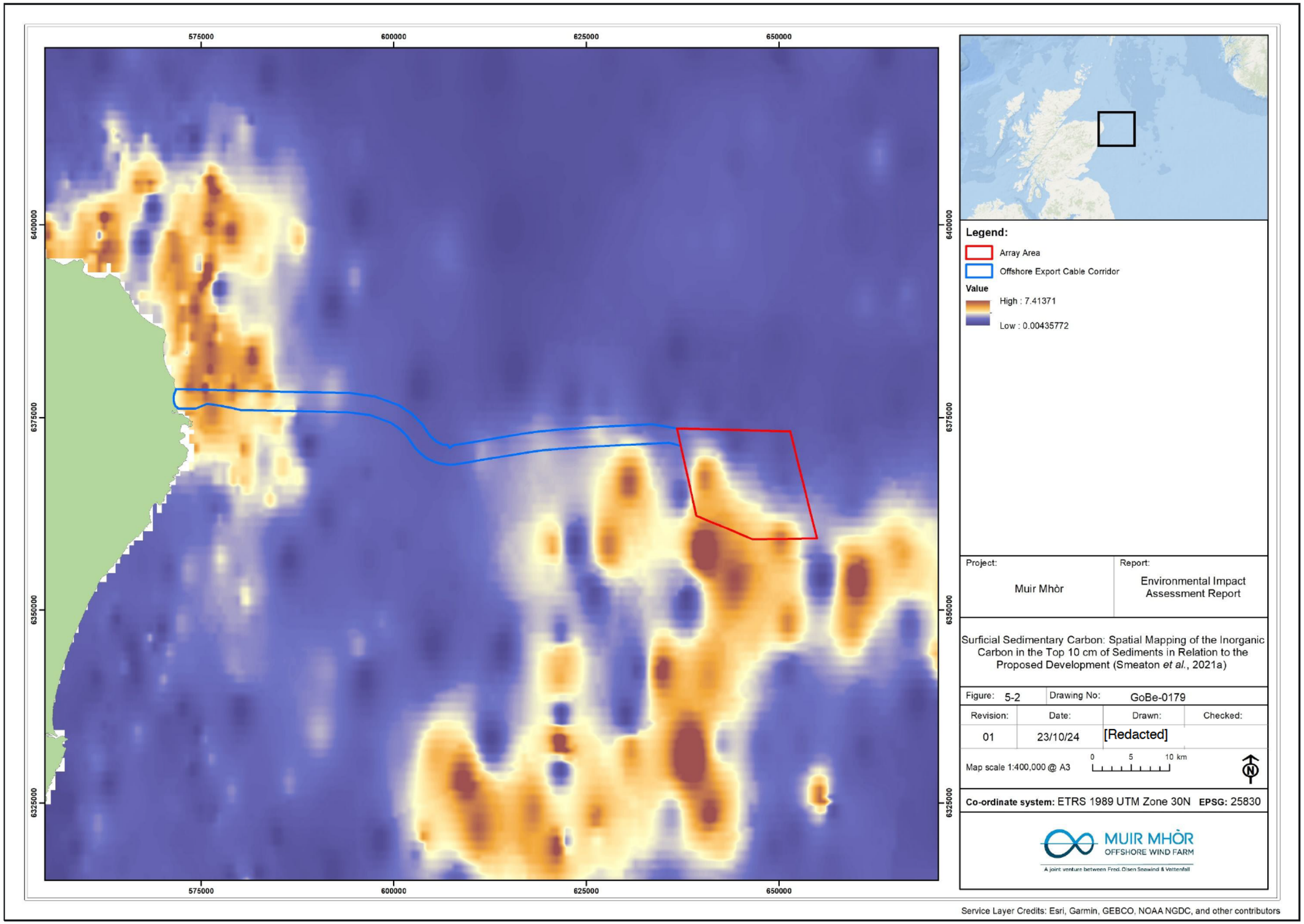

Figure 5-2 Surficial Sedimentary Carbon: Spatial Mapping of the Inorganic Carbon in the Top 10 cm of Sediments in Relation to the Proposed Development (Smeaton et al., 2021a)

6. WORST CASE DESIGN SCENARIO

6.1.1. The Developer has adopted a design envelope approach to impact assessment (also known as a 'Rochdale Envelope'). In line with guidance from the Scottish Government, the design envelope approach offers flexibility in the EIAR process by enabling impact assessment to be carried out against several potential design options.

