MONA OFFSHORE WIND PROJECT

Environmental Statement

Volume 2, Chapter 1: Physical Processes

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Image of an offshore wind farm

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Annexes

Annex number	Annex title
1.1	Physical processes technical report

Glossary

Term	Meaning
Bathymetry	The measurement of depth of water in oceans, seas, or lakes.
Barchan	A crescent-shaped shifting sand dune.
Ebb tide	The tidal phase during which the water level is falling.
Erosion	Depletion of sediment in the intertidal region.
Fetch	Length in the wind direction of the marine area where water waves are generated by wind.
Flood tide	The tidal phase during which the water level is rising.
Intertidal region	An area of a shoreline that is covered at high tide and uncovered at low tide.
Lee	Shelter from wind or weather given by an object.
Littoral currents	Flow derived from tide and wave climate.
Low Water Mark	The level reached by the sea at low tide.
Mean High Water	The highest water level reached during and average tide.
Mean High Water Spring (MHWS)	The most inshore level location reached by the sea at high tide during mean high water spring tide. This is defined as the average throughout the year, of two successive high waters, during a 24-hour period in each month when the range of the tide is at its greatest.
Mean Low Water Spring (MLWS)	The most inshore location reached by the sea at low tide during low water spring tide. This is defined as the average throughout the year, of two successive low waters, during a 24-hour period in each month when the range of the tide is at its greatest.
Mean Sea Level (MSL)	The average tidal height over a long period of time.
Metocean	Refers to the syllabic abbreviation of meteorology and (physical) oceanography.
Neap tide	Tide that occurs when the sun and moon are at right angles to each other and the gravitational pull of the sun partially cancels out the pull of the moon on the ocean.
Residual current	The net flow over the course of the tidal cycle. This is effectively the driving force of the sediment transport.
Sandwave	A lower regime sedimentary structure that forms across from tidal currents.
Scour protection	Measures to prevent loss of seabed sediment around any structure placed in or on the seabed (e.g. by use of protective aprons, mattresses, rock and gravel placement)
Sedimentation	The process of settling or being deposited as a sediment.
Semidiurnal	Twice daily.
Significant wave height	Mean wave height (trough to crest) of the highest third of the waves.
Slack tide	Tidal phase at which the current turns from flood to ebb (high-water slack tide) or from ebb to flood (low-water slack tide).
Spring tide	Tide that occurs when the sun and moon are directly in line with the Earth and their gravitational pulls on the ocean reinforce each other.
Suspended Particulate Matter (SPM)	Particles that are suspended in the water column.
Tidal ellipse	The path that a package of water would follow over the course of a tidal cycle.

Term	Meaning
Turbidity	The quality of being cloudy, opaque, or thick with suspended matter.
Wave height	The distance from trough to crest of a wave.

Acronyms

Acronym	Description
2D UHRS	2D Ultra High Resolution Seismic
BEIS	The Department for Business, Energy and Industrial Strategy
BGS	British Geological Survey
BODC	British Oceanographic Data Centre
CCS	Carbon Capture and Storage
CEA	Cumulative Effect Assessment
Cefas	Centre for Environment Fisheries and Aquaculture Science
CMS	Construction Method Statement
COWRIE	Collaborative Offshore Wind Energy Research into the Environment
CPT	Cone Penetration Test
CSIP	Cable Specification and Installation Plan
DCO	Development Consent Order
Defra	Department for Environment Food and Rural Affairs
DESNZ	The Department for Energy Security and Net Zero
DSV	Digital Sound Velocity
DML	Deemed Marine Licence
ECMWF	European Centre for Medium-range Weather Forecast
EIA	Environmental Impact Assessment
EMODnet	European Marine Observation and Data Network
EWG	Expert Working Group
GEMS	Geotechnical Engineering and Marine Surveys
HDD	Horizontal Directional Drilling
HRA	Habitats Regulations Assessment
JNCC	Joint Nature Conservation Committee
MBES	Multi-Beam Echo Sounder
MCA	Maritime Coastguard Agency
MCZ	Marine Conservation Zone
MDS	Maximum Design Scenario
MEDIN	Marine Environmental Data Information Network
MHWS	Mean High Water Springs

