Salamander Offshore Wind Farm

Offshore EIA Report

Volume ER.A.3, Chapter 8: Water and Sediment Quality

SALAMANDER

Powered by Ørsted and
Simply Blue Group

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Glossary

Term	Definition
Applicant	Salamander Wind Project Company Limited (formerly called Simply Blue Energy (Scotland) Limited), a joint venture between Ørsted, Simply Blue Group, and Subsea7.
Bathing Waters	Popular swimming sites that have been officially designated under the Bathing Water (Scotland) Regulations 2008 Their water quality is regularly monitored during open season (May to September).
Benthic	Referring to animals or plants that live on the seabed.
Climate Change	A long-term trend in the variation of the climate resulting from changes in the global atmospheric, and ocean, temperatures, and affecting mean sea level, wave height, period and direction, wind speed and storm occurrence.
Cumulative effects	The combined effect of Salamander Project in combination with the effects from a number of different projects, on the same single receptor/resource.
Cumulative impacts	Impacts that result from changes caused by other past, present or reasonably foreseeable actions together with the Salamander Project.
Environmental Impact Assessment (EIA)	A statutory process by which the likely significant effects of certain projects must be assessed before a formal decision to proceed can be made. It involves the collection and consideration of environmental information, which fulfils the assessment requirements of the Environmental Impact Assessment (Scotland) Regulations (2017), including the publication of an Environmental Impact Assessment Report (EIAR).
EIA Regulations (Scotland)	Regulation 14 of The Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2017 ("2017 MW Regulations"), regulation 12 of The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017 ("2017 EW Regulations") and Schedule 4 of The Marine Works (Environmental Impact Assessment) Regulations 2007 ("2017 MW Regulations"), all collectively referred to as "EIA Regulations".
Far-field Study Area	Defined the distance away from the Project which suspended sediment plumes may be advected (and meaningfully interact with potentially sensitive receptors). This has been defined by a spring tidal excursion ellipse buffer around the Offshore Array Area and the Offshore Export Cable Corridor.
Inter-related effects	Impacts that arise across the three project phases (i.e. project lifetime effects) as well as the interaction of multiple effects on a receptor (i.e. receptor-led effects).

Landfall	The generic term applied to the entire landfall area between Mean Low Water Spring (MLWS) tide and the Transition Joint Bay (TJB) inclusive of all construction works, including the offshore and onshore Export Cable Corridor (ECC), intertidal working area and landfall compound, where the offshore cables come ashore north of Peterhead.
Intertidal Zone	The zone between Mean High Water Springs and Mean Low Water Springs. May also be referred to as the littoral zone.
Near-field Study Area	The area comprising the Offshore Array Area, the Offshore Export Cable Corridor and the Landfall between Mean High Water Springs and Mean Low Water Springs.
Offshore Array Area	The offshore area within which the wind turbine generators, foundations, mooring lines and anchors, and inter-array cables and associated infrastructure will be located.
Offshore Development	The entire Offshore Development, including all offshore components of the Project (WTGs, Inter-array and Offshore Export Cable(s), floating substructures, mooring lines and anchors, and all other associated offshore infrastructure) required across all Project phases from development to decommissioning, for which the Applicant is seeking consent.
Offshore Development Area	The total area comprising the Offshore Array Area and the Offshore Export Cable Corridor.
Offshore Export Cable Corridor	The area that will contain the Offshore Export Cable(s) between the boundary of the Offshore Array Area and Mean High Water Spring (MHWS).
River Basin Management Plan	The River Basin Management Plans (RBMP) in Scotland are produced by the Scottish Environment Protection Agency (SEPA) on behalf of the Scottish Government. The RBMPs aim to protect and improve Scotland's water environment for the benefit of people, wildlife, and the economy. They cover actions for public bodies, industry, and land managers in Scotland. The RBMPs set out a range of actions to address the impacts affecting water quality, physical condition, water resources, and the migration of wild fish.
Salamander Project	The proposed Salamander Offshore Wind Farm. The term covers all elements of both the offshore and onshore aspects of the project.
Scoping	An early part of the Environmental Impact Assessment process by which the key potential significant impacts of the project are identified, and methodologies identified for how these should be assessed. This process gives the relevant authorities and key consultees opportunity to comment and define the full extent of the final Environmental Impact Assessment – which can also then be tailored through the consultation process.

Scour	Local erosion of sediments caused by local flow acceleration around an obstacle and associated turbulence enhancement.
Sediment	Particulate matter derived from rock, minerals or bioclastic debris.
Semi-Submersible	A Semi-Submersible structure is a buoyancy-stabilised platform which floats partially submerged on the surface of the ocean whilst anchored to the seabed. The structure gains its stability through the distribution of buoyancy force associated with its large footprint and geometry which ensures the wind loading on the structure and turbine are countered by an equivalent buoyancy force on the opposite side of the structure. Included in the Project Design Envelope, there are variations of the semi-submersible concept, such as barge, buoy, or hybrid.
Suspended sediment concentrations	Mass of sediment in suspension per unit volume of water.
Tension Leg Platform	A Tension Leg Platform is a semi-submerged buoyant structure, anchored to the seabed with tensioned mooring lines. The combination of the structure buoyancy and tension in the anchor/mooring system provides the platform stability. This system-driven stability (as opposed to the stability coming just from the floating substructure itself) allows for a comparatively smaller and lighter structure compared to Semi-Submersible equivalents.
Tidal range	Vertical difference in height between consecutive high and low waters over a tidal cycle.
Tidal excursion	The Lagrangian movement (the physics of fluid motion as an individual fluid parcel moves through space and time) of a water particle during a tidal cycle.
Tidal excursion ellipse	The path followed by a water particle in one complete tidal cycle.
Water Framework Directive	The Water Framework Directive (WFD) is a Directive of European origin that aims to manage, protect and improve the water environment. It applies to all rivers, lakes, estuaries, coastal waters, and groundwater.

Acronyms

Term	Definition
AL	Action Level
As	Arsenic
bLAT	Below Lowest Astronomical Tide
C	Carbon
CAW	Cooled Atlantic Water
CEA	Cumulative Effects Assessment
Cefas	Centre for Environment, Fisheries and Aquaculture Science
CEMP	Construction Environmental Management Plan
EAC	Environmental Assessment Criteria
ECC	Export Cable Corridor
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EQS	Environmental Quality Standards
EQSD	Environmental Quality Standard Directive
ERL	Effect Range Low
ERLs	Environmental Risk Limits
EU	European Union
GEP	Good Ecological Potential
GES	Good Ecological Standard
GPP	Guidance for Pollution Prevention
HRA	Habitat Regulations Appraisal

INNS	Invasive Non-native Species
LAT	Lowest Astronomical Tide
MAC eco	Maximum Acceptable Concentration for Ecosystem (RIVM)
MHWS	Mean High Water Springs
MPCP	Marine Pollution Contingency Plan
MPC	Maximum Permissible Concentration (RIVM)
MD-LOT	Marine Directorate – Licensing Operations Team
N	Nitrogen
NC	Negligible Concentration (RIVM standards)
NCMPA	Nature Conservation Marine Protected Area
nm	Nautical mile
NSIP	Nationally Significant Infrastructure Project
NVZ	Nutrient Vulnerable Zones
OAA	Offshore Array Area
OMF	Outer Moray Firth
OSPAR	Oslo-Paris convention
P	Phosphorous
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
PEL	Probably Effect Level
PSA	Particle Size Analysis
RBMP	River Basin Management Plan
RIVM	Rijksinstituut voor Volksgezondheid en Milieu
SAC	Special Area of Conservation

SEPA	Scottish Environment Protection Agency
SNH	Scottish Natural Heritage (now NatureScot)
SPA	Special Protection Area
SPM	Suspended Particulate Matter
SRC	Serious Risk Concentration (RIVM)
SSC	Suspended Sediment Concentration
SSS	Sea Surface Salinity
SST	Sea Surface Temperature
SWPC	Salamander Wind Project Company Ltd (formerly called SBES)
TEL	Threshold Effect Level
THC	Total Hydrocarbon Concentration
TOC	Total Organic Carbon
TOM	Total Organic Matter
WFD	Water Framework Directive
WTG	Wind Turbine Generator

8 Water and Sediment Quality

8.1 Introduction

8.1.1.1 The Applicant, Salamander Wind Project Company Ltd. (SWPC) a Joint Venture (JV) partnership between Ørsted, Simply Blue Group and Subsea7,) is proposing the development of the Salamander Offshore Wind Farm (hereafter 'Salamander Project'). The Salamander Project will consist of the installation of a floating offshore wind farm (up to 100 megawatts (MW) capacity) approximately 35 kilometres (km) east of Peterhead. It will consist of both offshore and onshore infrastructure, including an offshore generating station (wind farm), export cables to landfall, and connection to the electricity transmission network (please see **Volume ER.A.2, Chapter 4: Project Description** for full details on the Project Design).

8.1.1.2 This chapter of the Environmental Impact Assessment Report (EIAR) presents the results of the EIA of potential effects of the Salamander Project on Water and Sediment Quality. Specifically, this chapter considers the potential impact of the Salamander Project seaward of Mean High Water Springs (MHWS) during the Construction, Operation and Maintenance, And Decommissioning phases of the Offshore Development.

8.1.1.3 The chapter provides an overview of the existing environment for the proposed Offshore Development Area, followed by an assessment of significance of effect on Water and Sediment Quality receptors, as well as an assessment of potential cumulative effects with other relevant projects and effects arising from interactions on receptors across topics.

8.1.1.4 This chapter should be read alongside and in consideration of the following:

- **Volume ER.A.3, Chapter: 7 Marine Physical Processes.**

8.1.1.5 This chapter has been authored by Environmental Resources Management (ERM) Limited. Further competency details of the authors of this chapter are outlined in **Volume ER.A.4, Annex 1.1: Details of the Project Team.**

8.2 Purpose

8.2.1.1 The primary purpose of this EIAR is for the application for the Salamander Project satisfying the requirements of Section 36 of the Electricity Act 1989 and associated Marine Licences. This EIAR chapter describes the potential environmental impacts from the Salamander Project, on Water and Sediment Quality and assesses the significance of their effect.

8.2.1.2 The EIAR has been finalised following the completion of the pre-application consultation (**Volume RP.A.4, Report 1: Pre-Application Consultation (PAC) Report**) and the Salamander EIA Scoping Report (SBES, 2023) and takes account of the relevant advice set out within the Scoping Opinion from Marine Directorate - Licensing Operations Team (MD-LOT) (MD-LOT, 2023) relevant to the Offshore Development. Comments relating to the Energy Balancing Infrastructure (EBI) will be addressed within the Onshore EIAR. The Offshore EIAR will accompany the application to MD-LOT for Section 36 Consent under the Electricity Act 1989, and Marine Licences under the Marine (Scotland) Act 2010 and the Marine and Coastal Access Act.

8.2.1.3 This EIAR chapter:

- Outlines the existing environmental baseline determined from assessment of publicly available data, project-specific survey data and stakeholder consultation;
- Presents the potential environmental impacts and resulting effects arising from the Salamander Project on Water and Sediment Quality receptors;

- Identifies mitigation measures designed to prevent, reduce, or offset adverse effects and enhance beneficial effects on the environment;
- Identifies any uncertainties or limitations in the methods used and conclusions drawn from the compiled environmental information.
- Includes consideration for compliance to the Water Framework Directive (WFD) and assesses potential impacts on the identified designated receptors.

8.3 Planning and Policy Context

8.3.1.1 The preparation of the Water and Sediment Quality Chapter has been informed by the following policy, legislation, and guidance outlined in **Table 8-1**.

Table 8-1 Relevant policy, legislation and guidance relevant to the Water and Sediment Quality assessment

Relevant policy, legislation, and guidance
Policy
The River Basin Management Plan (RBMP) for Scotland 2021 – 2027
Sectoral Marine Plan for Offshore Wind Energy (Scottish Government, 2020)
Scotland's National Marine Plan (2015)
Legislation
Marine and Coastal Access Act 2009
Directive 2000/60/EC, Water Framework Directive (WFD)
Directive 2008/56/EC, Marine Strategy Framework Directive (MSFD)
Directive 2008/105/EC Environmental Quality Standards (EQSD)
Directive 2006/7/EC EU Bathing Waters Directive
Directive 2006/113/EC EU Shellfish Waters Directive
Water Environment and Water Services (Scotland) Act 2003
The Water Environment (Controlled Activities) (Scotland) Regulations 2011
The Pollution Prevention and Control (Scotland) Regulations 2012
Environmental Authorisations (Scotland) Regulations 2018
The Bathing Waters (Scotland) Regulations 2008

Relevant policy, legislation, and guidance
The Water Environment (Shellfish Water Protected Areas: Designation) (Scotland) Order 2013
The Water Environment (Shellfish Water Protected Areas: Designation) (Scotland) Order 2016
Scotland River Basin District (Quality of Shellfish Water Protected Areas) (Scotland) Directions 2021
The Water Environment (Shellfish Water Protected Areas: Objectives and Classification etc.) (Solway Tweed) Directions 2021
The Energy Act 2004
MARPOL The International Convention for the Prevention of Pollution from Ships
Guidance
Guidance for Ecological Impact Assessment (EIA) in the UK and Ireland. Terrestrial, Freshwater, Coastal and Marine (CEEIM, 2019)
CIRCA C584 Coastal and Marine Environmental Site Guide (CIRCA, 2003)
Assessment of the Environmental Impact of Offshore Wind-Farms (OSPAR, 2008)
Offshore Wind Farms. Guidance note for EIA in respect to FEPA and CPA requirements (Cefas *et al.*, 2004)
OSPAR Assessment of the Environmental Impacts of Cables (OSPAR, 2009)
Priority Marine Features (PMFs) as described in NatureScot Commissioned Report 388
COWRIE Coastal Process Modelling for Offshore Wind Farm Environmental Impact Assessment: Best Practice Guidance (COWRIE, 2009)
Guidelines for Data Acquisition to Support Marine Environmental Assessments of Offshore Renewable Energy Projects (Cefas, 2011)
Guidance note on carrying out a Water Framework Directive assessment on Environmental Impact Assessment developments (DEFRA, 2012)
Review of cabling techniques and environmental effects applicable to the offshore wind farm industry, Technical Report. (BERR, 2008)
Guidance on Best Practice for Marine and Coastal Physical Processes Baseline Survey and Monitoring Requirements to inform EIA of Major Development Projects (Brooks *et al.*, 2018)
Supporting Guidance (WAT-SG-53) Environmental Quality Standards and Standards for Discharges to Surface Waters (SEPA, 2020)
Land Use Planning System SEPA Guidance Note 17: Marine Development and Marine Aquaculture Planning Guidance, Version 6 (SEPA, 2014)
GPP Guidance for Pollution Prevention (SEPA, 2023)

Relevant policy, legislation, and guidance
The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended). A Practical Guide. (SEPA, 2022)
SEPA standing advice for the Department for Business, Energy and Industrial Strategy and Marine Scotland on marine consultations. (SEPA, 2022)

8.3.1.2 Further details on the requirements for EIA are presented in **Volume ER.A.2, Chapter 2: Legislative Context and Regulatory Requirements**. The most relevant policies, legislations, and guidance applicable to the topic of Water and Sediment Quality are addressed below.

8.3.2 The Water Framework Directive and Environmental Quality Standards Directive

8.3.2.1 The Water Framework Directive (WFD) sets out legal requirements intended to encourage the sustainable use of water and to protect and improve the quality of surface waters (including rivers, lakes, transitional and coastal waters (in Scotland to 3 nm/5.5 km), and man-made water bodies), and groundwater bodies. The EU Directive is transposed into Scottish law through the Water Environment (Controlled Activities) (Scotland) Regulations 2011 and the key objectives are to prevent all water bodies deterioration, to further protect and maintain good status and where necessary, set targets to restore all water bodies to reach overall quantitative and qualitative good status.

8.3.2.2 River Basin Management Plans (RBMPs) developed for each River Basin District set out the current status classification of all waterbodies, as well as the objectives and actions required to maintain or improve the current Status of each waterbody. All UK waterbodies are required to achieve Good Ecological Status (GES) or Good Ecological Potential (GEP) by 2027, with interim targets in 2015 and 2021.

8.3.2.3 Water body classification is based on two separate categories: ecological and chemical status. For a water body to be in overall 'good' status, both ecological and chemical status must be at least 'good'. The ecological status of surface waters is classified using information on the biological, physico-chemical and hydromorphological quality of the body of water. Ecological status is recorded on the scale of high, good, moderate, poor or bad. 'High' denotes largely undisturbed conditions and the other classes represent increasing deviation from this natural condition, otherwise described as a 'reference condition'. Classification under the WFD is determined in accordance with the 'one out, all out' principle, meaning that the worst assessment result for a biological quality element determines the overall assessment result. This means that the condition of a single quality element can cause a water body to fail to reach its WFD classification objectives.

8.3.2.4 Water chemical status is assessed by compliance with environmental standards for chemicals that are listed in the EC Environmental Quality Standards Directive (2008/105/EC) (EQS). These chemicals include priority substances, priority hazardous substances, and eight other pollutants carried over from the Dangerous Substance Daughter Directives. Chemical status is recorded as 'good' or 'fail'. The chemical status classification for the water body is determined by the worst scoring chemical.

8.3.2.5 The WFD seeks to reduce Priority Substances (there are 20 Priority Substances and 13 Priority Hazardous Substances = 33 in total) in the marine environment through the implementation of the Environmental Quality Standards Directive (EQSD) for discharges and outfalls. In addition, there are a further eight pollutants, which fall under the scope of Directive 86/280/EEC and which are included in List I of the Annex to Directive 76/464/EEC, but are not in the Priority Substances list. Environmental quality standards for these

substances are, however, included in the Environmental Quality Standards Directive 2008/105/EC. Where the hydromorphology of a surface water body has been significantly altered for anthropogenic purposes, it can be designated as an Artificial or Heavily Modified Water Body (A/HMWB). An alternative environmental objective, GEP applies in these cases.

8.3.3 The Bathing Waters Directive

8.3.3.1 The Bathing Waters Directive is implemented through the Bathing Waters Regulations (Scotland) 2008 and sets limits of bacterial indicator concentrations at a number of identified bathing waters in Scotland. The regulations aim to protect human health at locations where large numbers of people make use of the beaches and bathe during bathing season (1 June to 15 September). This requires that bathing waters are monitored every year by the Scottish Environment Protection Agency (SEPA) and the monitoring calendar should provide for at least four samples to be taken per bathing season, in the summer months from June to September (except where the season is very short or where there are special geographic constraints).

8.3.3.2 SEPA monitors and assesses bathing water quality at each designated bathing water site between June and September. Most bathing waters are sampled 18 times during the season with some remote sites sampled ten times and consistently excellent water quality sites sampled five times. EU water quality classifications are calculated at the end of the season and apply to each bathing water for the duration of the following season. In 2012, the bacterial parameters were updated upon the World Health Organisation (WHO) recommendations, to tests for:

- Escherichia coli;
- Intestinal enterococci; and
- Observations on phytoplankton growth, including cyanobacteria (blue-green algae), and macroalgae (seaweed).

8.3.4 The Shellfish Waters Directive

8.3.4.1 The Shellfish Waters Directive is implemented through the Water Environment (Shellfish Water Protected Areas: Designation) (Scotland) Order 2013 and the Water Environment (Shellfish Water Protected Areas: Designation) (Scotland) Order 2016 (Loch Ryan designated 85th Shellfish Protected Area). The regulations aim at preventing the deterioration of the protected Shellfish Waters quality, protect and improve their water quality and support the growth of healthy shellfish (bivalve and gastropod molluscs) and contribute to good quality edible shellfish. SEPA is responsible for monitoring shellfish waters and for environmental protection and improvement of Shellfish Water Protected Areas via implementation of environmental regulations and targets set out in Scotland's River Basin Management Plan.

8.3.4.2 This legislation brought the protection and improvement of shellfish waters into the river basin management planning process via the Water Environment (Shellfish Water Protected Areas: Environmental Objectives etc.) (Scotland) Regulations 2013 and the Scotland River Basin District (Quality of Shellfish protected Areas) (Scotland) Directions 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.

8.3.4.3 The Shellfish Waters Directive established parameters applicable to designated Shellfish Waters, as well as indicative values, mandatory values, reference methods of analysis and the minimum frequency for taking

samples and measurements. These parameters are set for pH, temperature, colouration, suspended solids, salinity, faecal coliforms, saxitoxin, substances affecting shellfish taste and the presence or concentration of certain substances (dissolved oxygen, hydrocarbons, metals, organohalogenated substances etc.). SEPA and Food Standards Scotland (FSS) must take samples from the waters to verify their conformity with the criteria set by the Directive.

8.3.5 The Marine Strategy Framework Directive

8.3.5.1 The objective of the Marine Strategy Framework Directive (MSFD) was to achieve 'good environmental status' in Europe's seas by 2020, and to protect the resources upon which marine-related economic and social activities depend. The Directive has been transposed into domestic law through the Marine Strategy Regulations 2010.

8.3.5.2 The MSFD enshrines, in a legislative framework, the ecosystem approach to the management of human activities having an impact on the marine environment, to enable the sustainable use of the marine environment and to safeguard its use for future generations. The MSFD establishes European marine regions and sub-regions on the basis of geographical and environmental criteria and requires each Member State to develop a strategy for its marine waters (or Marine Strategy) and achieve good environmental status (GES) by 2020, after which a review of the directive will be undertaken. Because the MSFD follows an adaptive management approach, the Marine Strategies must be kept up-to-date and is reviewed on a 6-year cycle. In coastal waters out to 1 nm (3 nm/5.5 km in Scotland), both the WFD and the MSFD apply, however, inside WFD coastal waters the MSFD only applies for aspects of good environmental status that are not already addressed by the WFD. The MSFD covers coastal waters beyond the 1 or 3 nm and encompasses territorial seas and the wider marine region.

8.3.5.3 There are important differences between the WFD and MSFD objectives, meaning:

- WFD: Its primary goal is to achieve good ecological and chemical status for all its designated water bodies. It introduces a combined approach to managing water quality through both point source and diffuse pollution controls.
- MSFD: Its primary aim is to protect the marine environment, prevent its deterioration, and, where practicable, restore marine ecosystems in areas where they have been adversely affected.

8.3.5.4 The determination of GES is based on the assessment of marine environmental quality, determined by 11 indicators (termed 'descriptors'): these are either 'Pressure' descriptors (non-indigenous species, eutrophication, hydrographical changes, contaminants in the environment, contaminants in the seafood, marine litter and underwater noise) or 'State' descriptors (biodiversity, commercially exploited fish and shellfish, food webs and sea-floor integrity) (EEA, 2023).

8.3.6 MARPOL Convention

8.3.6.1 The International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978 and 1997 (Protocol - Annex VI) (IMO, 2019) and the introduction of further annexes (e.g. control of pollution by sewage from ships, 2003) was developed by the International Maritime Organization (established by the United Nations) to minimise bad shipping practices, leading to pollution of the oceans and seas, including dumping, oil and air pollution. The UK is a signatory to the MARPOL Convention 73/78.