6.1.2. The assessment of impacts on blue carbon has been undertaken with respect to the details provided in Volume 1, Chapter 3 (Project Description). A 'worst case' design scenario has been selected for each impact which would lead to the greatest impact for all receptors, including blue carbon, when selected from a range of values. Greater adverse significance of effects is not predicted to arise should any other development scenario, based on details within Volume 1, Chapter 3 (Project Description) (e.g., different infrastructure layout), to that assessed here, be taken forward in the final design scheme.

6.1.3. Table 6-1 presents the worst-case design scenario for each impact associated with the assessment of blue carbon, along with justification.

Table 6-1 Worst Case Design Scenarios with respect to the Blue Carbon Assessment

Impact	Embedded Commitment	Worst Case Design Scenario	Justification
Construction (Predicted duration of five years)			
Temporary habitat disturbance	C-02, C-09, C-34	**Total area of habitat disturbance = 7,731,870 m²** **Foundation seabed preparation area = 6,066,000 m²** *Offshore Electrical Platform(s) (OEP(s)):* • Seabed preparation method = Boulder clearance grabs; and • Maximum sediment disturbance area for two OEP(s) = 36,000 m² *WTG anchoring operations.* • Deployment of 9 drag-embedment anchors, per WTG (total 603 anchors, 200 m drag distance x 50 m drag box) = 6,030,000 m² **Wave buoy anchoring operations = 2,000 m²** • Seabed preparation for 4 x Wave rider buoys with 1 anchor point each = 2,000 m² **Jack-Up Vessels (JUV) and anchoring operations = 83,620 m²** • Anchor deployment area of disturbance for installation of OEP jacket foundations = 35,000 m²; • Anchor deployment area of disturbance for installation of OEP topside = 35,000 m² ; • OEP JUV footprint 6 legs per JUV, 227 m2 per leg = 1,362 m²; • 5 jack-up operations x 2 OEP construction = 5 x 2 x 1,362 m² = 13,620 m²; and • JUV operations for WTGs are not applicable for the offshore array, applies to nearshore port location only. **IAC Junction Box Installation = 1,800 m²** • Max Dimensions (L x W x H) = 15 x 6 x 4 m; • Seabed Footprint per unit = 90 m2; • Max Number of Units = 20; • Total Seabed Footprint within Array Area= 90 x 20 = 1,800 m2; and • Anchoring method = ballast/weight of the unit itself, no additional anchoring planned **Cable seabed preparation and installation = 1,569,000.906 m²** • Burial of export cables by jetting (270 km length x 3 m disturbance width) = 810,000 m²; • Burial of interconnector cable by jetting (3 km length x 3 m disturbance width) = 9,000 m²; • Burial of inter-array cables (tether wave) by jetting (250 km x 3 m disturbance width) = 750,000 m²; • Export cable jointing - largest cable diameter = 310 mm, therefore cross-Sectional area = 0.0755 m² per cable. Joints every 25 km, 90 km length per cable = 4 joints; and • 4 joints x 0.0755m² per joint x 3 cables = 0.906 m² (no additional boulder and sandwave clearance planned for jointing **HDD installation = 9,450 m²** • Total installation area: Cofferdam area = 450 m²; and • HDD bores x 3 = 3000 m L x 1m D x 3 = 9,000 m²	Temporary habitat disturbance relates to the maximum total area of habitat disturbance during the construction phase. The footprint of infrastructure is assessed as a temporary impact in construction, and as a permanent impact in Operation and Maintenance (O&M). It should be noted that for gravity anchors, the seabed preparation area is less than the footprint of the foundation scour protection. The Worst-Case Design Scenario presents a precautionary approach to temporary habitat disturbance because it counts both the total footprint of seabed clearance as well as cable burial across both the array and offshore ECC. This approach counts the footprint of seabed habitat to be impacted by construction in the same area twice. However, this precautionary approach has been taken because there is some potential for recovery of habitats between the activities due to project timescales.