Acronym	Description
MLWS	Mean Low Water Springs
MMO	Marine Management Organisation
MPA	Marine Protected Area
MSL	Mean Sea Level
NIS	Natura Impact Statement
NOAA	National Oceanic and Atmospheric Administration
NPS	National Policy Statements
NRW	Natural Resources Wales
NSIP	Nationally Significant Infrastructure Project
OPRED	Offshore Petroleum Regulator for Environment and Decommissioning
OSP	Offshore Substation Platforms
PEIR	Preliminary Environmental Information Report
PSA	Particle Sieve Analysis
PSU	Practical Salinity Unit equivalent to ‰
SAC	Special Areas of Conservation
SBP	Sub-Bottom Profiler
SCI	Site of Community Importance
SMP	Shoreline Management Plan
SPA	Special Protection Area
SPM	Suspended Particulate Matter
SSC	Suspended sediment concentrations
SSS	Side Scan Sonar
SSSI	Site of Special Scientific Interest
UK	United Kingdom
UKCP	United Kingdom Climate Projections
UKHO	United Kingdom Hydrographic Office
UXO	Unexploded ordnance
ZOI	Zone of Influence

Units

Unit	Description
º	Degrees (angle from true North)
%	Percentage
cm	Centimetres (distance)
cm/s	Centimetres per second (speed)
km	Kilometres (distance)

Unit	Description
km^2	Square kilometres (distance)
m	Metres (distance)
m^2	Square metres (area)
m^3/h	Cubic metres per hour (discharge rate)
mg/l	Milligrams per litre (concentration)
mm	Millimetres (distance)
m/s	Metres per second (speed)
$m^3/d/m$	Cubic metres transported per day per metre width of transport path (i.e. perpendicular to direction of transport)
$m^3/s/m$	Cubic metres transported per second per metre width of transport path (i.e. perpendicular to direction of transport)

1 Physical processes

1.1 Introduction

1.1.1 Overview

1.1.1.1 This chapter of the Environmental Statement presents the assessment of the potential impact of the Mona Offshore Wind Project on physical processes. Specifically, this chapter considers the potential impact of the Mona Offshore Wind Project seaward of Mean High Water Springs (MHWS) during the construction, operations and maintenance, and decommissioning phases. The impacts of the Mona Offshore Wind Project landward of MHWS are addressed in Volume 3: Onshore chapters of the Environmental Statement. Specifically, Volume 3, Chapter 1: Geology, hydrogeology and ground conditions of the Environmental Statement and Volume 3, Chapter 2: Hydrology and flood risk of the Environmental Statement.

1.1.1.2 The assessment presented also informs and is informed by the following technical chapters:

- Volume 2, Chapter 2: Benthic subtidal and intertidal ecology of the Environmental Statement
- Volume 2, Chapter 3: Fish and shellfish ecology of the Environmental Statement
- Volume 2, Chapter 4: Marine mammals of the Environmental Statement
- Volume 2, Chapter 9: Marine archaeology of the Environmental Statement
- Volume 2, Chapter 10: Other sea users of the Environmental Statement.

1.1.1.3 This chapter also draws upon information contained within Volume 6, Annex 1.1: Physical processes technical report of the Environmental Statement. Previous experience in offshore wind developments has indicated that changes in physical processes are generally limited in magnitude and scale. For the purposes of identifying significant impacts a comparative study was undertaken which assessed potential changes in physical process drivers (i.e. tidal currents and waves using numerical modelling techniques). These changes were not found to be significant therefore further detailed studies were not required. A full detailed study was not undertaken from the outset, rather reference made to published characteristics and noted sensitivities.