8.3.6.2 The objective of this convention is to preserve the marine environment in an attempt to completely eliminate pollution by oil, sewage and other harmful substances and to minimise accidental spillage of such substances. All ships flagged under countries that are signatories and parties to MARPOL are subject to its

requirements, regardless of where they sail; and member nations are responsible for vessels registered on their national ship registry.

8.3.7 Sediment Pollution Guidelines

8.3.7.1 Environmental Quality Standards (EQS) for UK statutory seabed sediments quality standards have yet to be established. Therefore, to assess potential contamination and pollution in offshore and nearshore seabed sediments, a number of published guidelines and assessment criteria have been considered. *In situ* values of physico-chemical variables are measured against background levels described in the guidelines, which are based on concentrations of compounds in undisturbed sediments.

Cefas Action Levels for the Disposal of Dredged Material

8.3.7.2 Action levels for disposal of dredged material defined by the Centre for Environment, Fisheries and Aquaculture Science (Cefas), have been considered common practice to use, although it should be noted that these are not statutory. In the absence of specific Scottish contaminant levels, the Cefas Action Levels are applied as best practice for assessment of sediment contaminant levels.

8.3.7.3 Action Levels are used as part of a 'weight of evidence' approach to assessing dredged material and its suitability for disposal to sea. These values will be used in conjunction with a range of other assessment methods, e.g. bioassays, as well as historical data and knowledge regarding the dredging site, the material's physical characteristics, the disposal site characteristics and other relevant data, to make management decisions regarding the fate of dredged material (MMO, 2015).

8.3.7.4 In general, contaminant levels in dredged material below Action Level 1 (AL1) are of no concern and are unlikely to influence the licensing decision. However, dredged material with contaminant levels above Action Level 2 (AL2) is generally considered unsuitable for sea disposal. Where contaminant levels lie between AL1 and AL2, further consideration must be made before disposal (MMO, 2014). Cefas current Action Levels are shown in **Table 8-2.**

Table 8-2 Cefas Action Levels (from the Marine Management Organisation (MMO), 2014)

Contaminant/Compound	Action Level 1	Action Level 2
	mg/kg Dry Weight (ppm)	*mg/kg Dry Weight (ppm)*
Arsenic	20	100
Mercury	0.3	3
Cadmium	0.4	5
Chromium	40	400
Copper	40	400
Nickel	20	200
Lead	50	500

Contaminant/Compound	Action Level 1	Action Level 2
	mg/kg Dry Weight (ppm)	*mg/kg Dry Weight (ppm)*
Zinc	130	800
Orgotins; TBT DBT MBT	0.1	1
PCB's, sum of ICES 7	0.01	none
PCB's, sum of 25 congeners	0.02	0.2
*DDT	*0.001	-
*Dieldrin	*0.005	-

*These levels were set in 1994

Canadian Sediment Quality Guidelines for the Protection of Aquatic Life

8.3.7.5 For metals and hydrocarbons in seabed sediments, assessment criteria developed by the Canadian Council of Ministers of the Environment (CCME) have been considered common practice to use. The guidelines were developed from the available scientific information on the biological effects of sediment associated chemicals.

8.3.7.6 These standards are not statutory and are based on the protection of pristine environments. The standards include 2 assessment levels as shown in **Table 8-3**, the Threshold Effect Level (TEL) is the lower of the levels and represents the concentration below which adverse biological effects are expected to occur only rarely, during an indefinite period of exposure. The Probable Effect Level (PEL) is higher and defines a concentration above which effects may be expected frequently in a wider range of organisms. For concentrations between the TEL and PEL, adverse effects occur occasionally (CCME, 2001).

Table 8-3 Canadian Council of Ministers of the Environment (CCME) interim marine sediment quality guidelines

Contaminant/Compound		Threshold Effect Level (TEL)	Probable Effect Level (PEL)
-		*mg/kg Dry Weight*	*mg/kg Dry Weight*
Metals	Arsenic	7.24	41.6
	Cadmium	0.7	4.2
	Chromium	52.3	160
	Copper	18.7	108
	Lead	30.2	112

Contaminant/Compound		Threshold Effect Level (TEL)	Probable Effect Level (PEL)
-		*mg/kg Dry Weight*	*mg/kg Dry Weight*
	Mercury	0.13	0.7
	Zinc	124	271
	Total Polychlorinated Biphenols (PCBs)	21.5	189
Polycyclic Aromatic Hydrocarbons (PAHs)	Acenaphthene	6.71	88.9
	Acenaphthylene	5.87	128
	Anthracene	46.9	245
	Benz(a)anthracene	74.8	693
	Benz(a)pyrene	88.8	763
	Chrysene	108	846
	Dibenz(a,h)anthracene	6.22	135
	Fluoranthene	113	1494
	Fluorene	21.2	144
	2-Methylnaphthalene	20.2	201
	Naphthalene	34.6	391
	Phenanthrene	86.7	544
	Pyrene	153	1398

OSPAR Sediment Quality Guidelines

8.3.7.7 The Oslo and Paris Conventions for the protection of the marine environment of the North-East Atlantic (OSPAR) Environmental Assessment Criteria (EAC) have also been applied to metal and PAH concentrations comparisons. OSPAR's Environmental Assessment Criteria established "Effect range-low" (ERL) values for sediment assessment of metals and PAH, where the ERL value indicates a concentration below which effects on organisms are rarely observed (OSPAR, 2011).

Other Guidelines

8.3.7.8 In the absence of local guidelines, Dutch RIVM (Rijksinstituut voor Volksgezondheid en Milieu, translated as Dutch National Institute for Public Health and the Environment) Environmental Risk Limits (ERLs), were applied as Total Hydrocarbon Concentration (THC) comparisons.

8.3.7.9 RIVM uses a tiered approach to derive ERLs for sediments, considering the direct exposure of sediment organisms to the substance. The following four ERLs are distinguished for sediments (RIVM, 2012):

- Negligible Concentration (NC): the concentration below which there is no risk of effects on the sediment biota.
- Maximum Permissible Concentration (MPC): the concentration that protects 95% of the sediment species from chronic effects.
- Serious Risk Concentration (SRC): the concentration that protects 50% of the sediment species from acute effects.
- Maximum Acceptable Concentration for Ecosystems (MAC eco): the concentration that protects 95% of the sediment species from acute effects.

8.3.7.10 The ERLs for sediments are based on ecotoxicological data, such as no-observed-effect concentrations and median lethal concentrations (LC50s), from laboratory and field studies. The ERLs also take into account the natural background concentrations, the bioavailability, and the speciation of the substance in the sediment. The ERLs for sediments are used as a basis for setting EQS for the protection of the water environment. RIVM standards set THC limits of MPC of 1000 mg/kg_{dw} and SRC of 5000 mg/kg_{dw} (RIVM, 2012).

8.4 Consultation

8.4.1.1 Consultation is a key part of the application process. It has played an important part in ensuring that the baseline characterisation and impact assessment is appropriate to the scale of development as well as meeting the requirements of the regulators and their advisors.

8.4.1.2 An overview of the Salamander Project consultation process is outlined in **Volume ER.A.2, Chapter 5: Stakeholder Consultation**. Consultation regarding Water and Sediment Quality has been conducted through the EIA scoping process. A Scoping Opinion was produced and published on the 21 June 2023. Scottish Ministers considered the content of the Scoping Report as sufficient and in accordance with the EIA Regulations.

8.4.1.3 The issues raised during consultation specific to Water and Sediment Quality are outlined in **Table 8-4**, including consideration of where the issues have been addressed within the EIAR.

Table 8-4 Consultation responses specific to water and sediment quality

Consultee	Date and Forum	Topic and Agreements	Where it is addressed within this EIAR
Marine Directorate - Licensing Operations Team (MD-LOT)	21 June 2023; Scoping Opinion	2.6.8 Section 4.8 of the Scoping Report states that a decommissioning programme will be prepared prior to construction but for the purposes of the Scoping Report, it is anticipated that all infrastructure above the seabed or ground level will be completely removed with any rock and/or scour protection being left in situ. The Scottish Ministers advise that the EIA Report must include an assessment of potential significant effects during the decommissioning phase. Any uncertainty on the impacts upon receptors from activities during decommissioning should be clearly explained, along with the implications for the assessment of significant effects.	**Section 8.11.4** Decommissioning. This section addresses the current decommissioning strategy.
		2.6.12 The Scottish Ministers advise that the Developer must make every attempt to narrow the range of options. Where flexibility in the design envelope is required, this must be defined within the EIA Report and the reasons for requiring such flexibility clearly stated. At the time of application, the parameters of the Proposed Development should not be so wide-ranging as to represent effectively different projects. To address any uncertainty, the EIA Report must consider the potential impacts associated with each of the different scenarios. The criteria for selecting the worst case and the most likely scenario, together with the potential impacts arising from these, must also be described. The parameters of the Proposed Development must be clearly and consistently defined in the application for the s.36 consent and marine licences and the accompanying EIA Report.	**Table 8-12** Project Design Envelope parameters relevant to the water and sediment quality topic. The table lists all the worst-case scenario design parameters to be assessed in the EIA.

Consultee	Date and Forum	Topic and Agreements	Where it is addressed within this EIAR
MD-LOT	21 June 2023; Scoping Opinion	3.2.1 Matters are not scoped out unless specifically addressed and justified by the Developer and confirmed as being scoped out by the Scottish Ministers. The matters scoped out should be documented and an appropriate justification noted in the EIA Re	**Section 8.8.2** Impacts scoped out of the EIAR. This section addresses and lists all the receptors, relevant to the water and sediment quality topic, scoped out of the EIA.
		3.3.1 Any embedded mitigation relied upon for the purposes of the assessment should be clearly and accurately explained in detail within the EIA Report. The likely efficacy of the mitigation proposed should be explained with reference	**Section 8.12** Mitigation and Monitoring. This section identifies and describes any proposed monitoring of significant effects, relevant the water and sediment quality topic.
MD-LOT	21 June 2023; Scoping Opinion	5.3.1 The Scottish Ministers are broadly content with the baseline data sources used by the Developer in Table 7.2.3 of the Scoping Report and the identification of potential impacts to be scoped in/out contained in Section 7.2.7. However, the Scottish Ministers direct the Developer to the SEPA representation including their standing advice and advise this must be fully considered and in the EIA Report.	Section starting at **paragraph 8.8.3.2** highlights SEPA published Standing Advice applicable to the offshore infrastructure elements of an OWF project and discusses the implementation of mitigation measures.
NatureScot	21 June 2023; Scoping Response	**Wet storage** Section 4.6.2 (Floating Substructures) refers to the potential for wet storage of the substructures prior to their installation within the array area, either at the initial assembly site, the wind turbine integration site or a separate dedicated storage location. Section 4.7.1 (Floating Assembly) also indicates that once operational the substructures and WTGs will form an integrated assembly piece – the replacement of any major component parts of which is expected to be achieved by towing the assembly to port. Wet storage could represent a significant impact. Consideration of the potential impacts on all receptors needs to be addressed with the EIAR and HRA. We would welcome further discussion	Wet storage of the floating substructures (and integrated WTGs) prior to tow-out to the Offshore Array Area is considered to be outside the scope of this EIA and the Marine Licence applications for the Offshore Development. This is due to the fact that at this stage of the Salamanader Project it is not known which port(s) will be used for wet storage and therefore it is challenging to undertake a meaningful assessment of impacts related to wet storage. The intent is that the Salamander Project will utilise the services of a port(s) that offer wet storage sites, which will have appropriate consents (obtained by the port authority) for wet storage of floating substructures,

Consultee	Date and Forum	Topic and Agreements	Where it is addressed within this EIAR
		on this as and when further details are confirmed, noting the intention to seek a separate marine licence application for any requirements for wet storage outwith the array area.	fabrication and assembly with the WTGs. To enable the availability of this option for the Salamander Project within the required timeframe, SBES is an official member of the TS-FLOW UK-North Joint Industry Project (JIP) exploring the challenges of wet storage and identifying the opportunities and potentially suitable locations for these activities. This JIP is in collaboration with relevant ports and other floating offshore wind developers. Separate Marine Licences and associated impact assessments for wet storage areas outwith the Offshore Development Area will be applied for and undertaken as appropriate.
SEPA standing advice for the Department for Business, Energy and Industrial Strategy and Marine Scotland on marine consultations	September 2022 Published Guidance Note	Please do not routinely consult SEPA directly on any applications which are purely within the marine environment, including at any stage of EIA or repeat consultations. Please consider our standing advice in Section 3 and Table 1 as SEPA's views and consultation response, where relevant.	Acknowledged
		Notwithstanding the advice above, should there be a development proposal of potentially significant impact on aspects of the environment directly regulated by SEPA which is not dealt with adequately by our standing advice or is novel or unusual, then please do consult us specifying exactly the aspect of the environment regulated by SEPA on which advice is sought.	Acknowledged

Consultee	Date and Forum	Topic and Agreements	Where it is addressed within this EIAR
		For all matters covered by the below advice, SEPA has not assessed the application, has no site-specific comments to make and, where relevant, does not consider EIA is required from our perspective.	Acknowledged
		Bathing Waters Mitigation: Any operation should be cross checked to see if the proposed site is in or adjacent to a designated bathing water (within 2 km). If so, all physical operations should be done outwith the Bathing Water Season (1 June to 15 September). If works to be done within Bathing Water Season, a strong case should be made as to why a particular operation would not present a risk to Bathing Waters. Please refer to the Bathing waters section of our website www2.sepa.org.uk/bathingwaters/ for further guidance on the Bathing Waters Directive (2006/7/EC).	**Table 8-8** considers all the designated Bathing Waters located within the Salamander Project Study Area and scopes in the sites located within 2 km from any project activity.
		Pollution Prevention Mitigation: To prevent pollution and safeguard marine ecology interests it is vital that good working practice is adopted, and appropriate steps taken to prevent water pollution and minimise disturbance to sensitive receptors. Measures need to be in place to minimise the release of sediment plumes and to contain and prevent construction and waste materials e.g. paint from falling from a structure into the water body beneath. Where appropriate, mitigation measures should be sought within method statements and onsite compliance should be confirmed through site visits. Please refer to gpp-5-works-and-maintenance-in-or-near-water.pdf (netregs.org.uk). This includes working with concrete, cement and grout. SEPA has no objection to the release of sediment tracing material into the water environment for the undertaking of a dispersion study (e.g. for aquaculture or septic tank flows). However, we strongly recommend the use of biodegradable	**Section 8.8.3** Embedded Mitigation. Details the proposed embedded mitigation measures to prevent and minimise pollution concerns.

Consultee	Date and Forum	Topic and Agreements	Where it is addressed within this EIAR
		material. We do not consider the use of nonbiodegradable products (e.g. microplastic beads) to be the best environmental option.	
		On-shore works and restoration: With regard to works on the shoreline, the applicant should refer to the appropriate sections in the Guidance for Pollution Prevention (GPPs) and CIRIA Guidance, in particular C744 Coastal and marine environmental site guide. 2nd edition, 2015 CIRIA. Disturbance to the shoreline should be minimised and the shore restored to as near its former condition following the works as reasonably possible on completion of the works. SEPA recommends that new infrastructure, including sea outfalls (including septic tank outfalls), be buried where possible and redundant structures and materials be removed.	Not applicable to offshore environment
		The developer should consider if waste deposition could constitute landfill and should therefore be subject to authorisation under PPC and should comply with all relevant environmental legislation and to check our website at www.sepa.org.uk/regulations/ and contact SEPA via the online form with any site-specific issues. Where appropriate, any waste materials should be removed and disposed of at a licensed onshore site	**Section 8.8.3** Embedded Mitigation. Details the proposed embedded mitigation measures to address waste deposition and SEPA standing advice.
		Dredging Mitigation: Dredged material should be disposed of at an offshore sea disposal site and that work must be carried out in line with best dredging practices. Material should be deposited on the beach below MHWS and allowed to disperse naturally. If any dredged material accumulates above MHWS, disposal operations must cease until the material has dispersed.	Section starting at **paragraph 8.8.3.2** details SEPA standing advice on dredging spoils disposal. This methodology has been further proposed in **Section 8.12** Mitigation and Monitoring.

Consultee	Date and Forum	Topic and Agreements	Where it is addressed within this EIAR
		Waste material (includes dredge spoil) above the low water mark Waste material, which includes dredge spoil, deposited above the low water mark is subject to Waste Management Licensing controls regulated by SEPA unless it is subject to a licence issued under Part 4 of the Marine (Scotland) Act 2010 (which can extend to Mean High Water Spring Tide including within estuaries, rivers and channels), in which case it is excluded from such controls. However, if the waste deposition could constitute a landfill, then PPC not Waste Management Licensing would apply, and in this situation no Marine Licence exclusion is provided for. Where dredge spoil is used for land reclamation works or harbour works then the method of construction will determine how the activity is regulated. If the works are carried out by way of deposit of material directly onto the intertidal zone or within a permeable bunded area (for example a bund made of placed stones) then the works will be considered to be occurring in the marine environment and will be regulated by Marine Scotland. If the works are constructed by way of initially creating an impermeable bund (such as a sheet piled metal wall) then the use of waste such as dredge spoil for infill works will be considered to be occurring above mean high water springs and therefore will be controlled by SEPA. Such works would require either a waste management licence or a waste management exemption. The applicant should consult the local SEPA Regulatory Services team (see contact sheet for details) for advice on whether or not the proposed waste deposition would constitute a landfill and hence fall within PPC regulation, including for the controlled placement of dredged sands from harbours onto adjacent beaches and/or seabed.	**Section 8.8.3.2** onwards details SEPA standing advice on dredging spoils disposal. This methodology has been further proposed in **Section 8.12** Mitigation and Monitoring.

Consultee	Date and Forum	Topic and Agreements	Where it is addressed within this EIAR
		Decommissioning: While MS-LOT consult on Marine Licence applications for decommissioning, the applicant will consult themselves on the Decommissioning Programme (as per Energy Act 2004) required to be submitted as part of the s.36/Marine Licences issued for renewables construction. SEPA does not require to be consulted and will provide no comments on the Decommissioning Programme. Please ensure that conditions cover decommissioning where appropriate and the removal of all devices and as much of the support infrastructure/cabling is removed and all waste materials are removed and reused, recycled or disposed of at a licensed onshore site.	**Section 8.11.4** details the proposed Decommissioning plan.
SEPA	21 June 2023; Scoping Response	Onshore Substation (OnSS), that includes Energy Balancing Infrastructure (EBI) containing battery storage: Please refer to sepa-triage-framework-and-standing-advice.pdf – and within it Table 2: Standing advice for planning authorities.	Not relevant to the offshore environment.
Department of Agricultural Environment and Rural Affairs	21 June 2023; Scoping Response	Marine Strategy – Good Environmental Status: The location of these planned developments are such that any negative impact to the achievement of Good Environmental Status in Northern Ireland waters is extremely unlikely.	Transboundary effects for this topic area have been scoped out.
		Marine Strategy Branch Response Bathing & Shellfish Water Protected Areas: The location of these planned developments are such that any negative impact to Northern Ireland's Shellfish Water Protected Areas or Bathing Waters are extremely unlikely.	Transboundary effects for this topic area have been scoped out.

8.5 Study Area

8.5.1.1 The Water and Sediment Quality Study Area has been defined on the basis of the area that will be directly impacted by the offshore infrastructure (near-field) and the adjacent areas that may be affected by indirect impacts (far-field), such as sediment suspension and redeposition. The near-field Study Area is divided into the following four sub-areas:

- Intertidal area at the landfall site, between Mean High Water Springs (MHWS) and Mean Low Water Springs (MLWS);
- Nearshore and Offshore Export Cable Corridor (ECC);
- The Offshore Array Area (OAA) (33.25 km^2), located approximately 35 km offshore; and
- Two buffer zones of 50 m and 500 m around the OAA and the ECC respectively.

8.5.1.2 The far-field Study Area is defined by:

- The distance away from the Offshore Development Area in which suspended sediment plumes may be advected (and affect the receptors identified). This is defined by the tidal ellipses (shape) and excursion zone (distance)[1] from the direct project footprint under mean spring tidal conditions as described in **Volume ER.A.3, Chapter 7: Marine Physical Processes and Volume ER.A.4, Annex 7.1: Marine Physical Processes Technical Annex.** The tidal excursion zone includes a buffer zone of 8 km in width within the OAA; 12 to 14 km in the middle of the Offshore ECC and up to 17 km close to the landfall; and
- The "wider area" comprising regional scale physical processes and regional physico-chemical characteristics of water and sediment quality, not directly impacted by the Salamander Project activity.

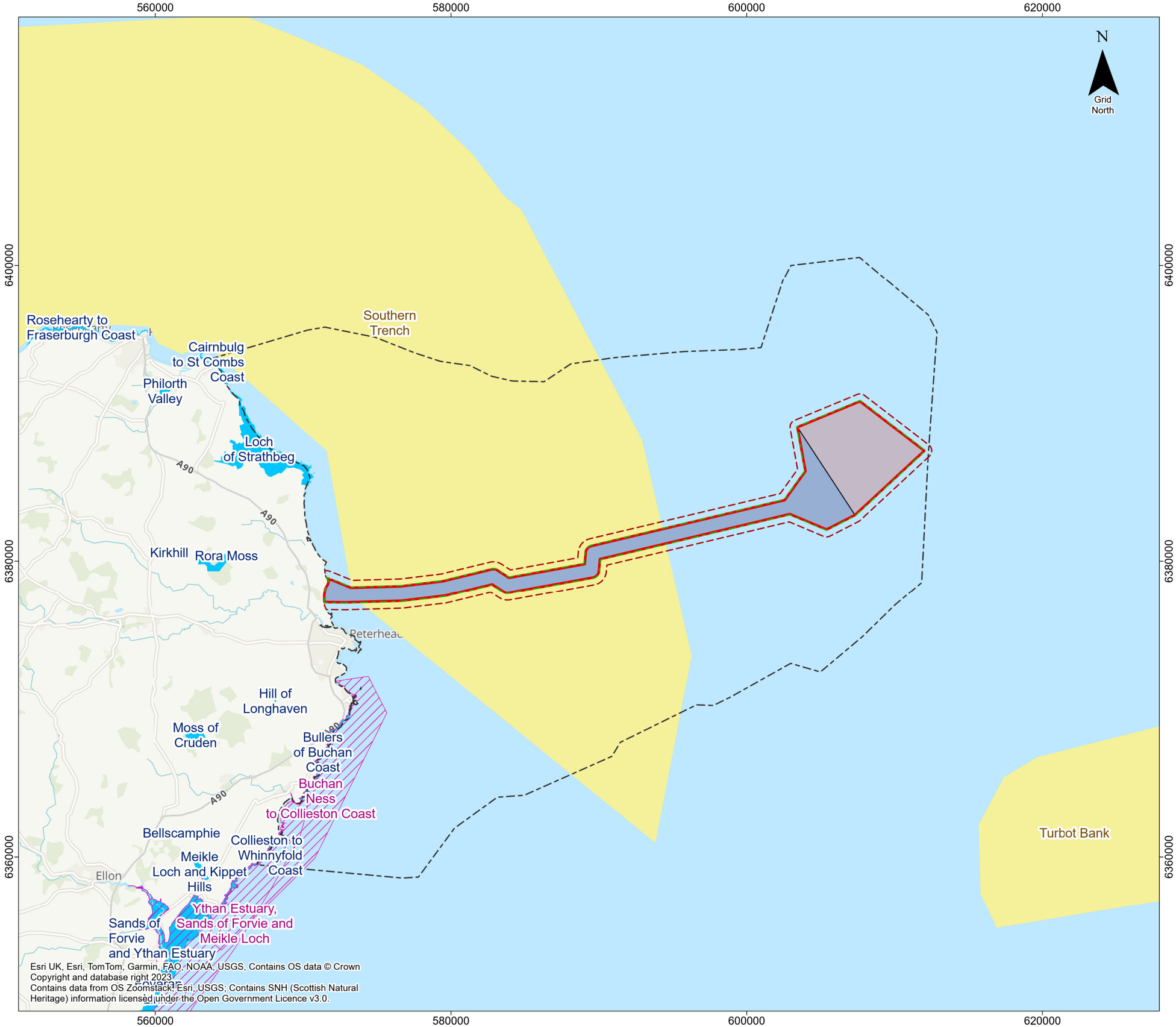
8.5.1.3 The Study Area for Water and Sediment Quality is shown in **Figure 8-1.** The relevant designated nature conservation zones, the near-field Study Area and specific buffer zone areas of influence (50 m buffer around the ECC and 500 m buffer around the OAA), the far-field Study Area (Spring Tidal Excursion buffer) and the wider area (wider area shown on map, not delineated) are also shown:

[1] Tidal ellipse refers to the shape traced by the tip of the current velocity vector over one tidal cycle. It describes the magnitude and direction of the tidal currents at a given location. Tidal excursion refers to the average distance travelled by a water particle during one tidal cycle.