Impact	Embedded Commitment	Worst Case Design Scenario	Justification
Operation and Maintenance *(The operational lifetime of the Proposed Development is approximately 35 years)*			
Permanent and/or long-term habitat loss/alteration due to the addition of infrastructure to the area	C-02, C-39	**Maximum area of permanent and/or long-term habitat loss/alternation = 2,757,400 m²** **WTG anchor footprints, and scour protection = 1,038,500 m²** • Up to nine anchors per WTG (nine gravity anchors per WTG = (9 x 500 m²) x 67 WTGs] = 301,500 m²; and • Gravity anchor scour protection area (excluding anchor footprint) = 737,000 m² **Mooring line movement (strimming effect) = 874,350 m²** • Any movement (strimming effect) will be at the transition where the mooring line touches down on the seabed, rather than the full chain length along the seabed; and • Assuming a 1 m movement corridor along the full chain length along the seabed. Potential moorings seabed movement area = 67 x 9 x 1450 x 1 = 874,350 m². **OEP foundation footprints = 36,000 m²** • Two OEP(s) disturbance = 36,000 m² **IAC Junction Box footprint = 1,800 m²** • Max Dimensions (L x W x H) = 15 x 6 x 4 m; • Seabed Footprint per unit = 90 m²; • Max Number of Units = 20; and • Total Seabed Footprint within Array Area = 90 x 20 = 1,800 m² **Lidar and wave buoy anchor footprints = 4000 m²** • Two Lidar buoys with two anchor points each (gravity anchors) = 2,000 m² • Four Wave rider buoys with one anchor point each = 2,000 m² **Dynamic inter-array cable (strimming effect) = 6,700 m²** • 50m² per each tether wave cable x 2 cables x 67 WTGs = 6,700 m² **Dynamic inter-array cable anchor footprints = 10,050 m²** • Tether wave cable, with up to 3 anchor points on seabed = 25 m² x 3 anchors x 2 cables x 67 WTGs = 10,050 m² **Inter-array cable protection = 375,000 m²** • Up to 50% of IAC cables protected (total length 250 km) = 125 km at 3 m width; and • Maximum area of cable protection for IAC = 375,000 m² to a maximum height of 2 m above the seabed. **Interconnector cable protection = 4,500 m²** • Up to 50% of interconnector cables protected (total length 3 km) = 1.5 km at 3 m width; and • Maximum area of cable protection for interconnector cables = 4,500 m2 to a maximum height of 2 m above the seabed. **Export cable protection = 405,000 m²** • Up to 50% of export cables protected (total length 270 km) = 135 km at 3 m width. • Maximum area of cable protection for export cables = 405,000 m² to a maximum height of 2 m above the seabed	The Worst-Case Design Scenario is defined by the maximum area of seabed lost by the footprint of structures on the seabed, scour protection, cable protection, and cable crossings. Habitat loss from drilling and drill arisings is of a smaller magnitude of impact than presence of project infrastructure. As a result, the outcome of the assessment is therefore inherently precautionary.

Impact	Embedded Commitment	Worst Case Design Scenario	Justification
		Export cable crossings = 1,500 m² • 3 crossings with existing infrastructure (based on the centreline of the offshore ECC); and • Maximum total footprint = 500 m² (footprint) x 3 (number of crossings) = 1,500 m² to a maximum height of 5 m above the seabed	
Temporary habitat disturbance	C-02, C-08, C-34	**Total direct disturbance to seabed from maintenance activities = 1,930,600 m²** **WTGs and OEP(s) = 635,600 m²** • JUV footprint for WTG and OEP(s) = 8 x 227 x 2 = 3,632 m²; • 5 JUV trips per year = 175 trips over 35-year operational lifetime; • Total = 3632 m² x 175 = 635,600 m²; and • JUV Operations for WTGs are N/A for the offshore array, applies to nearshore port location only. **Inter-array cables = 245,000 m²** • Up to seven inter-array cable failures assumed throughout the lifetime of the wind farm, with 7,000 m (length) x 5 m (width) (35,000 m²) disrupted per repair, placement for a total impacted area of 245,000 m² over the lifetime of the Proposed Development (approximately 35 years). **Export Cables = 1,050,000 m²** • 1 repair per cable every 5 years, 7 repairs per cable over lifetime of the windfarm (35 years) x 3 export cables = 21 repairs in total; • Area per repair = 1,000 m x 50 m = 50,000m² per repair; and • Total = 21 x 50,000 m² = 1,050,000 m² • Interconnector cable 1 repair every 5 years	The Worst-Case Design Scenario is defined by the maximum area of habitat disturbance arising from maintenance activities during the approximately 35-year O&M phase. The worst-case scenario is defined by the maximum number of jack-up and anchoring operations and the total cable replacement and repairs through maintenance activities that could have an interaction with the seabed during operation.

7. IMPACT ASSESSMENT

7.1.1. As set out in Volume 2, Chapter 9 (Benthic Subtidal and Intertidal Ecology), sediments may be disturbed temporarily as a result of construction or O&M activities or lost as a result of habitat loss/alteration due to the addition of infrastructure to the area, including the introduction of scour protection.

7.1.2. Temporary habitat disturbance will occur during construction, with a maximum disturbance area of up to 7.68 km^2, with up to 1.61 km^2 during the O&M phase of the Proposed Development, resulting in a total area of approximately 9.29 km^2 that could be temporarily disturbed during both phases. It should be noted that there is potential for sediment disturbance to occur during decommissioning, however, the method for decommissioning has not been determined at this stage and so impacts from this phase of the Proposed Development have been excluded from this assessment. However, it is expected that sediment disturbance during the decommissioning phase will be less than for the construction phase of the Project.