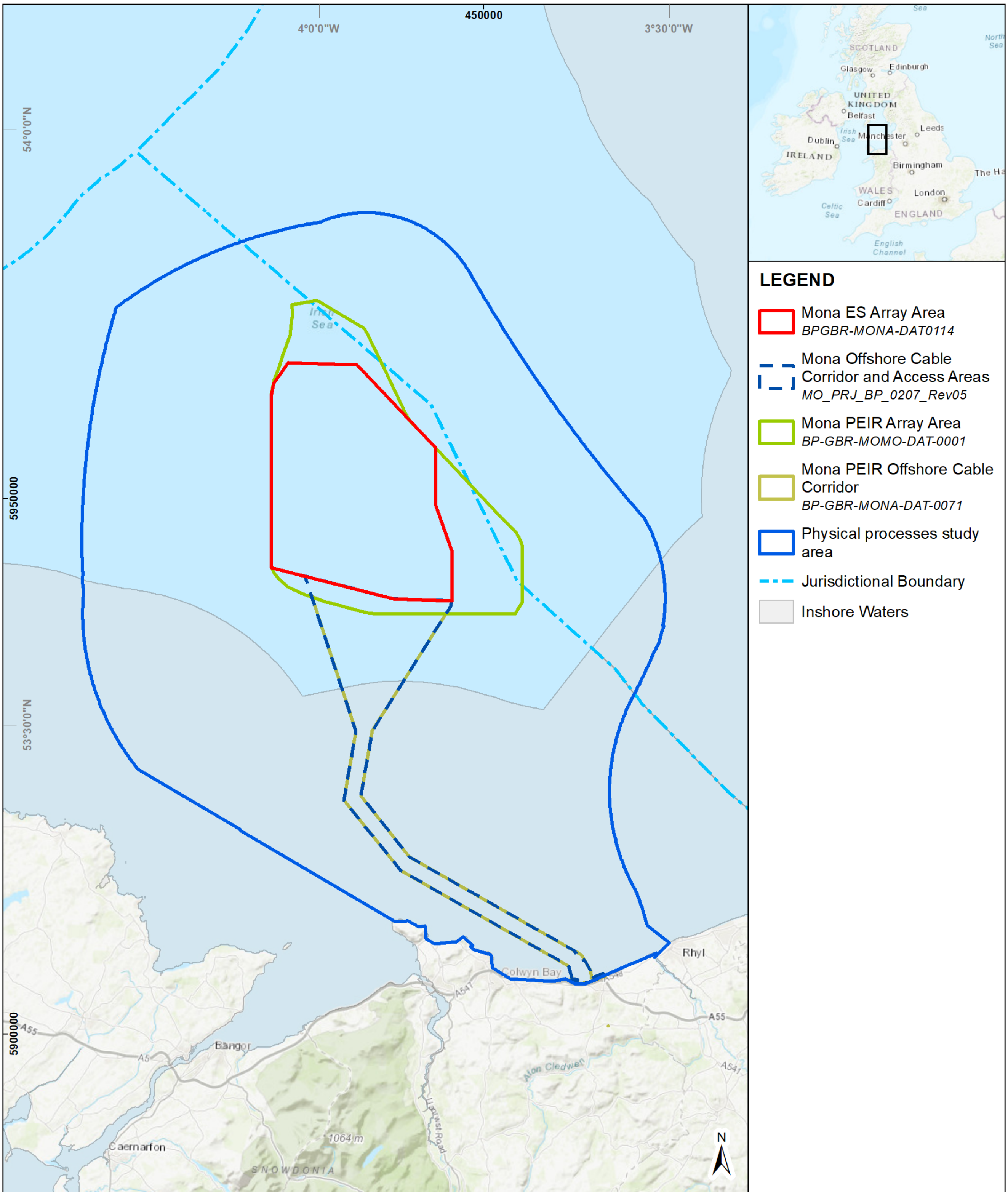
1.1.1.4 The physical processes modelling that has been undertaken to support this chapter, presented in Volume 6, Annex 1.1: Physical processes technical report of the Environmental Statement, is based on the Mona Array Area presented in the Preliminary Environmental Information Report (PEIR), (Mona Offshore Wind Ltd, 2023), as illustrated in Figure 1.1. The Mona Array Area (also presented in Figure 1.1) has been reduced from the boundary presented in the PEIR for the application stage, with the proposed range of wind turbine infrastructure within the envelope of the project description presented within the PEIR, both in terms of turbine numbers and size of infrastructure. This is described in Volume 1, Chapter 3: Project description of the Environmental Statement. This chapter presents and assesses up to date parameters for the Environmental Statement and explains if and when the modelling differs from the Environmental Statement parameters.