Salamander

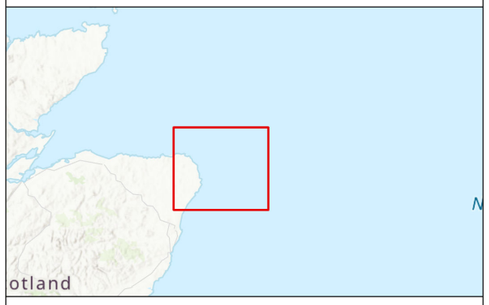
Figure 8-1

Water and Sediment Quality Study Area



Legend

- Marine Protected Area
- Site of Special Scientific Interest
- Special Protection Area
- Spring Tidal Excursion buffer
- 50m buffer
- 500m buffer
- Offshore Export Cable Corridor
- Offshore Array Area
- Offshore Development Area



Coordinate System: WGS 1984 UTM Zone 30N

Scale @ A3 : 1:250,000

0 7.5 15 Kilometers

0 1.75 3.5 7 Nautical Miles

Rev	Description	Date
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Doc. Title : Water and Sediment Quality Study Area
Doc. No : SWF01ER0256
Created by : NB
Checked by : GLS
Approved by : DK

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8.6 Methodology to inform Baseline

8.6.1 Site Specific Surveys

8.6.1.1 In order to provide site specific and up to date information on which to base the impact assessment, an environmental survey was conducted to collect baseline data on sediment physico-chemical characteristics. Details of this survey are presented in **Table 8-10**.

Table 8-5 Site specific surveys

Survey	Conducted by	Outcome of Survey
Geophysical and Environmental subtidal survey	Ocean Infinity (2022a)	Environmental Baseline Survey collecting *in situ* benthic fauna and sediment physico-chemical data in addition to geophysical data from the Offshore Array Area up to 8 km from the shore (the closest station along the ECC that was successfully sampled was approximately 8 km from shore).
Inter-tidal survey report	Ocean Infinity (2022b)	Phase I and Phase II intertidal biotope mapping to obtain standardised information on the presence and extent of the broad scale habitats and habitats of conservation importance.

8.6.1.2 The Salamander Project has been unable to acquire project specific, or secondary survey data, within the nearshore ~8 km area of the Offshore ECC (referred to as Nearshore ECC), in a timeframe suitable to undertake the EIA in 2023 for submission of the EIAR in early 2024. This current 'data gap' covers the area from the MLWS at the Landfall location, through to the 1°40 line approximately 8 km east. The rest of the Offshore ECC from the 1°40 line to the OAA (and the Offshore Array Area itself) has been surveyed. Notwithstanding, information has been obtained regarding some of the general baseline conditions e.g. hydrodynamics and seabed type, are available. This is considered sufficient to allow understanding of baseline conditions.

8.6.2 Data Sources

8.6.2.1 The data sources that have been used to inform this Water and Sediment Quality Chapter of the EIA Report are presented within **Table 8-6**.

Table 8-6 Summary of key publicly available datasets for Water and Sediment Quality

Source	Year	Spatial Coverage*	Summary
ABPmer SEASTATES	1979 to 2022	Full coverage of the Study Area	Tides, winds and waves. Modelled hindcast wave and hydrodynamic data from across the Study Area. [Source: www.seastates.net/]
BODC – Clean Seas Environmental Monitoring Programme	1989 to present	Partial coverage of the Study Area – coverage of the wider area as	Temperature and salinity data

Source	Year	Spatial Coverage*	Summary
		shown in **Figure 8-1.**	
British Geological Survey	2022	Full coverage of the Study Area	Seabed morphology and bathymetry (INFOMAR), sediment types. [Source: www.bgs.ac.uk/GeoIndex/offshore.htm]
Cefas – Suspended sediment climatologies around the UK	2016	Full coverage of the Study Area	Suspended sediments concentrations and distribution
Cefas – Silva, 2016. Monthly average non-algal Suspended Particulate Matter concentrations on the UK shelf waters	2016	Full coverage of the Study Area	Survey data on suspended solids around the UK
Coastal Water Body Classifications SEPA	2017	Partial coverage of the Study Area – coastal area	Coastal water bodies
Copernicus	2023	Full coverage of the Study Area	1.5 km horizontal resolution model providing surface and vertical profiles of biochemical and physical water quality data [https://marine.copernicus.eu/]
EMODnet – EMODnet broad-scale seabed habitat map for Europe 2019 (EUSeaMap)	2023	Full coverage of the Study Area	Modelled distribution of EUNIS substrate types [Source: EMODnet.com]
JNCC – Coasts and seas of the United Kingdom. Region 3 North-east Scotland: Cape Wrath to St. Cyrus	1996	Partial coverage of the Study Area – coastal area	Overview of environment, geology and ecology
Marine Scotland – Scotland's Marine Atlas: Information for The National Marine Plan	2011	Partial coverage of the Study Area – coastal area	Hazardous substances in Scottish seas
Marine Scotland – Annual Cycles of Physical, Chemical and Biological Parameters in Scottish Waters 1960-2010. Shelf waters.	2014	Partial coverage of the Study Area – limited extension	Physico-chemical data in the proximity of the Salamander Project site and water profiles
Marine Scotland - Sedimentary organic carbon quality and reactivity	2022	Partial coverage of the Study Area – limited extension	Carbon and organic matter content

Source	Year	Spatial Coverage*	Summary
NatureScot - SNH Natural Heritage Trends, The seas around Scotland 2004	2004	Partial coverage of the Study Area – coastal area	Overview of the seas around Scotland including ecology
OSPAR Intermediate Assessment 2017– Contaminant assessments	2017	Partial coverage of the Study Area	
Scotland's aquaculture	2023	Full coverage of the Study Area	Overview of Shellfish Protected Waters http:aquaculture.scotland.gov.uk/map/map.aspx
Scotland Environment	2023	Full coverage of the Study Area	Overview of environmental data https://map.environment.gov.scot/sewebmap/
SEPA - Bathing Waters	2023	Full coverage of the Study Area	Designated bathing waters locations and status https://informatics.sepa.org.uk/BathingWaters/
SEPA - Shellfish Waters	2023	Full coverage of the Study Area	Designated shellfish waters location and status
SEPA - Water Framework Directive (WFD) River Basin Management Plan (RBMP) Waterbody status	2019	Partial coverage of the Study Area – coastal area	
SEPA - Scotland's water environment 2019: A summary and progress report	2019	Partial coverage of the Study Area – coastal area	

** For datasets with 'partial coverage', information can be found in **Section 8.7** - Baseline Environment detailing the origin of data and distance of relevant data to the project site.*

8.7 Baseline Environment

8.7.1 Existing baseline

8.7.1.1 Baseline conditions refer to the pre-construction condition of potential pathways, receptors and the general environment, in the absence of the Salamander Project. The near-field and the far-field Study Areas have been considered in the collation of baseline data.

8.7.1.2 The Water and Sediment Quality baseline data section is sub-divided into the following sections:

- Sediment quality:
  - Sediment physical properties; and
  - Sediment chemical properties.
- Water quality:
  - Water physical properties; and
  - Water chemical properties.

8.7.1.3 A WFD compliance assessment must be carried out for activities taking place within a WFD designated water bodies out to 3 nm (5.5 km). The WFD compliance assessment identifies all the relevant receptors within 2 km from any proposed Salamander Project activities within the 3 nm boundary. The statutory receptors are:

- WFD designated and protected areas located within the Water Body, including:
  - Bathing waters;
  - Shellfish waters;
  - Nutrient sensitive areas;
  - Marine protected areas;
- Water quality;
- Hydromorphology;
- Biology - habitats;
- Biology – fish; and
- Consideration for Invasive Non-Native Species (INNS) must be included.

8.7.1.4 Predicted future baseline changes, under climate change projection scenarios, will be discussed in a separate chapter: **Volume ER.A.3, Chapter 20: Climate Change and Carbon.**

8.7.1.5 The OAA of is located within the northern North Sea basin with water depth between 87 to 110 m below Lowest Astronomical Tide (LAT). The hydrodynamic properties of the Study Area (e.g. currents and waves) are discussed in detail in **Volume ER.A.3, Chapter 7: Marine Physical Processes**. In summary:

- Tidal excursion: during mean spring tidal conditions, the approximate overall tidal excursion distance is: 8 km in the OAA; 12 to 14 km in the middle of the Offshore ECC and up to 17 km close to the landfall. Tidal excursion distances on a mean neap tide are approximately half the corresponding mean spring value;
- Tidal water level characteristics: semi-diurnal, east to west direction with a mean peak height (spring tides) of ~2.45 m at the OAA and ~3.3 m at the landfall. Offshore the tidal axis is aligned north to south with a southerly flood tide and northerly ebb tide;
- Tidal current velocity: depth averaged mean spring currents within the OAA are in the approximate range 0.5–0.8 m/s, with equivalent neap flows of between approximately 0.2-0.4 m/s. Depth averaged mean spring currents near the coast increase to 1-1.5 m/s, with equivalent neap flows of between approximately 0.4-0.6 m/s;
- Non-tidal currents: the currents are primarily driven by storm surges and wind sheer stress. Overall, the speed of surface currents are of the order of 3% of the wind speed;
- Waves: wave regimes exhibit wind-driven seasonal and inter-annual variation. Waves in the OAA predominantly come from northerly and southerly directions (approximately 20% of time, each) and significant height can reach > 4 m. Waves in the Offshore ECC typically come from the south and southeast, significant heights can reach >4 m;
- Winds: within the Study Area stronger winds (>16 m/s) come from a south, southwesterly to northwesterly direction.

8.7.1.6 The geophysical properties of the Study Area are discussed in **Volume ER.A.3, Chapter 7: Marine Physical Processes**. In summary:

- Sediment types: sediments within the OAA mainly consist of sand (developing into gravelly sand and sandy gravel towards the west) and variable proportions of gravel and mud with the presence of sparse sandwaves and megaripples. Sediments along the Offshore ECC comprise mostly of gravelly sand towards the coast, with patches of sand where current speeds are highest;
- Bathymetric profile: Throughout the OAA water depths range between 87-110 m below Lowest Astronomical Tide (bLAT) (deeper in the southern region). Within the Offshore ECC, depths range from 0–96 m bLAT.

8.7.2 Sediment Quality

Physical Properties: Particulate Size, organic matter content

8.7.2.1 A detailed geomorphological baseline is discussed in **Volume ER.A.3, Chapter 7: Marine Physical Processes**.

8.7.2.2 *In situ* characterisation of the sediment physico-chemical properties was carried out through site-specific surveys (Ocean Infinity, 2022a) where sediment quality data was collected. A general overview of the seabed type expected in the area is shown in **Figure 8-2** (EMODnet, 2023).

Salamander

Figure 8-2

Sediment type distribution within the water and sediment quality Study Area

560000 580000 600000 620000

6420000 6400000 6380000 6360000

N

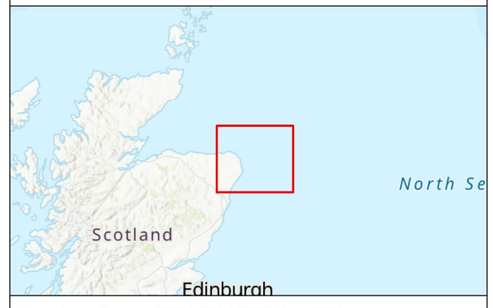
Grid North

Legend

- Offshore Development Area
- Offshore Array Area
- Offshore Export Cable Corridor
- Indicative Onshore Development Area
- 12nm limit
- No data

Seabed substrate

- 12. sandy Mud
- 13. muddy Sand
- 2. Sand
- 3. Coarse-grained sediment
- 5. Rock & boulders
- Spring Tidal Excursion buffer
- 500m buffer
- 50m buffer
- 3nm limit
- Open disposal sites
- Closed disposal sites
- Sewage Treatment Works



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Scale @ A3 : 1:315,000

0 9.5 19 Kilometers

0 2.25 4.5 9 Nautical Miles

Rev	Description	Date
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Doc. Title : Water and Sediment Quality Sediment Type
Doc. No : SWF01ER0257
Created by : NB
Checked by : GLS
Approved by : DK

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8.7.2.3 Particulate Size Analysis (PSA) results from 51 stations (with a data gap of 8 km from the coast), show sediment primarily dominated by sand throughout the Study Area, with gravel concentrations increasing westward along the Offshore ECC and muddy sands found at the OAA as shown in **Figure 8-3,** where "ECR" stations are located along the cable corridor and "WAA" stations represent sampled location at the OAA.

8.7.2.4 Sand was the dominating sediment fraction, with a mean content of 86.2% (SD=5.0), followed by Mud which had a mean content of 10.8% (SD=5.2), Silt at 9.4% (SD=4.6) and 1.4% (SD=0.7) Clay. The Gravel content was low and variable with a mean content of 3.0% (SD=5.29) (Ocean Infinity, 2022a). Sediments across the Study Area were classified (Folk classes) as patches of gravelly muddy sand, slightly gravelly muddy sand, gravelly sand, slightly gravelly sand, sand and muddy sand.

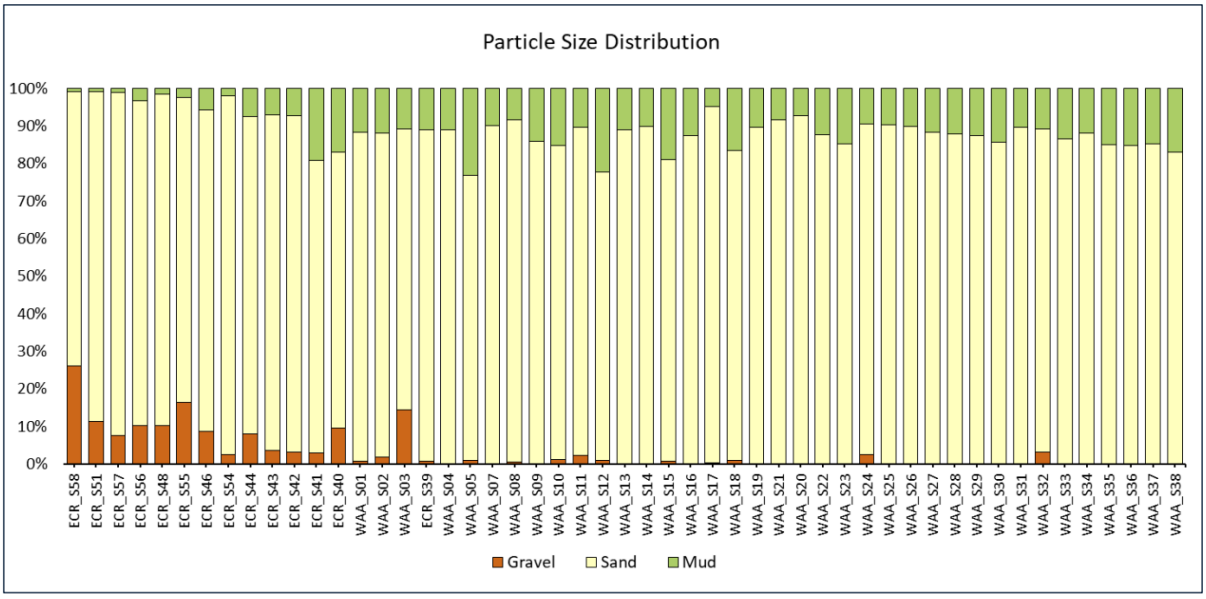


Figure 8-3 Particle size distribution along the Salamander Project area (Ocean Infinity, 2022a). Sorted by increasing Easting.

8.7.2.5 Total Organic Carbon (TOC) content was low and relatively uniform throughout the Study Area with concentrations ranging from a minimum of 0.09% to a maximum of 0.29% with significantly higher concentrations found at 1 of the stations along the Offshore ECC (ERC_44) at 0.46% and an overall mean of 0.18% (SD=0.07). Total Organic Matter (TOM) was low with a minimum concentration of 0.7% and a maximum of 2.4% and a mean content of 1.3% (SD=0.3), the highest value, of 2.4%, was found at the Offshore ECC (ECR_44).

Chemical Properties: hydrocarbons and metals

8.7.2.6 Total Hydrocarbon (THC) concentrations were low although generally higher in the OAA compared to the Offshore ECC, with the lowest concentrations recorded at the stations closest to landfall. THC averaged 3.9 mg/kg_{dw} with a minimum of 0.66 mg/kg_{dw} (ECR_S57) and a maximum of 7.4 mg/kg_{dw} (WAA_S23). Overall THC did not exceed the Dutch RIVM (Rijksinstituut voor Volksgezondheid en Milieu translated as Dutch National Institute for Public Health and the Environment) Environmental Risk Limits, stating Maximum Permissible Concentrations of 1000 mg/kg_{dw} and Serious Risk Concentrations of 5000 mg/kg_{dw}, at any grab sample site.

8.7.2.7 Polycyclic aromatic hydrocarbons (PAHs) are ubiquitous pollutants that enter the environment from the atmosphere or direct anthropogenic contamination events (primarily of fossil fuels and industrial wate origin) and originate from a variety of different sources including pyrogenic, petrogenic, and natural sources. PAHs have demonstrated harmful effects on organisms with their carcinogenic and mutagenic properties and are therefore, considered priority pollutants (Davis *et al*., 2019). PAHs released from high temperature processes (pyrogenic) tend to be of high molecular weight and have increased persistence in the environment (4–6 aromatic rings) whilst low molecular weight PAH (2-3 aromatic rings) generate from petrogenic origins and can occur due to inputs from accidental spills, petroleum combustion, terrestrial run off, and various discharges (Davis *et al*., 2019).

8.7.2.8 PAHs concentrations were overall low but variable across the Study Area with higher levels found at the Array Area compared to the Offshore ECC. CCME TEL values for the Dibenzo[a,h]anthracene congener were exceeded at station WAA_S16, in the OAA, but remained below PEL concentrations.

8.7.2.9 Heavy metals are of particular environmental importance as they are deposited in the sediments as a sink and their geo-accumulation is associated with contamination, bioaccumulation in living organisms and toxicity. Sources of metal contamination can be natural such as rocks and soils weathering processes, aeolian and atmospheric inputs, and anthropogenic such as sewage waste, dumping, industrial and agricultural run-off (Cefas, 2018). Metals enrichment in sediment generally increase with higher organic matter content and smaller particle size.

8.7.2.10 The metals measured were: Arsenic (As), Cadmium (Cd), Chromium (Cr as VI and total), Copper (Cu), Lead (Pb), Nickel (Ni), Tin (Sn), Vanadium (V), Zinc (Zn), Aluminium (Al), Barium (Ba) and Mercury (Hg)[2]. Spatial distribution of metals across the Study Area remained low, with concentrations below Cefas AL1 for all the metal species investigated. However concentrations increased with proximity to the shore and, although below Cefas AL1, the concentrations were reported above the CCME TEL (>7.24 mg/kg_{dw}) at five stations along the Offshore ECC.

8.7.2.11 Due to the 8 km survey gap along the Offshore ECC, metals concentration data for the nearshore Offshore ECC area was not available at the time of writing this report. Taking into consideration the patterns of metals distribution along the surveyed Study Area, it is expected that the concentration of most metal species investigated in the 8 km Offshore ECC survey gap are expected to be below Cefas AL1. A possible exception to this is Arsenic (As) concentration; these increased westward with proximity to the shore, leading to the possibility that there could be slight exceedances of Cefas AL1 for As levels within the survey gap area. However, the measurements recorded along the survey areas indicate that although there may be marginal increases above Cefas AL1, it is highly unlikely that any increase will be sufficient to exceed Cefas AL2. Therefore, the sediments within the 8 km data gap are not expected to present risk of significant contamination.

8.7.2.12 Arsenic (As) is a metal commonly discharged from abandoned mines alongside Cd, Pb, Ni, Zn Cu, Fe and Mg, and although Scotland has a long history of mining, the industry has not been significantly developed in the county of Aberdeenshire and no major riverine input and drainage from metal-mining areas are present near the Study Area; therefore, mining effluent contamination is not considered a primary contributor to increased As concentrations (Neff, 1997; The Scottish Government, 2015). Additionally, raised

[2] These are metals commonly associated with toxicity and pollution; and are associated with the EQS and MSFD requirements.

concentrations of other metals associated with mining affluent pollution (e.g. Pb and Cd), did not coincide with the locations where elevated (still below CAL1) As concentrations were detected.

8.7.2.13 Notably, in the nearshore Study Area to the south and east of Peterhead, a number of wastewater treatment plants, dredge spoils deposits sites (closed and open) and industrial marine discharge sites are present, which could act as source of metals. However, slightly elevated As concentrations are commonly found in the North Sea, legacy of historical industrial discharges but also affected by natural chemical weathering processes (Whalley *et al*., 1999).

8.7.2.14 Overall, sediment grain size increased westward with consistently low levels of TOM, limiting accumulation of contaminants in sediment, therefore, As concentrations above Cefas AL2 within the 8 km gap area, are not expected. Additionally, the absence of significant pollution (elevated THC, PAHs and metals) within the Study Area, indicates low concerns for the overall status of the quality of the sediment at the Salamander Project site.