7.1.3. Permanent habitat loss has been assessed to occur over an area of up to 2.22 km^2 during the O&M phase. To note, the area of permanent habitat loss is likely to be included in the area of temporary habitat disturbance, as all infrastructure is likely to be placed in areas that were already temporarily disturbed during construction. As such, the inclusion of these permanent habitat loss areas represents a precautionary worst case.

7.1.4. Overall, the Proposed Development has the potential to disturb up to 11.51 km^2 of marine sediments. This is a very small proportion (0.0025%) of the marine sediment within the Scottish EEZ of 462,315 km^2 (Burrows *et al.*, 2024) from which carbon could be released. It is also a small proportion (3%) of the marine sediment within the boundary of the Proposed Development (367 km^2) from which carbon could be released.

7.1.5. Carbon storage levels previously reported for UK waters have been shown to vary by substrate. Subtidal sand has been estimated to have carbon storage levels of approximately 1.7 kg/m^2, whereas subtidal mud and intertidal sand have been estimated to have carbon storage levels of approximately 5.5 kg/m^2 and 6.5 kg/m^2 respectively (Parker *et al.*, 2021; Swaile *et al.*, 2022).

7.1.6. Using the Smeaton *et al.* (2021a) data shown in Figure 5-1, it has been calculated that OC in the sediment ranges from 0.018 to 0.45 kg/m^2 with a mean of 0.33 kg/m^2 of OC within the Proposed Development. IC stores range from 0.33 to 5.87 kg/m^2 with a mean of 1.99 kg/m^2 within the Proposed Development. From this we can see that the mean value of IC is similar to the subtidal sand values reported previously which is the predominant substrate type recorded within the Proposed Development.

7.1.7. The reported average sequestration rates for subtidal sand vary with 10 $g/m^2/yr$ reported by Painting *et al.* (2010 in: Alonso *et al.*, 2012) and 29.5 $g/m^2/yr$ reported by Parker *et al.* (2021) for both subtidal sand and mud. An alternative consideration for areas of permanent habitat loss, due to the introduction of infrastructure associated with the Proposed Development, could be to consider the amount of sequestration potential lost over the lifetime of the Proposed Development (35 years). This would result in a lower overall carbon loss amount, as the lost sequestration potential would amount to approximately 0.7 kg/m^2 over the 35 year lifetime of the Proposed Development (average of 10 $g/m^2/y$ (sand) + 29.5 $g/m^2/yr$ (sand and/or mud) = 19.75 $g/m^2/yr$, over 35 years = 691.25 g/m^2 = 0.7 kg/m^2), as compared to combined IC and OC loss due to disturbance of approximately 2.32 kg/m^2 (mean IC density of 1.99 kg/m^2 + mean IC density of 0.33 kg/m^2 (Table 7-1). However, this assessment

assumes the more precautionary assessment, whereby permanent habitat loss is also considered in the same way as temporary disturbance.

7.1.8. If it is assumed that all temporary disturbance and permanent habitat loss resulted in loss of carbon from the sediments in which these activities occurred, the potential CO_2 emissions impact from the Proposed Development can be estimated. Based on the mean carbon storage across the Proposed Development for both OC and IC, the potential CO_2 emissions (CO_2e) impact would be 26,662 tonnes of CO_2e (Table 7-1). This is considered to be a very precautionary value, as it assumes that all CO_2 associated with the sediment is released, when it is likely that a proportion of CO_2 will remain associated with the disturbed sediments and resettle within a short distance from the location of disturbance, without becoming available to the wider system.

7.1.9. Based on the above, the potential release of carbon from marine sediments as a result of the Proposed Development is considered to be of negligible magnitude as only a very small area of sediment will be disturbed by the Proposed Development which may result in a proportion of the carbon stored to be released. The sensitivity of the receptor has been given a precautionary value of high as the exact fate of carbon when sediments are disturbed is poorly understood. The overall effect significance will therefore be negligible, which is not significant in EIA terms.

Table 7-1 Calculation of Potential CO_2 Emissions from the Proposed Development

	Organic Carbon	Inorganic Carbon
Mean Carbon Density (kg/m^2)	0.33	1.99
Total Area of Disturbance (m^2)	11,507,000	11,507,000
Potential loss of CO_2e from Proposed Development (kg)	3,751,282	22,910,437
Potential loss of CO_2e from Proposed Development (tonnes)	3,751.28	22,910.44

8. REFERENCES

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