1.1.1.5 In some cases, modelling of construction activities extended beyond the updated Mona Array Area which has been reduced by approximately 33% since the PEIR. Due to the close proximity of the modelled Mona Array Area presented at PEIR, and the

Mona Array Area presented for the Environmental Statement, illustrated in Figure 1.1, these areas display bathymetry, tidal currents and sediment classifications which are consistent with those within the updated Mona Array Area. It is considered that, given these similarities and that the revised layout represents a modest change in terms of the physical processes assessment, the modelling undertaken for the Mona Array Area presented at PEIR and layout remains valid and has therefore been used to inform the physical processes Environmental Statement assessment presented in this chapter.

1.1.1.6 Additional sensitivity testing has been undertaken to support variations from the Mona Array Area presented in the PEIR to the Mona Array Area at application. This is presented in Volume 6, Annex 1.1: Physical processes technical report of the Environmental Statement. Where disparities occur between the modelled and assessed parameter, they are cited within this chapter with reference to the applicability of the modelled data and how it is used to support the assessment.

1.1.1.7 In addition, Figure 1.1 demonstrates how the Mona Array Area has been reduced in size since the publication of the PEIR. However, to ensure a precautionary approach, the physical processes study area remains unchanged. This is discussed in detail in section 1.4.4.



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Data Sources:

EnBW bp Partners in UK offshore wind — RPS

Project Name:
MONA OFFSHORE WIND PROJECT

0 2.5 5 nm
0 5 10 km

Drawing Number:
RPSC-IBE1919-Mona-ES10

Drawing Title:
Mona Array Areas for PEIR and ES

Geodetic Information:
Datum: ETRS 1989
Projection: ETRS 1989 UTM Zone 30N
Scale@160mmx220mm: 1:600,000

VER	DATE	DETAILS	BY	CHECK
00	10/08/23	First Issue	NRS	RMcC
01	27/09/23	Final ES	RMcK	NRS

Figure 1.1: Mona Array Area for PEIR and application.

1.2 Legislative and policy context

1.2.1 Legislation

1.2.1.1 The policy context for the Mona Offshore Wind Project is set out in Volume 1, Chapter 2: Policy and legislative context of the Environmental Statement.

1.2.2 Planning policy context

1.2.2.1 The Mona Offshore Wind Project will be located in Welsh offshore waters (beyond 12 nautical miles (nm) from the Welsh coast) and inshore waters, with the onshore infrastructure located wholly within Wales, as set out in Volume 1, Chapter 1: Introduction of the Environmental Statement. As the Mona Offshore Wind Project is an offshore generating station with a capacity of greater than 350 MW located in Welsh waters, it is a Nationally Significant Infrastructure Project (NSIP) as defined by Section 15(3) of the Planning Act 2008 (as amended) (the 2008 Act). As such, there is a requirement to submit an application for a Development Consent Order (DCO) to the Planning Inspectorate to be decided by the Secretary of State for the Department for Energy Security and Net Zero (DESNZ). A summary of the policy provisions relevant to physical processes are provided in Table 1.1, with other relevant policy on decision making set out in Table 1.2.

1.2.3 National Policy Statements

1.2.3.1 There are currently six energy National Policy Statements (NPSs), three of which contain policy relevant to offshore wind development and the Mona Offshore Wind Project, specifically:

- Overarching NPS for Energy (NPS EN-1) which sets out the UK Government's policy for the delivery of major energy infrastructure (Department for Energy Security & Net Zero, 2024a)
- NPS for Renewable Energy Infrastructure (NPS EN-3) (Department for Energy Security & Net Zero, 2024b)
- NPS for Electricity Networks Infrastructure (NPS EN-5) (Department for Energy Security & Net Zero, 2024c).

1.2.3.2 NPS EN-1 and NPS EN-3 include guidance on what matters are to be considered in the physical processes assessment. These are summarised in Table 1.1 below. NPS EN-1 and NPS EN-3 also highlight a number of factors relating to the determination of an application and in relation to mitigation. These are summarised in Table 1.2 below.

Table 1.1: Summary of the NPS EN-1 and EN-3 provisions relevant to physical processes.