8.7.3 Water Quality

Hydrophysical properties: temperature, salinity and suspended solids

8.7.3.1 This region of the northern North Sea is influenced by the North Atlantic Drift, a western boundary current moving north-eastward (Norwegian Current) through the Faroe Shetland Channel to the Norwegian coast. The current has a mild warming effect on the waters of the northern North Sea, characterised by seasonal variations in Sea Surface Temperature (SST), affected by seasonal changes in air temperature and stratification, with colder SST observed during the winter months reaching <7 °C and warmer SST, >13 °C, found in the summer months (Slesser and Turrell, 2013; Copernicus, 2023).

8.7.3.2 Thermal stratification occurs in the warmer season (from May to October), affected by air temperatures and solar radiation warming up the top layer of the water column, creating differences in water density (salinity and temperature driven) within the water column. From June to October in the top 30 m of the water column, within the Cooled Atlantic Water (CAW) area of the North Sea (Slesser and Turrell, 2013), temperature is the highest, averaging 11.7 °C (maxima 14 °C). Deeper in the thermocline layer at 60 m to bottom depths, temperature decreased to an average of 7.1 °C (maxima 7.7 °C) with little intra-annual variation (minima 6.5 °C in May and maxima 8.6 °C in December) (Copernicus, 2023). Generally, in nearshore and shallower water depths, turbulent mixing (currents and wind driven) prevents stratification from occurring, where well mixed and stratified waters meet, a front is formed. Within the Study Area, a tidally driven stratification front is found off Buchan and described in **Volume ER.A.3, Chapter 7: Marine Physical Processes.**

8.7.3.3 Sea Surface Salinity (SSS) in the region ranges between 34 and 35.5 PSU (practical salinity unit) with salinity increasing with distance from the shore (Slesser and Turrell, 2013). Little intra-annual variation in SSS levels is found at the offshore CAW area with values ranging between 35 to 35.2 PSU (Slesser and Turrell, 2013). No significant variation in salinity levels is found deeper in the water column with values ranging between 35.1 and 35.3 PSU throughout the year. SSS levels nearshore do not vary significantly, ranging between 34.3 and 34.8 PSU through the year (Slesser and Turrell, 2013).

8.7.3.4 The suspended sediment concentrations (SSC) in this region of the North Sea, is characterised by significant seasonal variations (increased SSC during the winter months), driven by the mobility of unconsolidated sediments (finer sediments are more mobile) largely controlled by currents, wind-waves and storm events (**Figure 8-4**). Within the Study Area, SSC is generally low albeit varies sightly between the offshore and the nearshore areas, due primarily to differences in water depth, *in situ* current velocity and significant

differences in seabed sediments composition (sediment granulometry) as discussed in **Volume ER.A.3, Chapter 7: Marine Physical Processes**. Monthly averages of surface SSC (Cefas, 2016) in the OAA are low between 0.5 - 1.5 mg/l whilst ranging from 1.4 to 2.0 mg/l along the Offshore ECC. SSC can also vary significantly in the water column, with greater concentrations found nearer the seabed (Cefas, 2016).

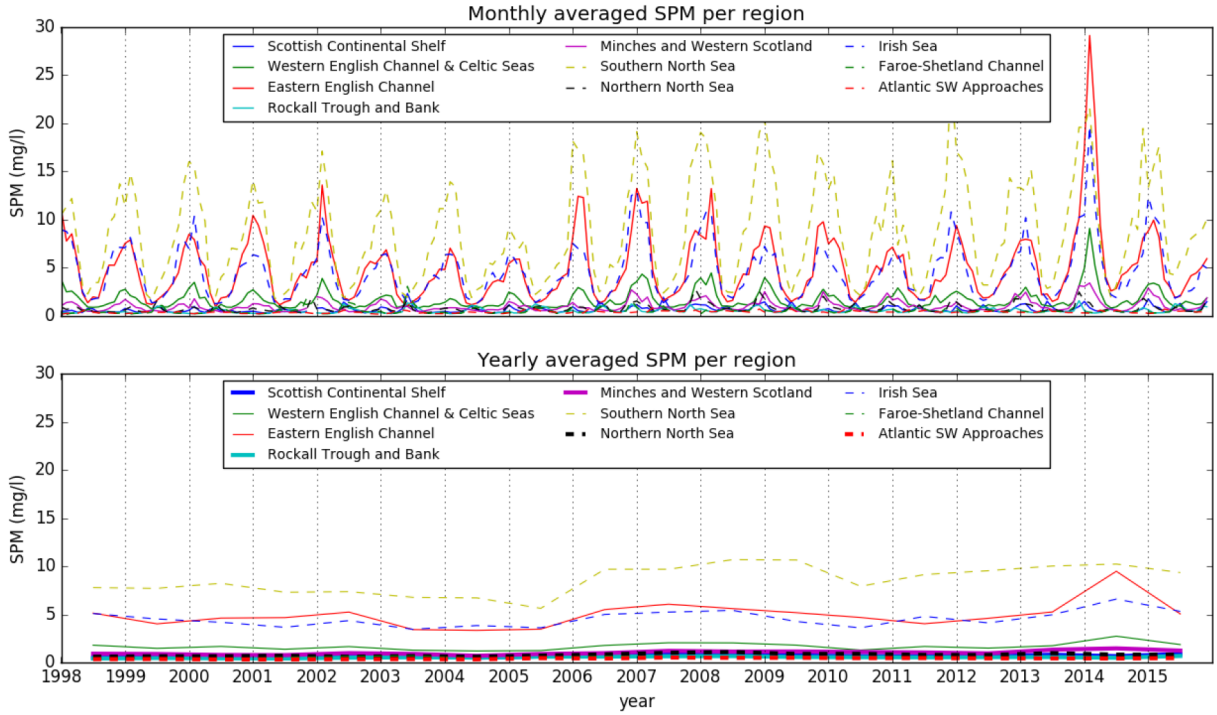


Figure 8-4 Monthly and annual Suspended Particulate Matter (SPM) for each region in the UK, in the period 1998-2015. Top: monthly averages; Bottom: yearly averages (Cefas, 2016).

Hydrochemical Properties: chlorophyll, nutrients and oxygen

8.7.3.5 *In situ* data from the offshore CAW area of the North Sea (Slesser and Turrell, 2013), shows surface Chlorophyll-α concentrations peaking in April (spring bloom) with observed values >4.35 µg/L and with low concentrations <0.9 µg/L , generally found throughout the rest of the year. Annual in situ data and sea surface observations from other nearshore areas in the region, highlight the occurrence of a secondary bloom, the autumn plankton bloom, not detected further offshore, with peak surface chlorophyll concentrations of 2 µg/L and 2.8 µg/L in April and October respectively (Outer Moray Firth (OMF) area).

8.7.3.6 Overall inorganic nutrients concentrations remained low throughout the region and remained typical for unpolluted coastal/offshore Atlantic waters. In the CAW area, phosphorous concentration, as phosphate (PO_4), increased in the cold season with concentrations >0.15 µg-at/L. Nitrogen as nitrate (NO_3) in the euphotic zone of many marine areas, is the primary limiting nutrient for primary producers (phytoplankton growth) and its concentration is seasonally affected, characterised by higher concentrations in autumn, winter and very early spring, and lower concentrations in late spring and summer post phytoplankton bloom (causing nutrients depletion). Nitrate peaked in April with concentrations >2.7 µg-at/L and was generally lower June to September with average concentrations ranging from 0.6 to 0.3 µg-at/L (Slesser and Turrell, 2013).

8.7.3.7 Nearshore (OMF area), surface dissolved oxygen concentrations remained high throughout the year ranging between 95% saturation levels in December and 113% in July (Slesser and Turrell, 2013). Offshore (CAW region), in proximity to the OAA, oxygen saturation decreased slightly, ranging between a minimum of 93% in December and a maximum of 109% in May. Seasonal stratification within the offshore region on the northern North Sea limits atmospheric gas exchange with the bottom layer of the water column, affecting dissolved oxygen concentrations below the thermocline, and oxygen saturations levels (at a depth of 60 m and below) decreased to <90% in the warmer months (down to 82% in November) (Slesser and Turrell, 2013).

8.7.3.8 In conclusion, there is no evidence of significant pollution within the waters of the Study Area, indicating low concerns for the overall status of the water quality in and around the Salamander Offshore Development Area.

8.7.4 Water Framework Directive Compliance Assessment

8.7.4.1 Baseline information in **Section 8.7.3** includes water quality information encompassing WFD designated transitional and coastal water bodies.

Protected Areas and Designated Water Bodies

8.7.4.2 Coastal and transitional waters within the zone of 3 nm (5.5 km) seaward from the coast are classed as WFD water bodies and have been managed by SEPA under the River Basin Management Plan (RBMP). Any proposed development and Nationally Significant Infrastructure Project (NSIP) within these water bodies must comply to the requirements of the WFD and a compliance assessment must be carried out demonstrating the project will not lead to deterioration in water body status.

8.7.4.3 The OAA is located east of Peterhead, approximately 35 km from the closest point to shore. It is, therefore, outside the boundary of any WFD water body. The Offshore ECC is planned to make landfall north of Peterhead and pass through WFD designated coastal water bodies, as shown in **Figure 8-5.**

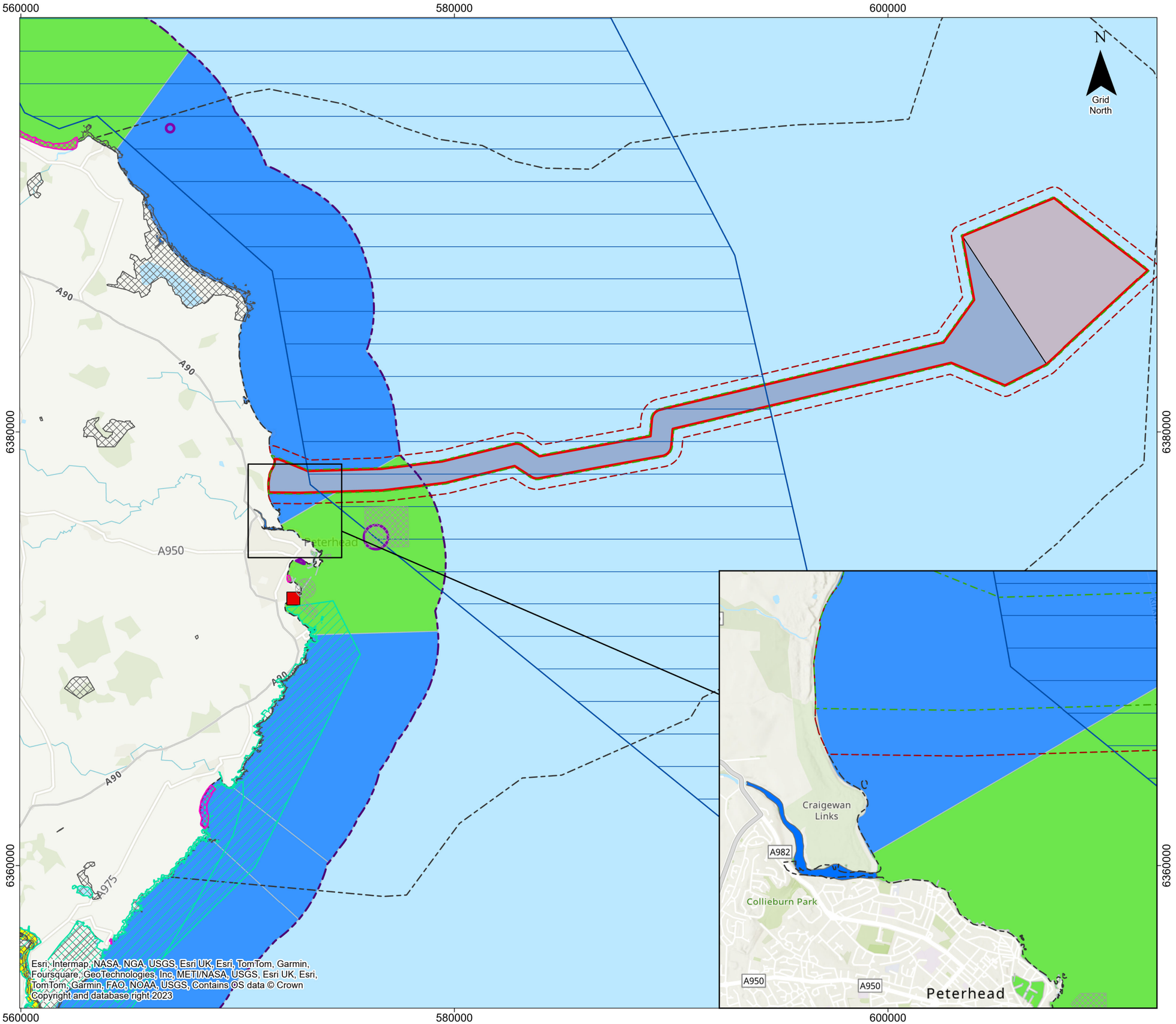
8.7.4.4 According to Government guidance (Marine Scotland Consenting and Licensing Guidance for offshore wind, wave and tidal energy applications (MS, 2018)), a WFD compliance assessment must be carried out for the activities and elements of the Salamander Project located within designated water bodies. The WFD designated coastal and transitional water bodies found within the Water and Sediment Quality Study Area and their proximity to the Offshore ECC are listed in **Table 8-7**.

8.7.4.5 All the designated water bodies located within 2 km (per WFD guidelines) from any Salamander Project activity have been scoped into the assessment.

Salamander

Figure 8-5

Water Framework Directive compliance assessment and water quality elements within Study Area



Legend

- Offshore Development Area
- Offshore Export Cable Corridor
- Offshore Array Area
- Sewage Treatment Works
- Marine Protected Area
- Site of Special Scientific Interest
- Special Protection Area
- Open disposal sites
- Closed disposal sites
- Bathing waters

Water Body

- High Status
- Good Status
- Moderate Status
- 500m buffer
- 50m buffer
- Spring Tidal Excursion buffer
- 3nm limit

Coordinate System: WGS 1984 UTM Zone 30N

Scale @ A3 : 1:170,000

0 5 10 Kilometers

0 1.25 2.5 5 Nautical Miles

Rev	Description	Date
00	FINAL	16/04/2024
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Doc. Title : WFD and Water Quality
Doc. No : SWF01ER0258
Created by : NB
Checked by : GLS
Approved by : DK

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Table 8-7 Water Framework Directive designated coastal and transitional water bodies located within the Study Area

Site	Designation	Distance from the ECC Km	Ecological Status
Scoped in			
Ugie Estuary to Buchan Ness (Peterhead) ID 200131*	Coastal water body	0	Good
Cairnbulg Point to the Ugie Estuary ID 200142*	Coastal water body	0	High
Ugie Estuary ID 200129*	Transitional water body	1.7	High
Scoped out (>2 km)			
Cruden Bay ID 200118	Coastal water body	14.1	High
Cruden Bay to the Don Estuary ID: 200117	Coastal water body	17.2	High
Strathbeg Estuary ID 200137	Transitional water body	12.4	High

***** Scoped into the assessment

8.7.4.6 Under the Bathing Water Directive (2006/7/EC), bathing water quality is described by four classification types: Excellent, Good, Sufficient, or Poor. Two designated Bathing Waters are located within the Spring Tidal Excursion Buffer as shown in **Table 8-8** the condition of these bathing waters is classified as Excellent and Good, showing no concern for water quality (**Table 8-8**). Both sites are located >2 km away (WFD boundary) from proposed Offshore Development Area activities and therefore, given the distance and the unlikely risk, Bathing Waters were scoped out of the assessment in the Salamander Offshore Scoping Report (Simply Blue Energy (Scotland) Ltd. (SBES), 2023), which was accepted by MD-LOT / Scottish Ministers in the Scoping Opinion.

Table 8-8 Water Framework Directive designated bathing waters located within the Study Area

Site	Distance from the ECC Km	Status
Peterhead Lido ID 41	4.8	Excellent
Cruden Bay ID 72	14.8	Good

8.7.4.7 Currently, no designated shellfish waters are found in proximity of the Study Area. The nearest shellfish water is approximately 220 km northeast of the Salamander Project site.

8.7.4.8 Nutrient sensitive areas, including areas designated as Nitrate Vulnerable Zones (NVZ) are water bodies affected by eutrophication associated with elevated nitrate concentrations. The inland region of Aberdeenshire, Banff, Buchan and Moray is considered a NVZ, however, the transitional water bodies within the Study Area, all have a surface water chemical status of Pass with no concerns for nitrate values. Additionally, no nutrient sensitive areas are present within 2 km of the proposed Salamander Project's activities or landfall site (2 km search threshold in accordance with UK Gov, 2023).

8.7.4.9 A list of the marine protected areas (Special Areas of Conservation (SACs) and Special Protected Areas (SPAs)) and Nature Conservation Marine Protected Areas (NCMPAs) that overlap with or are in proximity to the Salamander Project is shown in **Table 8-9**. Under the WFD, the designated sites located within 2 km of the proposed Salamander Project's activity shall be assessed. As the only site listed in **Table 8-9** that is within 2 km is a NCMPA no assessment of designated sites is required under the Habitat Regulations Appraisal (HRA) process; the Southern Trench MPA has been assessed in a standalone MPA assessment (**Volume ER.A.4, Annex 9.4: Benthic Features Impact Assessment Southern Trench MPA**).

Table 8-9 Marine protected areas within the vicinity of the Salamander Project

Site	Designation	Area km²	Distance from the Array	Distance from the ECC	Protected Features
Scoped in					
Southern Trench*	NCMPA	2,398	10.5	0	Burrowed mud: Inshore sublittoral sediment Fronts: large-scale feature Shelf deeps: large-scale feature Minke whale *Balaenoptera acutorostrata*: marine mammal Quaternary of Scotland: quaternary geology and geomorphology Submarine mass movement: geomorphology
Scoped out					
Turbot Bank	NCMPA	241	20.4	20.4	Sandeels
Bunchan Ness to Collieston Coast	SPA	54	34.5	4.9	Fulmar *Fulmarus glacialis* Guillemot *Uria aalge* Herring gull *Larus argentatus* Kittiwake *Rissa tridactyla* Shag *Phalacrocorax aristotelis* Seabirds assemblage
Ythan Estuary, Sands of Forvie and Meikle Loch	SPA	71	41.7	13.8	Common tern *Sterna hirundo* Eider *Somateria mollissima* Lapwing *Vanellus vanellus* Little tern *Sternula albifrons* Pink-footed goose *Anser brachyrhynchus* (non-breeding) Redshank *Tringa tetanus* (non breeding)

Scoped in as within 2 km from the Salamander Project

Other Receptors: Biology

8.7.4.10 Risks to higher and lower sensitivity biological habitats should be considered, where a project is within 500 m of any higher sensitivity habitat, or where it impacts more than 1% of any low sensitivity habitat. A number of higher sensitivity and lower sensitivity habitats are present or expected to be present in the Study Area, namely:

- Polychaeta reef – higher sensitivity habitat;
- Subtidal kelp beds – higher sensitivity habitat;
- Cobbles, grave and shingle – lower sensitivity habitat;
- Intertidal soft sediments like sand and mud – lower sensitivity habitat;
- Rocky shore – lower sensitivity habitat;
- Subtidal boulder fields – lower sensitivity habitat;
- Subtidal rocky reef – lower sensitivity habitat; and
- Subtidal soft sediments like sand and mud – lower sensitivity habitat.

8.7.4.11 Information on the habitats, their characteristics and distribution within the Study Area are presented in **Volume ER.A.3, Chapter 9: Benthic and Intertidal Ecology**. This chapter concluded that Salamander Project activities will not result in any significant impacts to these habitat features.

8.7.4.12 Where project activities may impact migratory fish present in, or travelling through estuaries, the WFD requires that a detailed assessment on fish ecology must be carried out. Two estuaries are located within the Study Area: the Ugie Estuary and the Strathbeg Estuary. The Ugie Estuary is located 1.7 km from the Offshore ECC landfall site, whilst the Strathbeg Estuary is >12 km away from any project activity and has been scoped out of the assessment in the Scoping Report (SBES, 2023), which was accepted by MD-LOT / Scottish Ministers in the Scoping Opinion. Information on the fish communities inhabiting the transitional water bodies is available in **Volume ER.A.3, Chapter 10: Fish and Shellfish Ecology**. This chapter concluded that there will be no significant impacts from project activities on migratory fish populations.

Other receptors: Hydromorphology and INNS

8.7.4.13 Information and assessment on WFD hydromorphology receptor for the water bodies affected by the Salamander Project, is available in **Volume ER.A.3, Chapter 7: Marine Physical Processe**s. This chapter concluded that there will be no significant impacts from project activities on the water bodies hydromorphology.

8.7.4.14 INNS have not been considered a concern in the WFD designated water bodies since their Biological Status and Freedom from Invasive Species parameter has been classified from Good to High. Risks associates with the introduction of INNS and their assessment are discussed in **Volume ER.A.3, Chapter 9: Benthic and Intertidal Ecology** and **Volume ER.A.3, Chapter 10: Fish and Shellfish Ecology**.

8.7.5 Future baseline

8.7.5.1 Based on IPCC (2021) climate reports and climate change projection scenarios the baseline environment for the Water and Sediment Quality is expected to evolve over the lifetime of the project (IPCC mid- (2060) and long-term (2100) assessments).

8.7.5.2 In climate forecasts initialised using recent observations, SST is expected to increase over time where models' projection for 2060 suggest a global SST increase of 0.2-0.5 °C (IPCC, 2021) the International Energy Agency (IEA) projects that if emissions continue their trend after 2050, the rise in temperature in 2100 would be around 2.6 °C (IEA, 2021). Cornes *et al*., (2023) suggest increases in the North Sea ranging from 1 °C to 4 °C by 2100, contingent on geographic location and the specific climate model employed.

8.7.5.3 SST increases would have significant consequences for water column physical and chemical properties, especially affecting thermal stratification. The ocean has become significantly more stratified over the last half-century as the climate has warmed, inhibiting the ability for heat, oxygen, and carbon dioxide from the surface to be transported deeper into the ocean, and as SST increases, stratification events would commence earlier in the year and last for longer (Guancheng *et al*., 2020).

8.7.5.4 The decrease in ocean mixing could consequently affect biogeochemical cycles of key dissolved macronutrients such as Nitrogen and Phosphorous, impacting Carbon export and the entirety of the marine food chain (Sharples *et al.*, 2020). The carbon pump and the biological export of organic matter works by transferring nutrients vertically and as sinking particles decompose, nutrients are remineralised (recycled) and released, made available to primary producers once again (Moore *et al.*, 2018). By changing macronutrients distribution through altered water column dynamics and limiting their bioavailability in surface waters and the photic zone (primary productivity zone), a decrease in primary and secondary biological productivity would be observed, in turn further decreasing organic matter export via sink (organic matter by photosynthetic and chemosynthetic autotrophs and zooplankton physiological activity, e.g. reduction in biomass and faecal pellets production).

8.7.5.5 A rise in SST and stratification will also negatively affect surface and water column oxygen solubility decreasing the overall oxygen concentration and saturation in the water. Salinity in the North Sea is also expected to decrease, due to ocean circulation driven changes and an increase in freshwater input from melting ice caps.

8.7.5.6 In addition, climate change, due to increased dissolved CO_2 content in the water, is altering the pH of the North Sea, making it more acidic in a phenomena called Ocean Acidification, with severe consequences for primary producers and marine life. It is projected that the pH in the UKCS could decrease at a rate of 0.003 per year resulting in a pH decrease of 0.37 by the year 2100 (Humphreys *et al*., 2020). The level of confidence in these predictions varies, with moderate confidence in the case of dissolved oxygen and salinity and lower confidence when it comes to stratification (Sharples *et al*., 2020; Mahaffey *et al*., 2020; Dye *et al*., 2020). Taking into consideration the climate change projections to 2060, these changes would be noticeable in the Salamander Project lifetime.

8.7.5.7 In terms of future baseline for WFD designated water bodies, the RBMP recognises the pressures contributing to waterbodies' status degradations and set out future targets to achieve and/or maintain good ecological status by 2027, implementing frequent monitoring and environmental management to minimise impacts on water quality and WFD designated receptors. Currently, the water bodies taken into consideration in this assessment, have an ecological status of good or above and therefore, it is expected this status will be maintained in the future.

8.7.5.8 Strict guidance, such as MSFD, WFD and SEPA guidelines on pollution prevention, the continuous implementation of EQS for surface water quality and Cefas sediment quality guidelines, will limit deterioration of the marine environment. However, climate change will likely have an impact on the physical properties of surface waters and the entirety of the water column, potentially affecting the water and sediment quality receptors.

8.7.6 Summary of Baseline Environment

8.7.6.1 From the information and data presented above it can be concluded that the baseline conditions for the Water and Sediment Quality and WFD receptors of the Study Area is generally good and the spatial variability of the physico-chemical properties of sediments and waters found in the Study Area are not indicative of pollution. Site specific information in relation to concentrations of chemical compounds in sediments does not record significantly elevated levels of contaminants, however, raised levels of As, below Cefas AL1, were recorded in the stations closer to shore, and therefore, due to the current 8 km data gap along the Offshore ECC, a potential for As level above Cefas AL1 but below Cefas AL2 was considered.

8.7.6.2 The planned Offshore ECC will intersect two WFD designated water bodies, classified at High and Good status. No bathing or shellfish waters are found within the immediate proximity of the construction activities (>2 km). Other WFD statutory receptors have been further considered in other chapters of this EIAR and referenced accordingly.

8.8 Limitations and Assumptions

8.8.1.1 The following limitations and assumptions have been identified for the Water and Sediment Quality assessment:

- While every effort has been made to ensure a wide range of literature has been used throughout this assessment, the data used to produce this literature will only provide a snapshot of the time of data collection;
- Survey data collection was not possible in the nearshore region of the Study Area due to accessibility issues. This area covers the section of the Offshore ECC closest to land, extending from MLWS at the landfall location, eastward to the 1°40 line approximately 8 km from the coast;
- Within the nearshore 8 km region, a number of assumptions have been made regarding the topic of sediment chemistry. These include assumptions based on expert judgement on spatial distribution and concentration of chemical compounds, especially As. The likely scenario of As concentration below Cefas AL2 has been assumed for the purpose of assessment; and
- No site-specific data on dissolved metal and hydrocarbons concentrations were available for the Study Area and publicly available data were used to inform assessment.

8.8.2 Impacts scoped out of the EIAR

8.8.2.1 The Water and Sediment Quality assessment covers all potential impacts identified during scoping, as well as any further potential impacts that have been highlighted as the EIA has progressed, as outlined in **Section 8.11**

8.8.2.2 However, following consideration of the baseline environment, the project description outlined in **Volume ER.A.2, Chapter 4: Project Description** and in line with the Scoping Opinion a number of impacts are scoped out and will not be considered in detail within this EIAR, as illustrated in **Table 8-10**.

8.8.2.3 Additionally, after further consideration of the potential risks of the Salamander Project's activities on each of the quality elements listed under the WFD assessment (screening assessment stage) and its criteria for

their evaluation (scoping assessment stage), a number of receptors have been considered not at risk and have been scoped out of the impact assessment as detailed in **Table 8-10**.

Table 8-10 Impacts scoped out of the Water and Sediment Quality assessment

Potential Impact	Project Aspect	Project Phase	Justification
Scoping Opinion (MD-LOT, 2023)			
Impacts on water quality status of designated bathing waters and shellfish waters due to increased suspended sediment and potential release of contaminants	OAA and Offshore ECC	Construction, Operation and Maintenance and Decommissioning	The distance between the Offshore Development Area and designated bathing waters and designated shellfish waters means there is no pathway for impact from the Salamander Project.
Changes in water quality due to increased suspended sediment concentrations	OAA and Offshore ECC	Construction, Operation and Maintenance and Decommissioning	Activities relating to the construction, routine maintenance, or decommissioning of the Salamander Project may result in an increase in suspended sediment concentrations. However, these impacts will be highly localised and temporary, for this reason they have been scoped out for further assessment.
Changes in water and sediment quality due to routine and accidental discharges from vessels	OAA and Offshore ECC	Construction, Operation and Maintenance and Decommissioning	Construction, routine maintenance activities and decommissioning activities may potentially result in reduced water and sediment quality in the vicinity due to accidental discharges from vessels. The impacts are likely to be short lived and localised. The risk will be adequately managed through the embedded mitigation measures, which will reduce the risk of accidental discharges.
Water Framework Directive Compliance Assessment			
Shellfish waters	OAA and Offshore ECC	Construction, Operation and Maintenance and Decommissioning	No shellfish waters are present within the designated water bodies or in the proximity to the Salamander Project activities therefore, no shellfish waters have been considered at risk and this receptor has been scoped out of assessment.
Nutrient sensitive areas	OAA and Offshore ECC	Construction, Operation and Maintenance and Decommissioning	No nitrate pollution concerns have been raised for the coastal and transition water bodies present within the Study Area. Given the absence of nutrient sensitive areas within the areas of assessment, it is deemed there is no pathway for effect from the Salamander Project, and this has not been considered further within assessment.

Potential Impact	Project Aspect	Project Phase	Justification
Bathing waters	OAA and Offshore ECC	Construction, Operation and Maintenance and Decommissioning	The closest designated bathing water is Peterhead Lido (ID 41) 4.8 km away from the Salamander Project activity. As such it is considered there is no pathway for potential impact, and bathing waters have been scoped out of the assessment.

8.8.3 Embedded Mitigation

8.8.3.1 The embedded mitigation relevant to the Water and Sediment Quality assessment is presented in **Table 8-11.**

Table 8-11 Embedded Mitigation for the Water and Sediment Quality assessment

Potential Impact and Effect	Mitigation ID	Mitigation	Project Aspect	Project Phase
Primary				
Remobilisation of sediments causing increased suspended solids concentration. Remobilisation of contaminated sediments.	Co6	The locations of the anchors will be determined in advance (of construction) using survey information, therefore the location of each anchor will be chosen based on technical performance and to minimise the need for seabed preparation where practicable. (i.e. avoid pock marks or straddling through micrositing).	OAA	Construction
Remobilisation of sediments causing increased suspended solids concentration. Remobilisation of contaminated sediments.	Co4	Drill mud discharge will be kept to as low as practicable and will be water-based, rather than oil-based, with minimum drilling lubricants used during the final exit phase onto the seabed.	Offshore ECC	Construction
Tertiary				
Remobilisation of sediments causing increased suspended solids concentration.	Co5	During trenchless installation methods, best practice will be followed to minimise the risk of bentonite entering the marine environment.	Offshore ECC	Construction

Potential Impact and Effect	Mitigation ID	Mitigation	Project Aspect	Project Phase
Remobilisation of contaminated sediments.				
Remobilisation of sediments causing increased suspended solids concentration. Remobilisation of contaminated sediments. Accidental release of pollutants from vessels. Accidental release of litter and debris from vessels.	Co9	Construction Environmental Management Plan (CEMP) will be developed and will include details of: - A Marine Pollution Contingency Plan (MPCP) to address the risks, methods and procedures to protect the Offshore Development Area from potential polluting events associated with the Salamander Project; - A chemical risk review to include information regarding how and when chemicals are to be used, stored and transported in accordance with recognised best practice guidance; - A biosecurity plan (offshore) detailing how the risk of introduction and spread of invasive non-native species will be minimised; - Waste management and disposal arrangements; and - Protocol for management of Dropped Objects.	OAA, Offshore ECC	Construction
Remobilisation of sediments causing increased suspended solids concentration. Accidental release of pollutants from vessels. Accidental release of litter and debris from vessels. Removal of biofouling and leaching of	Co10	Operational Environmental Management Plan (OEMP) will be developed and will include details of: - A MPCP to address the risks, methods and procedures to protect the Offshore Development Area from potential polluting events associated with the Salamander Project; and - Waste management and protection of the marine environment.	OAA, Offshore ECC	Operation & Maintenance

Potential Impact and Effect	Mitigation ID	Mitigation	Project Aspect	Project Phase
antifouling, anticorrosive agents.				
Accidental release of pollutants from vessels. Accidental release of litter and debris from vessels.	Co3	All Project vessels will follow the requirements set out in The International Convention for the Prevention of Pollution from Ships (MARPOL).	OAA, Offshore ECC	Construction, Operation & Maintenance, and Decommissioning
Accidental release of pollutants from vessels. Accidental release of litter and debris from vessels.	Co7	Adherence with the International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004 (BWM Convention).	OAA, Offshore ECC	Construction, Operation & Maintenance, and Decommissioning

8.8.3.2 Additional mitigation measures have been suggested by SEPA in the Scoping Response documentation: SCOP-0021 - Salamander Offshore Wind Farm - Consultation on Request for Scoping Opinion 2023. SEPA published Standing Advice for Marine Scotland on marine consultations and the extracts from the published document, applicable to the offshore infrastructure elements, are detailed below:

SEPA standing advice on: Pollution prevention

8.8.3.3 *"Many operations could potentially give rise to risk of pollution through silt mobilisation, silt suspension or chemical or oil spillages. To prevent pollution and safeguard marine ecology interests it is vital that good working practice is adopted, and appropriate steps taken to prevent water pollution and minimise disturbance to sensitive receptors. Measures need to be in place to minimise the release of sediment plumes and to contain and prevent construction and waste materials, e.g. paint from falling from a structure into the water body beneath. Where appropriate, mitigation measures should be sought within method statements and onsite compliance should be confirmed through site visits".*

SEPA standing advice on: Waste material (includes dredge spoil) above the low water mark

8.8.3.4 *"Waste material, which includes dredge spoil, deposited above the low water mark is subject to Waste Management Licensing controls regulated by SEPA unless it is subject to a licence issued under Part 4 of the Marine (Scotland) Act 2010 (which can extend to Mean High Water Spring Tide including within estuaries, rivers and channels), in which case it is excluded from such controls. However, if the waste deposition could*

constitute a landfill, then PPC not Waste Management Licensing would apply, and in this situation no Marine Licence exclusion is provided for.

8.8.3.5 *Where dredge spoil is used for land reclamation works or harbour works then the method of construction will determine how the activity is regulated. If the works are carried out by way of deposit of material directly onto the intertidal zone or within a permeable bunded area (for example a bund made of placed stones) then the works will be considered to be occurring in the marine environment and will be regulated by Marine Scotland. If the works are constructed by way of initially creating an impermeable bund (such as a sheet piled metal wall) then the use of waste such as dredge spoil for infill works will be considered to be occurring above mean high water springs and therefore will be controlled by SEPA. Such works would require either a waste management licence or a waste management exemption.*

8.8.3.6 *The applicant should consult the local SEPA Regulatory Services team (see contact sheet for details) for advice on whether or not the proposed waste deposition would constitute a landfill and hence fall within PPC regulation, including for the controlled placement of dredged sands from harbours onto adjacent beaches and/or seabed".*

8.9 Project Design Envelope Parameters

8.9.1.1 Given that the realistic worst-case scenario is based on the design option (or combination of options) that represents the greatest potential for change, as set out in **Volume ER.A.2, Chapter 4: Project Description**, a confidence can be taken that development of any alternative options within the Project Design Envelope parameters will give rise to no effects greater or worse than those assessed in this impact assessment. The Project Design Envelope parameters relevant to the Water and Sediment Quality assessment are outlined in **Table 8-12.** No alternative likely scenario has been selected at this stage.

Table 8-12 Design envelope parameters for Water and Sediment Quality

Impact	Design Envelope
General Information	
Total area of the Offshore Development Area	• Total OAA: 33.25 km² • Total ECC area: 47.4 km² • Total area of the Offshore Development Area: 80.65 km²
Design parameters	• Number of WTGs: ≤7 • Number of array cables: ≤8 • Cable length within Offshore Array: ≤8 cables 35 km; Cable length within Export Corridor: ≤2 cables with a combined total length of ≤85 km; • Maximum number of subsea hubs: 2 • Project lifetime: 35-year life cycle (operation phase)

Impact	Design Envelope
	• Offshore Construction will occur over an ≤18 month period (excluding pre-construction surveys) • Total number of anchors and mooring lines: ≤56 (≤8 anchors per substructure)
Construction Impacts	
Remobilisation of sediments leading to increased suspended solids concentration and potential resuspension of contaminated sediments into the water column. Worst-case scenario, maximum seabed sediments disturbance and displacement with gravity anchors and pile anchors, catenary mooring system and cable installation.	Approximate total volume of sediments displaced during Construction: ≤**8,154,236 m³** • Total spoil volume from anchor installation for ≤7 WTGs and gravity anchors ≤48,600 m³ • Total spoil volume from cable installation sandwave clearance ≤7,200,000 m³ (≤1,624,000 m³ array cables + ≤5,576,000 m³ export cables) • Total spoil volume from cable installation ≤900,000 m³ (≤262,500 m³ array + ≤637,500 m³ export cable) • Total spoil volume for subsea hubs (12 pile anchors in total) ≤636 m³ • Total spoil volume from excavated pits (trenchless method) ≤5,000 m³* Type of seabed preparation requirements could include sandwave clearance, boulder removal, dredging, levelling and pre lay grapnel run and rock placement. Cable installation methods could include jetting, vertical injection, mass flow excavation, ploughing / pre-ploughing, trenching / pre-trenching (incl. dredging, cutting) (with or without backfill). Typical trench depth: ≤2 m. Drilling may be undertaken for pile anchors or dredging may be undertaken for suction / gravity Anchors. Calculation considers only volume of sediment spoils displaced during construction operations and does not take into account surficial sediment disturbance such as seabed swept by dynamic cables, moorings, vessel anchors or jack-up rigging. *It is important to note that the volume of spoils derived from the pits of the trenchless export cables installations is not predicted to fully enter the marine environment. The spoils will be removed by the cutting head and drill as the boring occurs. At punch out, some of these spoils will potentially enter the intertidal/subtidal zone. This is therefore an unrealistic worst-case scenario however, realistic quantification is not possible at present.
Accidental release of pollutants, urban waste (sewage) and litter into the water column from vessels and/or helicopters during	Total number of vessel and helicopter trips**: ≤681** trips per year. ≤660 vessels and ≤21 helicopter trips over the construction period.

Impact	Design Envelope
transit and construction operations and additional risk of introduction of INNS.	
Operation and Maintenance Impacts	
Accidental release of pollutants, urban waste and litter into the water column from vessels and helicopter during transit and operations and risk of introduction of INNS.	Total number of vessel and helicopter trips: ≤**210** vessel trips per year. ≤7,350 vessel trips over 35-year life cycle. ≤140 helicopter trips per year. ≤4,900 helicopter trips over 35-year life cycle .
Temporary remobilisation of sediments leading to increased suspended solids concentration and potential resuspension of contaminated sediments into the water column during operations.	Approximate total area of the seabed disturbed during operations: **≤6,194,800 m²** • Total swept area of seabed from catenary moorings ≤3,920,000 m² • Total swept area of dynamic cables on seabed untethered ≤700,000 m² • Total area of seabed impacted from cable repair and reburial ≤1,468,000 m² • Total area of seabed impacted from vessel anchors ≤16,800 m² • Total area of the seabed impacted from anchor and mooring replacement ≤90,000 m² Approximate total volume of displaced sediments during remedial works: **≤89,700 m³** • Total spoil volume from cable reburial ≤55,000 m³ • Total spoils volume for anchor and mooring replacement ≤34,700 m³ Operational period 35-year life cycle.

Cleaning and leaching of antifouling and anticorrosion agents from infrastructure into the marine environment.
 	
Realistic worst-case scenario: Gravity anchors and semi-submersible floating substructures.
	Approximate total surface area treated with antifouling and anticorrosion agents: **≤1,073,200 m²**
	• Total gravity anchors area: ≤19,881 m² calculated as = 355.02 m² * 8 each WTGs = 2,840.16 m²
	  ○ ≤143.14 m² area of anchor top (base area not included as not exposed to the water column)
	  ○ Height 5 m

Impact	Design Envelope

	• Subsea hub surface area 4,000 m²;
	• Mooring chains surface area (with clumps) ≤755,319 m²;
	• Total floating structures area (assuming a cuboid shape - only 5 sides exposed) ≤294,000 m² calculated as = 61,600 m² (Semi-submersible) - 19,600 m² as the area of the cuboid not exposed to water, *7
	  ○ Draught range during operation 40 m (tension leg)
	  ○ Width and length 140 m
	Operational period 35-year life cycle.
	Calculations only comprise of areas coated with anti-corrosion compounds and anti-fouling in the marine environment. Anti-corrosion coating of floating substructure options: Coating, sacrificial anode and impressed current anode.

Decommissioning Impacts	
Currently realistic worst-case and likely scenarios for decommissioning operations will involve full removal of all infrastructure, therefore, similar impacts to the Construction phase and magnitude of seabed disturbance have been considered. This assumption is subject to best practice methods and technology appropriate at the time of decommissioning.	
Impacts associated with removal of infrastructure. Realistic worst-case scenario: Gravity anchors and semi-submersible floating substructures.	Approximate total volume of submerged infrastructure: **≤6,000,337 m³** • Volume of WTG substructures ≤5,488,000 m³ • Volume of mooring lines ≤6,531 m³ • Volume of scour protection surrounding mooring line anchors ≤266,300 m³ • Volume of dynamic cable within the water column ≤133 m³ • Volume of buoyancy modules within the water column, includes volume of cable for contingency ≤2,478 m³ • Volume of static array cable stabilisation ≤45,375 m³ • Volume of array cable joints ≤256 m³ • Volume of static array cable scour protection ≤66,000 m³ • Volume of export cable stabilisation ≤42,500 m³

Impact	Design Envelope
	• Volume of export cable joints ≤64 m³ • Volume of export cable stabilisation ≤16,500 m³ • Volume of export cable crossing pre-lay cable protection ≤16,000 m³ • Volume of export cable crossings ≤41,500 m³ • Volume of subsea hubs, including contingency ≤4,500 m³. Volume of subsea hub scour protection ≤4,200 m³ Spacing between WTGs from centerpoint of tower ≥ 1000 m Operation period 35-year life cycle

8.10 Assessment Methodology

8.10.1.1 **Volume ER.A.2, Chapter 6: EIA Methodology** sets out the general approach to the assessment of potential significant effects that may arise from the Salamander Project.

8.10.1.2 Whilst **Volume ER.A.2, Chapter 6: EIA Methodology** provides a general framework for identifying impacts and assessing the significance of their effects, in practice the approaches and criteria applied across different topics vary.

8.10.1.3 The proposed approach to the Water and Sediment Quality assessment that has been addressed in the EIA is outlined below.

8.10.1.4 WFD compliance assessment will be carried out alongside the assessment for the Water and Sediment Quality topic, following the published guidelines and criteria for the evaluation of the Salamander Project proposed impacts on the statutory receptors.

8.10.2 Assessment Criteria

8.10.2.1 Water and sediment quality are also considered 'pathways' to other environmental receptors, such as benthic ecology and fish and shellfish ecology, as they have the potential to indirectly impact their biology and therefore their status. The assessment of the impacts associated with the Water and Sediment Quality pathways, on the receptors identified in **Volume ER.A.3, Chapter 9: Benthic and Intertidal Ecology and Chapter 10: Fish and Shellfish Ecology**, are assessed accordingly in the respective chapters.

8.10.2.2 The assessment process considers the potential magnitude (high, medium, low, negligible or no change) of the change to the baseline conditions arising from the Salamander Project activities and the sensitivity (high, medium, low or negligible) of the particular receptor under consideration. The significance of an effect is established by combining magnitude and sensitivity. Embedded mitigation measures are considered and integrated within the assessment.

8.10.2.3 The specific scale of sensitivity for a receptor is dependent on the EIA topic/receptor in question, but in general, it may be defined in terms of quality, value, rarity or importance of the receptor being assessed and the ability of a receptor to adapt to change, tolerate, and/or recover from potential impacts.

8.10.2.4 The sensitivity of the receptors for Water and Sediment Quality is determined by a combination of parameters, which are heavily influenced by the quality and the value/importance of such receptors. The values criteria of designated and protected areas are determined as shown in **Table 8-13**.

Table 8-13 Receptor value criteria for Water and Sediment Quality

Receptor Value	Definition
High	High importance and protected on national and international level with classification parameters from Good to Excellent. The receptor is very sensitive to pressures with little or no capacity to tolerate or adapt to changes.
Medium	High importance and protected on national and international level with classification parameters from Good to Excellent. The receptor is sensitive to pressures with moderate capacity to tolerate or adapt to changes.
Low	High importance and protected on national and international level with classification parameters below Good. The receptor is able to tolerate or adapt to changes.
Negligible	Low importance with no protected status and the ability to tolerate and adapt to changes.

8.10.2.5 The ability of such receptors to tolerate changes and their adaptability, determines their overall sensitivity as detailed in **Table 8-14.** The definition of the magnitude of impact is described in **Table 8-14**. Expert judgement is particularly important when determining the sensitivity of receptors.

Table 8-14 Receptor sensitivity criteria for Water and Sediment Quality

Receptor Sensitivity	Definition
High	The water and sediment quality of the receptor supports the condition and status of valued (internationally and nationally) designated waters, with low to no capacity to accommodate a particular effect or tolerate a change in the conditions that determine the overall status of the receptor with a low ability to recover or adapt. Impacts would result in a change to the status of the receptor.
Medium	The water and sediment quality of the receptor supports the condition and status of valued (internationally and nationally) designated waters, with low to moderate capacity to accommodate a particular effect or tolerate a change in the conditions that determine the overall status of the receptor with a moderate ability to recover or adapt. Impacts unlikely to result in a change to the status of the receptor.
Low	The water and sediment quality of the receptor supports the condition and status of valued (internationally and nationally) designated waters, with high capacity to accommodate a particular

Receptor Sensitivity	Definition
	effect or tolerate a change in the conditions that determine the overall status of the receptor with the ability to recover or adapt. Impacts would result in no change to the status of the receptor.
Negligible	The receptor is generally tolerant and can accommodate a particular effect without the need to recover or adapt as changes do not affect baseline conditions.

Table 8-15 Categories and definitions used to determine the level of magnitude of an impact

Magnitude	Definition
High	Total change or major alteration to key elements/features of the baseline conditions. Occurs over a large spatial extent, resulting in widespread, long-term, or permanent changes of the baseline conditions, or affects a large proportion of a receptor population. And/or the impact is very likely to occur and/or will occur at a high frequency or intensity.
Medium	Partial change or alteration to one or more key elements/features of the baseline conditions. The impact occurs over a local to medium extent with a short- to medium-term change to baseline conditions or affects a moderate proportion of a receptor population. And/or the impact is likely to occur and/or will occur at a moderate frequency or intensity.
Low	Minor shift away from the baseline conditions. The impact is localised and temporary or short-term, leading to a detectable change in baseline conditions or a noticeable effect on a small proportion of a receptor population. And/or the impact is unlikely to occur or may occur but at low frequency or intensity.
Negligible	Very slight change from baseline conditions. The impact is highly localised and short-term, with full rapid recovery expected to result in very slight or imperceptible changes to baseline conditions or a receptor population. And/or the impact is very unlikely to occur; if it does, it will occur at a very low frequency or intensity.
No change	No change from baseline conditions.

8.10.2.6 To note: Some of the receptors identified for the Water and Sediment Quality and WFD compliance assessment topics have been scoped out of the assessment as discussed in **Table 8-10.** Others, such as:

- Hydromorphology (WFD receptor), will be assessed in **Volume ER.A.3, Chapter 7: Marine Physical Processes**;
- INNS (WFD receptor) will be assessed in **Volume ER.A.3, Chapter 9: Benthic and Intertidal Ecology** and in **Chapter 10: Fish and Shellfish Ecology**;
- Benthic habitats (WFD receptor) will be assessed in **Volume ER.A.3, Chapter 9: Benthic and Intertidal Ecology**; and

- Fish ecology (WFD receptor) will be assessed in **Volume ER.A.3, Chapter 10: Fish and Shellfish Ecology**.

8.10.2.7 The consideration of magnitude of a potential effect and sensitivity of the receptor (see **Volume ER.A.2, Chapter 6: EIA Methodology**) determines an expression, which may be quantitative or qualitative and is often informed by expert judgement, for the significance of the beneficial or adverse effects. Table 8-16 sets out how the magnitude of impact and the sensitivity of the receptor have been combined to provide an assessment of effect significance.

Table 8-16 Significance of effect matrix

Significance of effect		Receptor Sensitivity			
		Negligible	*Low*	*Medium*	*High*
Magnitude of impact	*Negligible*	Negligible	Negligible	Negligible	Negligible
	Low	Negligible	Negligible	Minor	Minor
	Medium	Negligible	Minor	Moderate	Moderate
	High	Negligible	Minor	Moderate	Major

8.10.2.8 The predicted levels of effects are defined as:

- Major – A fundamental change to the environment or receptor, resulting in significant effects in EIA terms;
- Moderate – A material but non-fundamental change to the environment or receptor, resulting in significant effects in EIA terms;
- Minor – A detectable or small-scale temporary but non-material change to the environment or receptor resulting in not significant effects in EIA terms; and
- Negligible – No detectable change to the environment or receptor resulting in not significant effects in EIA terms.

8.11 Impact Assessment

8.11.1.1 Impacts will be assessed separately for the Construction, Operation and Maintenance and Decommissioning phases of the Offshore Development.

8.11.2 Construction

8.11.2.1 The following impacts have been assessed for the Construction phase of the Salamander Project:

- Remobilisation of sediments causing increased suspended solids concentration in the water column leading to deterioration of water quality;

- Remobilisation of sediments and use of drilling muds causing potential resuspension of contaminated sediments into the water column leading to deterioration of water and sediment quality;
- Accidental release of pollutants and sewage waste and into the water column from vessels and helicopters during transit and construction operations; and
- Accidental release of litter and debris into the water column from vessels and helicopters during transit and construction operations.

Remobilisation of sediments causing increased suspended solids concentration in the water column leading to deterioration of water quality

8.11.2.2 This impact relates to the potential for disturbance and release of sediments into the water column and their subsequent deposition during construction activities leading to potential changes to the identified receptors (water quality, sediment quality and water quality within designated WFD water bodies).

Impact and Receiving Environment

8.11.2.3 During the Construction phase, the sediment layer is penetrated for the installation of anchors, moorings and cables. This will lead to seabed substrate disturbance, releasing sediments into the water column, which are transported and dispersed in suspension by currents and deposited over various distances.

8.11.2.4 The techniques employed for the installation of infrastructure and the type of anchors selected, affect the scale of the impact. Two realistic worst-case scenarios applicable to the Salamander Project have been considered; Scenario 1 involves the use of gravity anchors, where the seabed will be dredged, excavated and levelled in preparation for the installation of the structures. Scenario 2 considers the use of pile anchors, where the seabed will be excavated and drilled, leading to the release of drilling fluids and muds (natural bentonite clay) and drill cuttings into the water column and onto the undelaying sediment. Other construction activities involve cable laying, where interconnecting and export cables will be installed by jetting, ploughing, dredging, cutting (with or without backfill) and trenching. Drilling could potentially also be employed in trenchless cable installation, where methods shall be used to bring the marine export cable to shore with an exit pit no closer than 200 m below MHWS. A small amount of the drilled and displaced sediments are expected to enter the intertidal and the subtidal zone from the borehole pits punchout.

8.11.2.5 The impact intensity and range will vary across the Study Area depending on the nature of the activity, the seabed type and the hydromorphology of the site. Overall, an estimated 8,153,600 m^3 of sediment spoils are expected to be displaced during Construction, the majority coming from the installation of cables and seabed sandwave clearance (7,200,000 m^3). However, the disturbance will be confined to the activity area, therefore each installation intervention will be spatially distinct and can be considered as individual discrete events.

Receptor Sensitivity

8.11.2.6 The sensitivity of the receptors is determined by their relevant attributes and how they are affected by increases in SSC concentrations and resuspended sediment deposition. Water quality for instance, is determined by a number of variables, which react to impacts differently. Water chemical parameters such as metals and hydrocarbons concentrations will not be affected by changes in turbidity levels, whilst water physical characteristics, such as water clarity, could be significantly altered by long-term sediment resuspension. Additionally, non-temporary changes to the water quality of WFD water bodies could

ultimately deteriorate their ecological status. Remobilisation of sediment and subsequent sediment deposition could influence sediment quality by altering the physical properties of the substrate, such as inducing changes in particles grain size composition and TOM concentrations.

8.11.2.7 Overall, the sensitivity of a receptor is also determined by their ability to tolerate and adapt to changes. When discussing water and sediment quality, the large volume of the receiving environment, with the capacity for dilution and flushing, greatly favours adaptability and recoverability. The sensitivity of the near-field and far-field environment are taken into consideration and an overall assessment is proposed.

8.11.2.8 The overall sensitivity of sediment quality was assessed as **Medium** due to the reduced ability to recover fully to pre-construction status; however, the large volume of the receiving environment minimises the importance of the deterioration of a very small proportion of the seabed. Water Quality's sensitivity was assessed as **Medium**, as water quality could decline due to persistent turbidity however, it is highly tolerant to changes. The sensitivity of water quality within the designated WFD water bodies scoped into assessment was assessed also as **Medium** as similarly to the Water Quality receptor, this receptor is tolerant to changes and the impact magnitude and duration would determine the overall significant or not significant changes ecological status of the water bodies.

Impact Magnitude

8.11.2.9 To better understand the magnitude of the impact of the Salamander Project activities, the changes in SSC (magnitude, extent and duration) and sediment deposition, have been calculated through numerical modelling outputs taking into consideration the properties of the physical environment. The **Marine Physical Processes Technical Annex, Volume ER.A.4, Annex 7.1,** provides a detailed description of the associated numerical model parameters and assumptions.

8.11.2.10 Numerical modelling results calculate the plume effects on the anchor and cable installation activities for three different substrate types, sandy (medium/fine), gravelly sand and sandy gravels, (gravelly sands also assumed within the 8 km survey gap area). The sediment plume will be advected and lateral dispersion will occur, driven by turbulence and parameters such as current velocity (model using 0.5 m/s in the OAA – high tidal flow conditions), tide direction, eddies and water depth. The range of plume advection and diffusion can also vary significantly in the water column, with greater concentrations found nearer the seabed. Resuspended coarser sediment (sands and gravels) resettles and deposits rapidly on the seabed (rate is grain size dependent), limiting the dispersion range and duration of advection.

8.11.2.11 The magnitude of the impact of increased SCC on water quality is also dependent on the duration and frequency of the construction activity which varies between tasks and seabed types. The suspended sediments plume has an elongated oval shape with sediments dispersing in a north to south direction as shown in **Volume ER.A.3, Chapter 7: Marine Physical Processes**. There are four main zones of sediment plume effects based on the intensity and spatial extent of the impact, namely:

- 0 to 50 m (near-field): zone of concentrated SSC (tens to hundreds of thousands of mg/l) with measurable thickness of deposition, process lasting more than 30 minutes following end of active disturbance. More than one hour after end of disturbance, no change to SSC and no measurable ongoing deposition is predicted.
- 50 to 500 m (intermediate): zone of increased SSC (hundreds to low thousands of mg/l) and measurable thickness of deposition. More than one hour after end of disturbance, no change to SSC and no measurable ongoing deposition is predicted.
- 500 m to tidal excursion limit (far-field): zone of lesser measurable SSC (tens to low hundreds of mg/l) and no measurable thickness of deposition, 8 km in the OAA, 12 to 14 km in the middle of

Offshore ECC and 17 km close to landfall, SSC decreasing rapidly by dispersion to ambient values within one day after the end of active disturbance;

- Beyond tidal excursion buffer: no impact zone.

8.11.2.12 The impact on the receptors has been assessed separately for the two different scenarios described in **Paragraph 8.11.2.4**: Scenario 1 - gravity base anchors and Scenario 2 - pile anchors, is marginally different and receptor dependent. Specifically, in Scenario 2, and during trenchless cable installation (optional phase included in both foundations' scenarios), the use of drilling fluid/mud, introduces additional spoils and a finer sediment plume in the form of natural bentonite clay dispersed into coastal water near the landfall, affecting the water quality of WFD designated water bodies.

8.11.2.13 The realistic worst-case considered is a release of drilling mud with a conservative maximum concentration of 80,000 mg/l, up to the total volume of the conduit (1,964 m^3), in a relatively short period of time (minutes to hours), at up to two locations near landfall for the two export cables. The plume will be immediately subjected to turbulent dispersion in a very high energy environment with current velocities > 0.5 m/s, rapidly gaining distance as it is advected (the coastal tidal excursion is estimated at 17 km under spring tidal conditions). The impact would therefore be temporary with increased SSC rapidly dissipating and returning to natural background levels. Bentonite clay grain size is very small, leading to prolonged resuspension in the water column (days to weeks) and will therefore not deposit or accumulate onto the seabed in measurable thickness in any location more than a few tens of metres from the main point of release, limiting its impact on sediment quality.

8.11.2.14 Current data suggests that 2 mg/l is the maximum background of SSC recorded in surface waters under normal conditions in the OAA. In shallower waters (<30 m) during storm events, wave driven currents can naturally cause very high SSC in the thousands of mg/l or more, close to the seabed and especially in areas where mobile sediment is present. Therefore, the intensity of the impact on the receptors due to increased SSC during construction activities, are expected to be comparable to (or less than) the increases which can occur naturally under storm driven conditions and last for a similar amount of time.

8.11.2.15 The spatial extent of sediment transport and deposition will be affected by the currents, therefore could vary across the Study Area; however, deposition is expected to be localised, only within the near-field and intermediate impact zones of the activity (up to 500 m), limited by the coarser nature of the substrate at the site.

8.11.2.16 The overall duration of such events would also be limited, expecting SSC concentrations to return to background levels within 2 tidal cycles (~24 hours), therefore classifying the impact as reversible and short-term/temporary. After the initial disturbance event, causing high levels of SSC near the activity, turbidity may persist for several hours, but its level is not usually environmentally significant (less than 100 mg/l is expected).

8.11.2.17 The impact magnitude is contextualised by the dynamics of the receiving environment and is therefore categorised as **Low** for all the three receptors considered (sediment quality, water quality and water quality within designated WFD water bodies) with localised, temporary effects, and overall leading to changes on a small proportion of the receptors.

Significance of Effect and Additional Mitigation

8.11.2.18 Overall, the sensitivity of the receptors to the impacts associated with increased SSC and deposition during Construction has been assessed as Medium for sediment quality, Low for water quality and Low for water

quality within designated WFD water bodies. The impact magnitude was assessed as Low for all three receptors therefore resulting in **Minor** effects as summarised in **Table 8-17**, **Not Significant** in EIA terms. In light of the current assessment, **No Additional Mitigation** measures are required.

Table 8-17 Summary of impacts and effects for remobilisation of sediments causing increased suspended solids concentration in the water column

Receptor	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation
Sediment quality	Medium	Low	**Minor – Not Significant**	Not required
Water quality	Medium	Low	**Minor – Not Significant**	Not required
Water quality within designated WFD water bodies	Medium	Low	**Minor – Not Significant**	Not required

Remobilisation of sediments and use of drilling muds causing potential resuspension of contaminated sediments into the water column leading to deterioration of water and sediment quality

8.11.2.19 This impact relates to the potential for disturbance and release of contaminated sediments into the water column and their subsequent release into the water column or deposition onto the seabed during construction activities. This is associated with risk of changes to the identified receptors (water quality, sediment quality and water quality within designated WFD water bodies).

Impact and Receiving Environment

8.11.2.20 During the Construction phase of the OWF, the sediment layer is penetrated and/or removed for the installation of anchors, moorings and cables, leading to seabed substrate disturbance. This is expected to lead to the release of sediments into the water column and subsequent transport and dispersal in suspension by currents and deposited over various distances. Substrate disturbance will result in development of a sediment plume containing contaminants present within the sediment layer, such as heavy metals and hydrocarbons, dispersing them into the overlying water column.

8.11.2.21 The impact intensity and range will vary across the Salamander Project Study Area, depending on the nature of the activity, the seabed type and the hydromorphology of the site developed. During construction activities and seabed levelling for gravity anchors (realistic worst-case scenario) a maximum sediment plume advection distance of 8 km and 17 km further offshore and nearshore respectively, flowing north-south direction, is expected (**Volume ER.A.4, Annex 7.1: Marine Physical Processes Technical Annex**). Overall, an estimated 8,153,600 m^3 of sediment spoils are expected to be displaced during Construction, the majority coming from the installation of cables and seabed clearance (7,200,000 m^3). However, the disturbance will be confined to the activity area therefore, each installation intervention will be spatially distinct and can be considered as individual discrete events. In the case of pile anchors, and trenchless export cable installation,

drilling muds (water based non-toxic bentonite clay) will be used with minimal drilling lubricants used during the final exit phase on the seabed.

Receptor Sensitivity

8.11.2.22 The sensitivity of the receptors is determined by their relevant attributes and how they are affected by the potential increase in contaminant concentrations. Water quality could decline due to the presence of large quantities of contaminants and non-temporary changes to the water quality of WFD water bodies could ultimately deteriorate their overall ecological status.

8.11.2.23 Overall, the sensitivity of a receptor is also determined by their ability to tolerate and adapt to changes. When discussing water and sediment quality, a larger volume of a receiving environment, with the capacity for dilution and flushing, greatly favours adaptability and recoverability.

8.11.2.24 The overall sensitivity of sediment quality for this impact pathway was assessed as **Negligible** as the impact will not result in changes to quality of the sediment (the suspended and deposited material will originate in situ) and the receptor can accommodate the change without the need to recover or adapt. Water Quality sensitivity was assessed as **Medium**, as the water column is highly tolerant and adaptable to changes, aided by the localised nature of the impact and the large volume of the receiving environment. The sensitivity of water quality within designated WFD water bodies was likewise assessed as **Medium** as the receptor is tolerant to changes and the impact magnitude and duration would determine the overall significant or not significant changes ecological status of the water bodies (currently in Good and High WFD status).

Impact Magnitude

8.11.2.25 The magnitude of the impact of resuspended contaminated sediment on the receptors scoped into assessment is dependent on the duration and frequency of the event, which varies between construction activities and seabed types. As stated in the SSC impact assessment section (**Section 8.11.2.2**), the sediments comprise primarily of coarse-grained material which deposits and resettles quickly after disturbance, limiting dispersion. The plume, containing significant SSC, is expected to be localised and remain within the near-field (0-50 m) and intermediate (50-500 m) impact zones of the activity. The impact duration is expected to be temporary, only lasting up to two tidal cycles.

8.11.2.26 Overall, no contaminated sediments were found within the Study Area. The elevated levels of As (below Cefas AL1) which were recorded, are typical of the region and only heavy metals concentrations below Cefas AL2 are expected within the Study Area 8 km data gap. No contaminated sediments have been currently identified. Additionally, the use of environmentally friendly drilling muds such as natural bentonite clay, and limited lubricants, will limit the external input of contaminants in the water column and the surrounding substrate.

8.11.2.27 The impact magnitude is contextualised by the dynamics of the receiving environment and is therefore categorised as **Low** for all the three receptors considered (sediment quality, water quality and water quality of WFD designated water bodies) with localised, reversible, temporary effects, and overall no changes to the baseline conditions of the receptors are expected.

Significance of Effect and Additional Mitigation

8.11.2.28 Overall, the sensitivity of the receptors to the impacts associated with contaminated sediment resuspension and deposition during Construction has been assessed as Negligible for sediment quality, Medium for water quality and Medium water quality within designated WFD water bodies. The impact magnitude was assessed

as Low for all three receptors therefore resulting in **Negligible** to **Minor** effects as summarised in **Table 8-18**, **Not Significant** in EIA terms. In light of the current assessment, **No Additional Mitigation** measures are required.

Table 8-18 Summary of impacts and effects for remobilisation of contaminated sediments in the water column

Receptor	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation
Sediment quality	Negligible	Low	**Negligible – Not Significant**	Not required
Water quality	Medium	Low	**Minor – Not Significant**	Not required
Water quality within designated WFD water bodies	Medium	Low	**Minor – Not Significant**	Not required

Accidental release of pollutants and sewage into the water column from vessels and helicopters during transit and construction operations

8.11.2.29 This impact relates to the potential for accidental release of polluting compounds and nutrients from sewage into the water column from vessels and helicopters during construction activities. This may lead to potential changes to the identified receptors (water quality, sediment quality and water quality within designated WFD water bodies).

Impact and Receiving Environment

8.11.2.30 During the Construction phase, numerous vessels and helicopters will be present in and around the Offshore Development Area, introducing the risk of accidental pollution from spills, leaks of fuel and other compounds (e.g. hydrocarbon and heavy metals) and release of sewage waste carried on-board. Such releases into the water column would affect water quality, and if subsequently deposited on the seabed could affect seabed sediment quality. Accidental release of sewage waste into the surrounding waters could further lead to increased nutrients concentration in the water column and sediment.

8.11.2.31 An estimated 674 trips per year (including helicopter trips) are expected during the Construction phase, taking up to 18 months to complete. Each instance of vessel and helicopter presence at the Salamander Project Offshore Development Area introduces a degree of risk of accidental release of pollutants to the environment.

Receptor Sensitivity

8.11.2.32 The sensitivity of the receptors is determined by their relevant attributes and how they are affected by the potential increase in contaminant concentrations. Water and sediment quality and their chemistry baseline could be significantly affected by the presence of large quantities of contaminants and increased nutrient concentration. The accidental release of sewage waste could lead to excessive levels of inorganic macronutrient concentration in the water column, such as nitrogen and phosphorous. This can lead to elevated algal growth, and enhanced eutrophication events. The resultant algal blooms could lower levels

of O_2 in the water, which may potentially create anoxic zones in the water column. Such incidences within WFD water bodies would lead to a deterioration of water quality and potential downgrade of their ecological status.

8.11.2.33 Overall, the sensitivity of a receptor is also determined by their ability to tolerate and adapt to changes. When discussing water and sediment quality, the large volume of the receiving environment, and associated capacity for dilution and flushing, greatly favours adaptability and recoverability. The sensitivity of the near-field and far-field environment are taken into consideration and an overall assessment is proposed.

8.11.2.34 The overall sensitivity of sediment quality was assessed as **Low** as the receptor is tolerant to changes. The sensitivity of water quality has been assessed as **Low** as the water column is highly tolerant and adaptable to changes, and the overall localised nature of the impact and the large volume of the receiving environment. The sensitivity of water quality within designated WFD water bodies was assessed as **Low** as the receptor is tolerant to changes and the small scale of the impact would result in no change to the ecological status of the water bodies (currently in Good and High WFD status).

Impact Magnitude

8.11.2.35 A maximum number of six vessels are expected in the Offshore Development Area at one time, therefore limiting the impact potential. A number of helicopter trips are also expected during the 18 months of Construction (excluding pre-construction surveys) and have been included in the assessment since potential helicopter accidents could cause environmental degradation. Best practice techniques will be employed at all times during construction and vessel operations. This will strictly adhere to pollution prevention and environmental management plans agreed prior commencement of Construction to reduce the risk of pollution events. **Table 8-11** lists embedded mitigation measures that will be employed throughout the Salamander Project lifespan to prevent such pollution events from occurring, and the emergency response procedure that would be required should an incident occur.

8.11.2.36 Best practice techniques and mitigation measures will be embedded in the CEMP and employed to prevent pollution events, all vessels associated with the Salamander Project will comply with the International Convention for the Prevention of Pollution from Ships (MARPOL) 73/78. **Table 8-11** lists embedded mitigation measures that will be employed to prevent pollution events, and the emergency response procedure that would be required should an incident occur.

8.11.2.37 The impact magnitude is contextualised by the dynamic nature of the receiving environment and the embedded mitigation measures employed for the Salamander Project. It is therefore categorised as **Low** for all the three receptors considered (sediment quality, water quality and water quality of WFD designated water bodies) with localised, reversible, temporary effects, and overall, no changes to the baseline conditions of the receptors are expected.

Significance of Effect and Additional Mitigation

8.11.2.38 Overall, the sensitivity of the receptors to the impacts associated with the risk of accidental release of pollutants from vessels during Construction has been assessed as Low for sediment quality, Low for water quality and Low water quality within designated WFD water bodies. The impact magnitude was assessed as Low for all three receptors therefore resulting in **Negligible** effects as summarised in **Table 8-19**, **Not Significant** in EIA terms. In light of the current assessment and current embedded mitigation measures planned, **No Additional Mitigation** measures are required.

Table 8-19 Summary of impacts and effects for accidental release of pollutants from vessels in the water column

Receptor	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation
Sediment quality	Low	Low	**Negligible – Not Significant**	Not required
Water quality	Low	Low	**Negligible – Not Significant**	Not required
Water quality within designated WFD water bodies	Low	Low	**Negligible – Not Significant**	Not required

Accidental release of litter and debris into the water column from vessels and helicopters during transit and construction operations

8.11.2.39 This impact relates to the potential for the accidental release of municipal waste and construction debris into the water column and their subsequent deposition on the seabed during construction activities. This would potentially lead to changes to the identified receptors (water quality, sediment quality and water quality within designated WFD water bodies).

Impact and Receiving Environment

8.11.2.40 During the Construction phase , numerous vessels and helicopters will be present in and around the Salamander Project Offshore Development Area. The presence of vessels introduces the risk of accidental release of litter and debris from construction activities carried on-board into the water column and potential subsequent deposition on the seabed. The litter and debris considered include materials such as concrete, wood, metals and plastics and damaged parts of wind farm components, cement, grout, mortar, and binders. The increase of litter and debris in marine waters and sediments can pose a danger to marine life, kill or injure wildlife, damage or degrade the environment. The most important parameters affecting the level of impact are: the type and amount of waste or wastewater released, weather conditions, and the type of receiving sediments.

8.11.2.41 An estimated 674 trips per year (including helicopter trips) are expected during the Construction phase, taking up to 18 months to complete. Each instance of vessel and helicopter presence at the Salamander Project site introduces a degree of risk of accidental release of pollutants to the environment.

Receptor Sensitivity

8.11.2.42 Receptor sensitivity is determined by their relevant attributes and how they are affected by the potential increase in foreign bodies within their domain. Sediment quality could be affected by the presence of large quantities of discarded material by changing the physical properties of the receptor (e.g. particulate grain size, sediment type and morphology). The accidental release of litter and debris could also lead to habitat degradation within the water quality of WFD water bodies receptor and downgrade of their ecological status.

8.11.2.43 Overall, the sensitivity of a receptor is also determined by their ability to tolerate and adapt to changes. When discussing water and sediment quality, the large volume of the receiving environment, with the capacity for dilution and flushing, greatly favours adaptability and recoverability.

8.11.2.44 The overall sensitivity of sediment quality was assessed as **Low** as the receptor is tolerant to changes. The sensitivity of water quality has been assessed as **Low** as the water column is highly tolerant and adaptable to changes, aided by the overall localised nature of the impact and the large volume of the receiving environment. The sensitivity of water quality within designated WFD water bodies was assessed as **Low**, as the receptor is tolerant to changes and the small scale of the impact would result in no change to the ecological status of the water bodies (currently in good and high status).

Impact Magnitude

8.11.2.45 A maximum number of six vessels are expected in the area at one time, therefore limiting the impact potential. A number of helicopter trips are also expected during the 18 months of Construction (excluding pre-construction surveys) and have been included in the assessment since potential helicopter accidents could cause a large littering event and damage to the environment.

8.11.2.46 Best practice techniques and mitigation measures will be embedded in the CEMP and employed to prevent littering events, all vessels associated with the Salamander Project will comply with the International Convention for the Prevention of Pollution from Ships (MARPOL) 73/78. **Table 8-11** lists embedded mitigation measures that will be employed to prevent pollution events, and the emergency response procedure that would be required should an incident occur.

8.11.2.47 The impact magnitude is contextualised by the dynamics of the receiving environment and the control measures that will be put in place to avoid accidental littering events, or address one should it occur, therefore is categorised as **Low** for all the three receptors considered (sediment quality, water quality and water quality of WFD designated water bodies) with localised and reversible effects.

Significance of Effect and Additional Mitigation

8.11.2.48 Overall, the sensitivity of the receptors to the impacts associated with the risk of accidental release of litter and debris from vessels during Construction has been assessed as Low for sediment quality, Low for water quality and Low water quality within designated WFD water bodies. The impact magnitude was assessed as Low for all three receptors therefore resulting in **Negligible** effects as summarised in **Table 8-20**, **Not Significant** in EIA terms. In light of the current assessment and current embedded mitigation measures planned, **No Additional Mitigation** measures are required.

Table 8-20 Summary of impacts and effects for accidental release of litter and debris from vessels in the water column

Receptor	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation
Sediment quality	Low	Low	Negligible – Not Significant	Not required
Water quality	Low	Low	Negligible – Not Significant	Not required

Receptor	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation
Water quality within designated WFD water bodies	Low	Low	Negligible – Not Significant	Not required

8.11.3 Operation and Maintenance

8.11.3.1 The following impacts have been assessed for the Operation and Maintenance phase of the Salamander Project:

- Remobilisation of sediments causing increased suspended solids concentration in the water column leading to deterioration of water quality;
- Removal of biofouling from the subsea structures and leaching of antifouling, anticorrosive agents from coated infrastructure leading to water and sediment quality deterioration;
- Accidental release of pollutants and sewage waste and into the water column from vessels and helicopters during transit, Operation and Maintenance; and
- Accidental release of litter and debris into the water column from vessels and helicopters during transit, Operation and Maintenance.

Remobilisation of sediments causing increased suspended solids concentration in the water column leading to deterioration of water quality during maintenance and remedial works

8.11.3.2 This impact relates to the potential for disturbance and release of sediments into the water column and their subsequent deposition during operation and maintenance activities leading to potential changes to the identified receptors (water quality, sediment quality and water quality within designated WFD water bodies).

8.11.3.3 During the Operation and Maintenance phase scheduled maintenance and remedial works will take place which may lead to seabed disturbance and associated increased SSC.

8.11.3.4 The impact intensity and range of the impact will vary across the Study Area, depending on the nature of the activity, the seabed type and the hydromorphology of the site. However, it is expected to occur at a much smaller scale than during Construction.

8.11.3.5 During the lifetime of the Salamander Project, an estimated <14 subsea cables will be repaired and replaced with ~7.4 km of those needing reburial (1,468,00 m^2 area impacted by the process) and <40 mooring lines and anchor replacements occurring. The approximate volume of spoils expected to be produced during the seabed remedial works is 89,700 m^3. Any receptor sensitivity and the magnitude of the impact will be no greater than that identified for the impact assessed during the Construction phase (see paragraph 8.11.2.2 onward) and therefore classification and description of this impact and its mitigation measures, if applicable, are less than or equal to the Construction phase.

Removal of biofouling from the subsea structures and leaching of antifouling, anticorrosive agents from coated infrastructure leading to water and sediment quality deterioration

8.11.3.6 This impact relates to the potential for water and sediment quality deterioration caused by release of biofouling material from cleaning infrastructure and the leaching of antifouling, anticorrosive agents leading to potential changes to the identified receptors (water quality, sediment quality and water quality within designated WFD water bodies).

Impact and Receiving Environment

8.11.3.7 During the Operation and Maintenance phase, scheduled maintenance with associated cleaning of the subsea infrastructure will occur. Additionally, the presence of vessels and infrastructure, comprising floating substructures, anchors, moorings etc., treated with antifouling and anticorrosive agents introduce the risk of potentially toxic agents leaching into the surrounding environment.

8.11.3.8 Submerged OWF components are subject to fast corrosion processes in salt waters due to oxidation processes. Corrosion protection measures are employed to prevent the rapid degradation of steel structures. A number of anticorrosive and antifouling methods have been selected to protect subsea infrastructure at the Salamander Project comprising various types of coating (low-toxicity paints), the use of sacrificial anodes and the use of impressed current anodes. The most commonly used agent in the industry is cathodic protection, both galvanic and electrolytic. Galvanic protection (also cathodic or anodic protection), due to electrode wear, releases Al and Zn into the water column and seabed sediments. The approximate total surface area treated with antifouling and anticorrosion agents is 1,017,574 m².

8.11.3.9 Despite these measures, biofouling of submerged structures can still be expected to occur. Therefore, infrastructure will be inspected and cleaned regularly; however, the frequency of the cleaning will be informed upon inspection. The subsea structures can accommodate a moderate amount of marine growth; however, maintenance is necessary to extend the lifespan of the assets and to manage product efficiency, weight and drag-induced fatigue. The biofouling material will be removed from the structures using high pressure jetting tools. This will lead to release of biofouling debris into the water column causing temporary water column disturbance in the form of increased SSC and scattering of discarded material and subsequent seabed deposition.

Receptor Sensitivity

8.11.3.10 Receptor sensitivity is determined by their relevant attributes and how they are affected by the potential increase in contaminant concentrations. Sediment quality could be affected by the introduction of large quantities of leaching agents and by the presence of large quantities of discarded material. The chemistry baseline of the water quality receptors (both) could also be affected by the presence of large quantities of contaminants and the release of biofouling debris, leading to habitat degradation within the water quality of WFD water bodies receptors and downgrade their ecological status.

8.11.3.11 Overall, the sensitivity of a receptor is also determined by their ability to tolerate and adapt to changes. When discussing water and sediment quality, the large volume of the receiving environment, with the capacity for dilution and flushing, greatly favours adaptability and recoverability.

8.11.3.12 The overall sensitivity of sediment quality was assessed as **Low** as the receptor is tolerant to changes. The sensitivity of water quality has been assessed as **Low** as the water column is highly tolerant and adaptable to changes, aided by the localised nature of the impact and the large volume of the receiving environment.

The sensitivity of water quality within designated WFD water bodies was assessed as **Low** as the receptor is tolerant to changes and the small scale of the impact would result in no change to the ecological status of the water bodies (currently in Good and High status), furthermore, WFD designated water bodies are located at a considerable distance from the OAA, where there is greatest risk of impact occurrence.

Impact Magnitude

8.11.3.13 Removal of biofouling will only occur when deemed necessary and the overall spatial extent of the impact and the structures available for colonisation is small. The increased turbidity would only be temporary and limited to the area surrounding the structures to be cleaned. The effects of leaching of antifouling and anticorrosive agents will be long-term albeit localised and on a small scale. Low-toxicity paints will be selected throughout. Additionally, most of the cleaning activities will not occur within WFD designated water bodies which, will not be significantly affected by leaching agents, primarily found in the OAA.

8.11.3.14 The impact magnitude is contextualised by the dynamics of the receiving environment and, therefore is categorised as **Low** for all the three receptors considered (sediment quality, water quality and water quality of WFD designated water bodies) with localised, reversible, long-term effects.

Significance of Effect and Additional Mitigation

8.11.3.15 Overall, the sensitivity of the receptors to the impacts associated with removal of biofouling material accumulated on the structures and leaching of antifouling, anticorrosive agents from coated infrastructure, has been assessed as Low for sediment quality, Low for water quality and Low water quality within designated WFD water bodies. The impact magnitude was assessed as Low for all three receptors therefore resulting in **Negligible** effects as summarised in **Table 8-21**, **Not Significant** in EIA terms. In light of the current assessment and current embedded mitigation measures planned, **No Additional Mitigation** measures are required.

Table 8-21 Summary of impacts and effects for removal of biofouling from the subsea structures and leaching of antifouling, anticorrosive agents from coated infrastructure

Receptor	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation
Sediment quality	Low	Low	**Negligible – Not Significant**	Not required
Water quality	Low	Low	**Negligible – Not Significant**	Not required
Water quality within designated WFD water bodies	Low	Low	**Negligible – Not Significant**	Not required

Accidental release of pollutants and sewage waste into the water column from vessels during transit and maintenance

8.11.3.16 This impact relates to the potential for accidental release of polluting compounds and nutrients from sewage into the water column from vessels during Operation and Maintenance, maintenance and remedial activities

leading to potential changes to the identified receptors (water quality, sediment quality and water quality within designated WFD water bodies).

8.11.3.17 During the 35-year operational life of the Salamander Project, numerous vessels will be present in and around the OWF, introducing the risk of accidental release of pollutants and sewage waste into the water column, however, it is anticipated to occur on a much smaller scale than during Construction as an estimated total number of 210 vessels trips per year (7,350 vessel trips over 35-year life cycle) are expected. Any receptor sensitivity and the magnitude of the impact will be no greater than that identified for the impact assessed during the Construction phase (see paragraph 8.11.2.29 onward) and therefore classification and description of this impact and its mitigation measures, if applicable, are the same as in the Construction phase, detailed in the relevant section above.

Accidental release of litter and debris into the water column from vessels during transit and maintenance operations

8.11.3.18 This impact relates to the potential for accidental release of municipal waste and construction debris into the water column from vessels during Operation and Maintenance, maintenance and remedial activities leading to potential changes to the identified receptors (water quality, sediment quality and water quality within designated WFD water bodies).

8.11.3.19 During the 35-year operational life of the Salamander Project, numerous vessels will be present in and around the OWF, introducing the risk of accidental release of municipal waste and construction debris into the water column, however, it is anticipated to occur on a much smaller scale than during Construction as an estimated total number of 210 vessels trips per year (7,350 vessel trips over 35-year life cycle) are expected. Any receptor sensitivity and the magnitude of the impact will be no greater than that identified for the impact assessed during the Construction phase (see **paragraph 8.11.2.39** onward) and therefore classification and description of this impact and its mitigation measures, if applicable, are the same as in the Construction phase, detailed in the relevant section above.

8.11.4 Decommissioning

8.11.4.1 As per current legislation (Energy act 2004) and guidance, the Decommissioning phase of the Salamander Project, involves reverse installation with the complete removal of all structures. This would comprise the dismantling and removal of up to seven WTGs and associated floating substructures, removal of the dynamic and buried cables, anchors and mooring, scour protection (potentially left *in situ*) and cable stabilisation for an approximate total volume of submerged OWF infrastructure of 6,000,337 m^3. The decommissioning programme will be submitted for approval ahead of the construction of the Offshore Development. The Decommissioning Plan will be periodically reviewed and updated ahead of decommissioning to allow the most up to date legislation and guidance will be applied to the plan.

8.11.4.2 Given the current plan for reversal of the installation process, the impacts during Decommissioning on sediment quality, water quality and water quality within designated WFD water bodies receptors, are expected to be analogous to, or less than those assessed for the Construction phase of the Salamander Project and as such, the impacts are considered as **Not Significant**.

8.11.5 Summary of Impact Assessment

8.11.5.1 Taking into consideration the assessment carried out on other WFD receptors in **Volume ER.A.3**:

- **Volume ER.A.3, Chapter 7: Marine Physical Processes,** assessing hydromorphology receptor;

- **Volume ER.A.3, Chapter 9: Benthic and Intertidal Ecology,** assessing the benthic ecology, biology receptor; and
- **Volume ER.A.3, Chapter 10: Fish and Shellfish Ecology,** assessing the fish ecology, biology receptor.

8.11.5.2 The significance of the effects on the receptors has been considered as **Not Significant** in EIA terms. In light of the current assessment and current embedded mitigation measures planned, **No Additional Mitigation** measures are required.

8.11.5.3 A summary of the impacts and effects identified for the Water and Sediment Quality assessment above is outlined in **Table 8-22**.

Table 8-22 Summary of Impacts and Effects for Water and Sediment Quality

Salamander Project Activity and Impact	Project Aspect	Embedded Mitigation ID	Receptor	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Significance of Effect	Significance of Effect in EIA terms
Construction									
Remobilisation of sediments causing increased suspended solids concentration in the water column leading to deterioration of water quality	OAA and Offshore ECC	Co4; Co5; Co6; Co9	Sediment quality	Medium	Low	Minor	No additional mitigation measures have been identified for this effect above and beyond the embedded mitigation listed in **Table 8-11** as it was concluded that the effect was Not Significant	Minor	Not Significant
			Water quality	Medium	Low	Minor		Minor	Not Significant
			Water quality within designated WFD water bodies	Medium	Low	Minor		Minor	Not Significant
Remobilisation of sediments and use of drilling muds causing potential resuspension of contaminated sediments into the water column leading to deterioration of water and sediment quality	OAA and Offshore ECC	Co4; Co5; Co6; Co9	Sediment quality	Negligible	Low	Negligible		Negligible	Not Significant
			Water quality	Medium	Low	Minor		Minor	Not Significant
			Water quality within designated	Medium	Low	Minor		Minor	Not Significant

Salamander Project Activity and Impact	Project Aspect	Embedded Mitigation ID	Receptor	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Significance of Effect	Significance of Effect in EIA terms
			WFD water bodies						
Accidental release of pollutants and sewage waste and into the water column from vessels and helicopters during transit and construction operations	OAA and Offshore ECC	Co3; Co7; Co9	Sediment quality	Low	Low	Negligible		Negligible	Not Significant
			Water quality	Low	Low	Negligible		Negligible	Not Significant
			Water quality within designated WFD water bodies	Low	Low	Negligible		Negligible	Not Significant
Accidental release of litter and debris into the water column from vessels and helicopters during transit and construction operations	OAA and Offshore ECC	Co3; Co7; Co9	Sediment quality	Low	Low	Negligible		Negligible	Not Significant
			Water quality	Low	Low	Negligible		Negligible	Not Significant
			Water quality within designated WFD water bodies	Low	Low	Negligible		Negligible	Not Significant

Salamander Project Activity and Impact	Project Aspect	Embedded Mitigation ID	Receptor	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Significance of Effect	Significance of Effect in EIA terms
Operation and Maintenance									
Remobilisation of sediments causing increased suspended solids concentration in the water column leading to deterioration of water quality	OAA and Offshore ECC	Co10	Sediment quality	Low	Low	Negligible	No additional mitigation measures have been identified for this effect above and beyond the embedded mitigation listed in **Table 8-11** as it was concluded that the effect was Not Significant	Negligible	Not Significant
			Water quality	Medium	Low	Minor		Minor	Not Significant
			Water quality within designated WFD water bodies	Medium	Low	Minor		Minor	Not Significant
Removal of biofouling from the subsea structures and leaching of antifouling, anticorrosive agents from coated infrastructure leading to water and sediment quality deterioration	OAA and Offshore ECC	Co10	Sediment quality	Low	Low	Negligible		Negligible	Not Significant
			Water quality	Low	Low	Negligible		Negligible	Not Significant
			Water quality within designated WFD water bodies	Low	Low	Negligible		Negligible	Not Significant

Salamander Project Activity and Impact	Project Aspect	Embedded Mitigation ID	Receptor	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Significance of Effect	Significance of Effect in EIA terms
Accidental release of pollutants and sewage waste and into the water column from vessels and helicopters during transit, operations and maintenance	OAA and Offshore ECC	Co3; Co7; Co10	Sediment quality	Low	Low	Negligible		Negligible	Not Significant
			Water quality	Low	Low	Negligible		Negligible	Not Significant
			Water quality within designated WFD water bodies	Low	Low	Negligible		Negligible	Not Significant
Accidental release of litter and debris into the water column from vessels and helicopters during transit and construction operations	OAA and Offshore ECC	Co3; Co7; Co10	Sediment quality	Low	Low	Negligible		Negligible	Not Significant
			Water quality	Low	Low	Negligible		Negligible	Not Significant
			Water quality within designated WFD water bodies	Low	Low	Negligible		Negligible	Not Significant

Salamander Project Activity and Impact	Project Aspect	Embedded Mitigation ID	Receptor	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Significance of Effect	Significance of Effect in EIA terms
Decommissioning									
Remobilisation of sediments causing increased suspended solids concentration in the water column leading to deterioration of water quality	OAA and Offshore ECC	Co3; Co7; Co10	Sediment quality	Medium	Low	Minor	No additional mitigation measures have been identified for this effect above and beyond the embedded mitigation listed in **Table 8-11** as it was concluded that the effect was Not Significant	Minor	Not Significant
			Water quality	Medium	Low	Minor		Minor	Not Significant
			Water quality within designated WFD water bodies	Medium	Low	Minor		Minor	Not Significant
Remobilisation of sediments causing potential resuspension of contaminated sediments into the water column leading to deterioration of water and sediment quality	OAA and Offshore ECC	Co3; Co7; Co10	Sediment quality	Negligible	Low	Negligible		Negligible	Not Significant
			Water quality	Medium	Low	Minor		Minor	Not Significant
			Water quality within designated WFD water bodies	Medium	Low	Minor		Minor	Not Significant

Salamander Project Activity and Impact	Project Aspect	Embedded Mitigation ID	Receptor	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Significance of Effect	Significance of Effect in EIA terms
Accidental release of pollutants and sewage waste and into the water column from vessels and helicopters during transit and decommissioning operations	OAA and Offshore ECC	Co3; Co7	Sediment quality	Low	Low	Negligible		Negligible	Not Significant
			Water quality	Low	Low	Negligible		Negligible	Not Significant
			Water quality within designated WFD water bodies	Low	Low	Negligible		Negligible	Not Significant
Accidental release of litter and debris into the water column from vessels and helicopters during transit and decommissioning operations	OAA and Offshore ECC	Co3; Co7	Sediment quality	Low	Low	Negligible		Negligible	Not Significant
			Water quality	Low	Low	Negligible		Negligible	Not Significant
			Water quality within designated WFD water bodies	Low	Low	Negligible		Negligible	Not Significant

8.12 Mitigation and Monitoring

8.12.1.1 No additional mitigation as a result of the Water and Sediment Quality assessment is required beyond the embedded mitigation plans proposal. The CEMP and the MPCP incorporate monitoring that would be required in the unlikely occurrence of events such as significant accidents or accidental release of large volumes of polluting compounds as stated in the CEMP.

8.13 Cumulative Effect Assessment (CEA)

8.13.1.1 A Cumulative Effects Assessment (CEA) has been made based on existing and proposed developments in the Study Area. The approach to the CEA is described in **Volume ER.A.2, Chapter 6: EIA Methodology**. Cumulative effects are defined as those effects on a receptor that may arise when the development is considered together with other projects.

8.13.1.2 The maximum spatial extent of potential effects on Water and Sediment Quality as identified within this chapter are determined by Salamander Project near-field and far-field Study Area. Areas beyond this range are unlikely to experience any measurable change. As such, only plans or projects with potential to overlap spatially or temporally will be included in the cumulative assessment.

8.13.1.3 On this basis, the projects considered within this cumulative assessment correspond to the projects identified in **Volume ER.A.3, Chapter 7: Marine Physical Processes** and listed in **Table 8-23**. Projects within 20 km of the Salamander Project have the potential to overlap tidal excursion zones and therefore are considered in the assessment. Further information on these projects is outlined in **Volume ER.A.2, Chapter 6: EIA Methodology**.

Table 8-23 Projects Within the Water and Sediment Quality Study Area considered within the cumulative effects assessment

Development / Activity	Type	Project Phase	Distance to OAA (km)	Distance to Offshore Export Cable Corridor (km)	Impacts considered
Green Volt Floating Offshore Wind Farm Export Cable	Floating Offshore Wind Farm	Consent Application Submitted	0.3	Overlaps	Cumulative increase of SSC, resuspended contaminants, accidental release of litter and sewage from construction activities and/or presence of vessels and helicopters (construction and operations). Increase in leaching contaminants during operations.
Cenos Floating Offshore Wind Farm Export Cable	Floating Offshore Wind Farm	Scoping Submitted	Overlaps	Overlaps	Cumulative increase of SSC, resuspended contaminants, accidental release of litter and sewage from construction activities and/or presence of vessels and helicopters (construction and operations). Increase in leaching contaminants during operations.
Central North Sea Electrification (CNSE) Project	Platform Electrification	Scoping Submitted	18.1	4.6	Cumulative increase of SSC, resuspended contaminants, accidental release of litter and sewage from construction activities and/or presence of vessels and helicopters (construction and operations). Increase in leaching contaminants during operations.
MarramWind Offshore Wind Farm Export	Floating Offshore Wind Farm	Scoping Submitted	1.5	Overlaps	Cumulative increase of SSC, resuspended contaminants, accidental release of litter and sewage from construction activities and/or presence of vessels and helicopters (construction

Development / Activity	Type	Project Phase	Distance to OAA (km)	Distance to Offshore Export Cable Corridor (km)	Impacts considered
Cable[3]					and operations). Increase in leaching contaminants during operations.
Muir Mhòr Offshore Wind Farm Export Cable	Floating Offshore Wind Farm	Scoping Submitted	5.53	Overlaps	Cumulative increase of SSC, resuspended contaminants, accidental release of litter and sewage from construction activities and/or presence of vessels and helicopters (construction and operations). Increase in leaching contaminants during operations.
Hywind Scotland Pilot Park	Floating Offshore Wind Farm	Operational	11.7 (Hywind project's array) and 14.3 (Hywind project's ECC)	8.1 (Hywind project's array) and 0.1 (Hywind project's ECC)	Cumulative increase of SSC, resuspended contaminants, accidental release of litter and sewage from construction activities and/or presence of vessels and helicopters (construction and operations). Increase in leaching contaminants during operations.
Buchan Floating Offshore Wind Farm Export Cable	Floating Offshore Wind Farm	Scoping Submitted	1.44	Overlaps	Cumulative increase of SSC, resuspended contaminants, accidental release of litter and sewage from construction activities and/or presence of vessels and helicopters (construction and operations). Increase in leaching contaminants during operations.

[3] Distances provided for MaramWind are based on the ECC area of search and should not be considered necessarily indicative of the route that will subsequently be proposed.

Development / Activity	Type	Project Phase	Distance to OAA (km)	Distance to Offshore Export Cable Corridor (km)	Impacts considered
NorthConnect	Interconnector	Approved	Overlaps	Overlaps	Cumulative increase of SSC, resuspended contaminants, accidental release of litter and sewage from construction activities and/or presence of vessels and helicopters (construction and operations). Increase in leaching contaminants during operations.
Eastern Green Link 2 (EGL2)	Interconnector	Consented	26.78	2.86	Cumulative increase of SSC, resuspended contaminants, accidental release of litter and sewage from construction activities and/or presence of vessels and helicopters (construction and operations). Increase in leaching contaminants during operations.
Peterhead (CR070)	Dredge Spoil Disposal	Operational	3.1	N/A	Contaminants and increase in SSC.
North Buchan Ness (CR080)	Dredge Spoil Disposal	Operational	1.7	N/A	Contaminants and increase in SSC.

8.13.1.4 An assessment of the potential cumulative effects for Water and Sediment Quality during the Construction and Operation and Maintenance phases of the Salamander Project has been carried out. The principal pathways identified for potential cumulative effects are:

- Cumulative remobilisation of sediments causing increased suspended solids concentration in the water column leading to deterioration of water quality;
- Cumulative remobilisation of sediments and use of drilling muds causing potential resuspension of contaminated sediments into the water column leading to deterioration of water and sediment quality;
- Cumulative effects of accidental release of pollutants and sewage waste and into the water column from vessels and helicopters during transit, Construction and Operations and Maintenance activities;
- Cumulative effects of accidental release of litter and debris into the water column from vessels and helicopters during transit, Construction and Operations and Maintenance activities; and
- Cumulative effects of removal of biofouling from the subsea structures and leaching of antifouling, anticorrosive agents from coated infrastructure leading to water and sediment quality deterioration during Operation and Maintenance.

8.13.1.5 The significance of potential cumulative effects is considered below. Construction and Operation and Maintenance phase are considered concurrently unless specified.

Potential cumulative remobilisation of sediments causing increased suspended solids concentration in the water column leading to deterioration of water quality

8.13.1.6 There is an overlap between the Salamander Project near-field and far-field Study Area and a number of projects listed in **Table 8-23** (all listed projects with the exception of Green Volt array area and operational oil and gas pipelines located >26 km away) which could potentially lead to cumulative effects through interactions between sediment plumes. Several of these projects are currently operational and therefore, large sediment plume interactions, mostly associated with installation of foundations/anchors and cables, are not expected (during Operation and Maintenance phase, the potential of the impact is reduced). For projects currently in the pre-consenting stage, construction activities could potentially take place simultaneously with the Salamander Project. Additionally, dredge disposal site CR070 and CR080 are located at a distance of circa 1.2 km and 1.6 km from the Offshore ECC, respectively.

8.13.1.7 The main area of overlap between the projects appears to be concentrated along the Offshore ECC installation, where concurrent sediment disturbance could take place, therefore risks of increased SSC could be greater. Should disturbance occur, interactions are expected to be minimal due to the rectilinear nature of the tidal excursion, primarily moving north-south direction, therefore avoiding most of the dredge disposal sites and other planned ECCs, which paths eventually diverge. The Green Volt ECC and Cenos ECC projects are set to overlap the Salamander Project Offshore ECC in places however, considering the realistic worst-case scenario of concurrent construction activities in the area, standard 500 m safety zones will be applied during any construction or operation and maintenance activities, greatly limiting the risk of plume coalescence. In addition, these projects are subject to similar tertiary mitigation measures to those employed for the Salamander Project, further reducing any cumulative impacts on the water and sediment quality in the area.

8.13.1.8 Importantly, the spatial extent of significant seabed disturbance and associated increase of SSC and deposition is expected to be localised only to the near-field and intermediate impact zones of the activity

(up to 500 m), limited by the coarser nature of the substrate at the site. Therefore, any interactions at distances > 500 m between projects and associated cumulative changes will be undetectable on the seabed, no such interactions are anticipated and the magnitude of the impact is therefore assessed as **Low**.

8.13.1.9 The sensitivity of the Water and Sediment Quality receptors is considered as **Medium** (sediment quality, water quality and water quality of WFD designated water bodies) and the impact magnitude was assessed as **Low** for all three receptors therefore resulting in **Minor** cumulative effects, which is **not significant** in EIA terms**.**

Potential cumulative remobilisation of sediments and use of drilling muds causing potential resuspension of contaminated sediments into the water column leading to deterioration of water and sediment quality.

8.13.1.10 Equally to the potential cumulative SSC discussed above, there is potential for cumulative impacts of resuspension of contaminated sediments to occur, due to the close proximity of some of the project identified in **Table 8-23**.

8.13.1.11 As stated for the risks of plumes interactions, mostly associated with installation of foundations/anchors and cables, and to a much lesser extent, with the Operation and Maintenance phase, the direct spatial extent of active and significant impact is localised within >500 m (plume dispersion area of detectable sediment deposition). The application of a standard 500 m safety zone when considering the realistic worst-case scenario of concurrent construction activities in the area, will significantly limit the risk of sediment plume coalescence. Although potentially contaminated finer sediments could remain suspended for longer periods of time and could potentially actively interact between projects, *in situ* data shows the absence of contaminated sediments in the area, therefore the magnitude of the impact is assessed as **Low**.

8.13.1.12 The sensitivity of the Water and Sediment Quality receptors is considered as **Negligible to Medium** (sediment quality, water quality and water quality of WFD designated water bodies) and the impact magnitude was assessed as **Low** for all three receptors therefore resulting in **Low** to **Minor** cumulative effects, which is **Not Significant** in EIA terms.

Potential cumulative effects of accidental release of pollutants and sewage waste and into the water column from vessels and helicopters during transit and construction operations.

8.13.1.13 Considering the potential for increased vessel and helicopters activity in the area, in the event concurrent construction activities will take place, there is potential for cumulative impacts of accidental release of pollutants and sewage waste during transits and operations at all stages of the Salamander Project lifespan. Each project will be implementing embedded mitigation measures and emergency response plans to reduce any risks and/or minimise impacts, therefore, the potential for cumulative impacts associated with accidental release of pollutants and sewage waste and the overall magnitude of the impact is assessed as **Low**.

8.13.1.14 The sensitivity of the Water and Sediment Quality receptors is considered as **Low** (sediment quality, water quality and water quality of WFD designated water bodies) and the impact magnitude was assessed as **Low** for all three receptors therefore resulting in **Negligible** cumulative effects, which is **not significant** in EIA terms.

Potential cumulative effects of accidental release of litter and debris into the water column from vessels and helicopters during transit, construction and operations and maintenance activities.

8.13.1.15 Considering the potential for increased vessel and helicopters activity in the area, in the event concurrent construction activities will take place, there is potential for cumulative impacts of accidental release of litter and construction debris during transits and operations at all stages of the Salamander Project lifespan. Each project will be implementing embedded mitigation measures and emergency response plans to reduce any risks and/or minimise impacts, therefore, the potential for cumulative impacts associated with accidental release of waste and the overall magnitude of the impact is assessed as **Low**.

8.13.1.16 The sensitivity of the Water and Sediment Quality receptors is considered as **Low** (sediment quality, water quality and water quality of WFD designated water bodies) and the impact magnitude was assessed as **Low** for all three receptors therefore resulting in **Negligible** cumulative effects, which is **not significant** in EIA terms.

Potential cumulative effects of removal of biofouling from the subsea structures and leaching of antifouling, anticorrosive agents from coated infrastructure leading to water and sediment quality deterioration during Operation and Maintenance.

8.13.1.17 There is potential for cumulative impacts of cleaning of structures and leaching of antifouling and anticorrosive agents to occur, due to the close proximity of some of the project identified in **Table 8-23**. However, most of these impacts are associated with the array area of OWFs, as ECCs are buried where possible. Most of the array areas of the projects considered in this CEA, are a significant distance away from the Salamander Project OAA; this therefore limits the potential for coalescence of discarded material and subsequential damage or degradation to the environment and leaching agent dispersal. Therefore, the overall magnitude of the impact is assessed as **Low**.

8.13.1.18 The sensitivity of the Water and Sediment Quality receptors is considered as **Low** (sediment quality, water quality and water quality of WFD designated water bodies) and the impact magnitude was assessed as **Low** for all three receptors therefore resulting in **Negligible** cumulative effects, which is **not significant** in EIA terms.

8.13.2 Potential Cumulative Impacts During Decommissioning

8.13.2.1 Due to the high level of uncertainty over the likely schedule for Decommissioning of the Salamander Project and other projects considered, cumulative effects assessment cannot be realistically completed for this phase.

8.14 Assessment of Impacts Cumulatively with the Onshore Development

8.14.1.1 The Onshore Development components are summarised in **Volume ER.A.2, Chapter 4: Project Description.** These Project aspects have been considered in relation to the impacts assessed within this chapter.

8.14.1.2 The main components of the Onshore Development which have the potential to disturb receptors of Water and Sediment Quality and WFD include activities taking place just above MHWS or within the intertidal zone such as trenchless cable installation, trenching at the landfall location, installation of the onshore cables and onshore substation and any additional temporary construction areas.

8.14.1.3 Receptors detailed within the impact assessment of this chapter primarily at risk of interactions with the Onshore Development include:

- Water Quality;
- Sediment Quality; and
- Water quality within designated WFD water bodies.

8.14.1.4 The impacts originated from the Onshore activities have been fully assessed within the Offshore impacts, **Section 8.11** and it is not anticipated that there will be any additional impacts from the construction and operation activities of the Onshore Development on the identified receptors. Overall, the sensitivity of the receptors is considered **Low** and the magnitude of the impacts was assessed as **Medium** to **Low** therefore resulting in **Minor** to **Negligible** effects. No significant cumulative effects are expected during Construction and Operation and Maintenance phases of Onshore and Offshore activities of the Salamander Project, and therefore the overall impact is assessed as **Not significant** in EIA terms. Therefore, there is no requirement for additional mitigation measures above the embedded measures proposed in **Section 8.8.3**.

8.15 Transboundary Effects

8.15.1.1 Transboundary effects are defined as effects that extend into other European Economic Area (EEA) states. These may occur from the Salamander Project alone, or cumulatively with other plans or projects. The Salamander Project area of influence is located exclusively within Scotland' exclusive economic zone (EEZ), therefore transboundary impacts have been scoped out of the EIA and have not been considered further for Water and Sediment Quality.

8.16 Inter-related Effects

8.16.1.1 The following assessment considers the potential for inter-related effects to arise across the three project phases (i.e. project lifetime effects) as well as the interaction of multiple effects on a receptor (i.e. receptor-led effects).

- Project lifetime effects are considered to be effects that occur throughout more than one phase of the project, (Construction, Operation and Maintenance, And Decommissioning) to interact to potentially create a more significant effect on a receptor, than if just assessed in isolation in these three key project phases (e.g. Construction, Operation and Maintenance, And Decommissioning).
- Receptor-led effects involve spatially or temporal interaction of effects, to create inter-related effects on a receptor or receptor group. Receptor-led effects might be short term, temporary or transient effects, or incorporate longer term effects.

8.16.1.2 It is important to note that the inter-related effects assessment considers only effects produced by the offshore elements of the Project and not from other projects, which are considered within **Section 8.13**.

8.16.1.3 The significance of the individual effects, as determined in **Section 8.11** is presented herein for each receptor group. A descriptive assessment of the scope for these individual effects to interact to create a different or greater effect has then been undertaken. This assessment incorporates qualitative and, where reasonably possible, quantitative assessments. It should be noted that the following assessment does not assign significance of effect for inter-related effects; rather, any inter-related effects that may be of greater significance than the individual effects acting in isolation on a given receptor are identified and discussed.

8.16.1.4 The information and impacts identified in the Water and Sediment Quality chapter are inter-related and used to inform other EIAR topics such as:

- **Volume ER.A.3 Chapter 9: Benthic and Intertidal Ecology;**
- **Volume ER.A.3 Chapter 10: Fish and Shellfish Ecology;**
- **Volume ER.A.3 Chapter 11: Marine Mammals; and**
- **Volume ER.A.3 Chapter 12: Offshore and Intertidal Ornithology.**

8.16.1.5 Impacts such as increased SSC and resuspension of contaminated sediments (leading to sediment and water quality changes), may affect other receptors, such benthic communities and fish (indirect effects of pathways changes); however, these inter-relationships are considered in the respective topic-specific chapters.

8.16.1.6 In terms of inter-relationships and potential interaction of multiple impacts, creating a more significant effect upon one receptor, the realistic worst-case scenario of interaction between various pathways and coalescence between impacts, has been taken into account during the main assessment. The effects of the impacts identified have been considered minor or negligible, therefore not producing an increased likelihood of significant inter-related impacts. Inter-related effects are mostly temporary and localised in nature over the lifetime of the OWF. A summary of these inter-relationships between impacts is presented in **Table 8-24**.

Table 8-24 Salamander Project lifetime Inter-related Effects Assessment for the Water and Sediment Quality Topic

Impacts	Residual Effects			Inter-related Effects
	Construction *18 months*	*O&M* *35 years*	*Decommissioning* *18 months*	
Remobilisation of sediments causing increased suspended solids concentration in the water column leading to deterioration of water quality	Minor	Negligible	Minor	The effects of increased SSC caused by seabed disturbance will primarily occur during the Construction and Decommissioning phases of the Salamander Project. The spatial extent of significant seabed disturbance and associated increase of SSC and deposition is expected to be localised, only within the near-field and intermediate impact zones of the activity (up to 500 m), limited by the coarser nature of the substrate at the site. The cumulative effects of the impact over the Salamander Project lifetime are not expected to result in greater significance than those assessed separately.
Remobilisation of sediments and use of drilling muds causing potential resuspension of contaminated sediments into the water column leading to deterioration of water and sediment quality.	Negligible	Negligible	Negligible	The effects of resuspended contaminated sediments caused by seabed disturbance will primarily occur during the Construction and Decommissioning phases of the Salamander Project. The spatial extent of significant seabed disturbance and associated sediment plume and deposition is expected to be localised, only within the near-field and intermediate impact zones of the activity (up to 500 m), limited by the coarser nature of the substrate at the site. Additionally, there is no evidence of significant pollution within the sediment of the Salamander Project near-filed Study Area. The cumulative effects of the impact over the Salamander Project lifetime are not expected to result in greater significance than those assessed separately.
Accidental release of pollutants and sewage waste and into the water column from vessels during transit	Negligible	Negligible	Negligible	The risk of accidental release of pollutants and sewage waste into the water column from vessels will primarily occur during the Construction and Decommissioning phases of the Salamander Project. Mitigation measures will be in place to reduce the risks and emergency response plans will be implemented in the unlikely event of an accident, further localising the extent of a spill. Furthermore, in the unlikely event of an accident,

and construction operations.				the high energy nature of the receiving environment and its ability to flush and disperse any substance entering the water column, would minimise the magnitude of the impact. The cumulative effects of the impact over the Salamander Project lifetime are not expected to result in greater significance than those assessed separately.
Accidental release of litter and debris into the water column from vessels during transit and construction operations.	Negligible	Negligible	Negligible	The risk of accidental release of litter and debris into the water column from vessels will primarily occur during the Construction and Decommissioning phases of the Salamander Project. Mitigation measures will be in place to reduce the risks and emergency response plans will be implemented in the unlikely event of an accident. The cumulative effects of the impact over the Salamander Project lifetime are not expected to result in greater significance than those assessed separately.
Removal of biofouling from the subsea structures and leaching of antifouling, anticorrosive agents from coated infrastructure leading to water and sediment quality deterioration.	Negligible	Negligible	Negligible	The risk of damage associated with release of biofouling debris and the effects of leaching compounds contamination will primarily occur during the Operation and Maintenance phase of the Salamander Project. Removal of biofouling will only occur when necessary and the surface area available for colonisation is small, limiting the magnitude of the impact. The effects of leaching of antifouling and anticorrosive agents will be long-term but localised and on a small scale, low-toxicity paints will be selected throughout. The cumulative effects of the impact over the Salamander Project lifetime are not expected to result in greater significance than those assessed separately.

Receptor Based Effects

There is potential for inter-relation between impacts of seabed sediment disturbance associated with increased SSC and resuspension of potentially contaminated sediment into the water column due to installation of seabed infrastructure. There is a potential for additional impacts caused by vessel traffic in the area, over the lifetime of the project. The sensitivity of the Water and Sediment Quality and WFD receptors is considered as Low to Medium. The overall significance of the effects is determined as Minor (increased SSC) to Negligible. Although there is potential for effects to be amplified in areas where there is spatial and temporal overlap, it is expected that there will be a degree of spatial and temporal separation and, therefore, the combined effects will not be any more significant than the individual worst-case effects considered in isolation.

8.17 Conclusion and Summary

8.17.1.1 This chapter provides an assessment of potential for impacts to Water and Sediment Quality and WFD receptors due to Construction, Operation and Maintenance and Decommissioning activities of the Salamander Project. The chapter provides an integrated assessment of Water and Sediment Quality topics alongside an integrated statutory WFD compliance assessment.

8.17.1.2 The baseline characterisation of the Salamander Project Study Area shows that the sediments off the east coast of Aberdeenshire primarily consist of coarser sand, gravelly sand or sandy gravel with very low mud and low TOM content. An 8 km shoreward survey gap along the Offshore ECC is acknowledged and assumptions, based on expert knowledge and scientific interpretation of current data, are stated. Overall, no excess of metal contaminants, in excess of Cefas AL2, were found at the Salamander Project site. Raised levels of Arsenic, but below Cefas AL1, were identified at the stations closer to shore, indicating the possible presence of Arsenic concentrations above Cefas AL1 and below Cefas AL2, along the 8 km data gap of the Offshore ECC. Hydrocarbons and PAHs concentrations remained low.

8.17.1.3 Water quality was generally high with low concentrations of inorganic nutrients and chlorophyll-α and high percentage of oxygen saturation. SSC was generally low throughout the year albeit varied sightly between the offshore and the nearshore areas, due primarily to differences in water depth, *in situ* currents velocity and sediments composition.

8.17.1.4 In conclusion, there is no evidence of significant pollution within the sediment and water of the Salamander Project Study Area, indicating low concerns for the overall status of the water and sediment quality in and around the Salamander Project site.

8.17.1.5 During the WFD compliance assessment, bathing waters, shellfish water and nutrient sensitive areas were scoped out due to the significant distance from the Salamander Project activity (>2 km). The Offshore ECC is in proximity to The Ugie Estuary ID 200129 (1.7 km), classified as High ecological status, and crosses two designated water bodies, the Ugie Estuary to Buchan Ness (Peterhead) ID 200131 and Cairnbulg Point to the Ugie Estuary ID 200142, classified as Good and High ecological status respectively.

8.17.1.6 Impacts and potential effects considered within this chapter were informed by existing policy and guidance, the Scoping Opinion, and stakeholder consultation. Three receptors were identified in total and brought forward for assessment:

- Sediment quality;
- Water quality;
- Water quality of WFD designated water bodies.

8.17.1.7 Three other WFD statutory receptors were assessed in separate chapters, hydromorphology and biology (benthic ecology and fish ecology) were assessed in **Volume ER.A.3, Chapter 7: Marine Physical Processes, Chapter 9: Benthic and Intertidal Ecology and Chapter 10: Fish and Shellfish Ecology** respectively.

8.17.1.8 Potential impacts to the receptors were determined, potential deviation from the baseline were identified and the worst-case scenario was discussed and assessed. The realistic worst-case scenarios for the proposed activities were considered gravity anchors or pile anchors.

8.17.1.9 The following impacts have been assessed for the Construction phase of the Salamander Project:

- Remobilisation of sediments causing increased suspended solids concentration in the water column leading to deterioration of water quality;

- Remobilisation of sediments and use of drilling muds causing potential resuspension of contaminated sediments into the water column leading to deterioration of water and sediment quality;
- Accidental release of pollutants and sewage waste and into the water column from vessels and helicopters during transit and construction operations; and
- Accidental release of litter and debris into the water column from vessels and helicopters during transit and construction operations.

8.17.1.10 The following impacts have been assessed for the Operation and Maintenance phase of the Salamander Project:

- Remobilisation of sediments causing increased suspended solids concentration in the water column leading to deterioration of water quality;
- Removal of biofouling from the subsea structures and leaching of antifouling, anticorrosive agents from coated infrastructure leading to water and sediment quality deterioration;
- Accidental release of pollutants and sewage waste and into the water column from vessels and helicopters during transit, Operation and Maintenance; and
- Accidental release of litter and debris into the water column from vessels and helicopters during transit and construction operations.

8.17.1.11 Due to continuous technological advancements and changes in policy and guidance, it is currently difficult to predict accurately what the decommissioning phase will entail, therefore, the worst-case scenario of complete removal of assets was considered.

8.17.1.12 Overall, the effects assessed were considered **Minor** or **Negligible**, and **No Significant Effects** are expected from the Salamander Project, therefore no additional mitigation has been proposed.

8.17.1.13 The CEA concluded that all cumulative effects assessed were considered minor or negligible, and that no significant cumulative effects are expected. Potential transboundary impacts have been scoped out of the EIA for the Salamander Project activities. Effects of the inter-related impacts identified have been considered **Minor** or **Negligible**, therefore not producing an increased likelihood of significant cumulative impacts over the Salamander Project lifetime.

8.18 References

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