Summary of NPS EN-1 and EN-3 provision	How and where considered in the Environmental Statement
NPS EN-1	
Where relevant, applicants should undertake coastal geomorphological and sediment transfer modelling to predict and understand impacts and help identify relevant mitigating or compensatory measures. (Section 5.6, paragraph 5.6.10)	Assessment of sediment dynamics undertaken using the hydrodynamic and spectral wave modelling, together with an understanding of the sediment regime. Refer to Volume 6, Annex 1.1: Physical processes technical report of the Environmental Statement.
The Environmental Statement should include an assessment of the effects on the coast, tidal rivers and estuaries. In particular, applicants should assess: • The impact of the proposed project on coastal processes and geomorphology, including by taking account of potential impacts from climate change. If the development will have an impact on coastal processes the applicants must demonstrate how the impacts will be managed to minimise adverse impacts on other parts of the coast • The implications of the proposed project on strategies for managing the coast as set out in Shoreline Management Plans (SMPs) (which are designed to identify the most sustainable approach to managing flood and coastal erosion risks from short to long term and are long term non-statutory plans which set out the agreed high-level objective for coastal flooding and erosion management for each SMP area), any relevant Marine Plans, River Basin Management Plans, and capital programmes for maintaining flood and coastal defences and Coastal Change Management Areas • The effects of the proposed project on marine ecology, biodiversity and protected sites • How coastal change could affect flood risk management infrastructure, drainage and flood risk • The effects of the proposed project on maintaining coastal recreation sites and features • The vulnerability of the proposed development to coastal change, taking account of climate change, during the project's operational life and any decommissioning period. (Section 5.6, paragraph 5.6.11)	Details of the relevant SMPs are presented in Table 1.5. Baseline and post-construction physical processes were compared alongside extreme storm conditions to consider the wave climate detailed in Volume 6, Annex 1.1: Physical processes technical report of the Environmental Statement. Climate change and the future impact of the Mona Offshore Wind Project is discussed in section 1.5.3. A Cumulative Effects Assessment (CEA) has been undertaken and is outlined in section 1.11. The effects of the proposed project on marine ecology, biodiversity and protected sites are assessed in Volume 2, Chapter 2: Benthic subtidal and intertidal ecology of the Environmental Statement, Volume 2, Chapter 3: Fish and shellfish ecology of the Environmental Statement, Volume 2, Chapter 4: Marine mammals of the Environmental Statement and Volume 2, Chapter 5: Offshore Ornithology of the Environmental Statement. Coastal recreation is addressed in Volume 2, Chapter 10: Other sea users of the Environmental Statement.
For any projects involving dredging or deposit of any substance or object into the sea, the applicants should consult the Marine Management Organisation (MMO), Historic England, or Natural Resources Wales (NRW) in Wales. Where a project has the potential to have a major impact in this respect, this is covered in the technology specific NPSs. (Section 5.6, paragraph 5.6.12)	The provisions for dredging activities are considered within Volume 1, Chapter 3: Project description of the Environmental Statement. Best practice techniques will be employed to ensure sediment mobilisation is minimised. Consultation was undertaken with the appropriate statutory bodies under the Evidence Plan through Expert Working Groups (EWG) as detailed in section 1.3. Assessment of sediment dynamics undertaken using the hydrodynamic and spectral wave modelling, together with an understanding of the sediment regime, as presented in section 1.5.1. Refer to Volume 6, Annex 1.1: Physical processes technical report of the Environmental Statement for further detailed information.

Summary of NPS EN-1 and EN-3 provision	How and where considered in the Environmental Statement
	Predicted changes to the tidal current, wave climate, littoral currents and sediment transport are quantified in Volume 6, Annex 1.1: Physical processes technical report of the Environmental Statement.
The applicants should be particularly careful to identify any effects of physical changes on the integrity and special features of Marine Protected Areas (MPAs). These could include Marine Conservation Zones (MCZs), habitat sites including Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) with marine features, Ramsar sites, Sites of Community Importance (SCIs) and potential SCIs and Sites of Special Scientific Interest (SSSIs). Applicants should also identify any effects on the special character of Heritage Coasts. (Section 5.6, paragraph 5.6.13)	Designated sites and features of importance within and surrounding the physical processes study area have been identified in section 1.4.6. Further information is also provided in the Information to support the Appropriate Assessment (document reference E.1). Potential impacts have also been identified and the significance of the effects on physical processes receptors has been assessed in section 1.9.
NPS EN-3	
Applicant assessments are expected to include predictions of physical effects arising from modifications to hydrodynamics (waves and tides), sediments and sediment transport, and seabed morphology that will result from the construction, operation and decommissioning of the required infrastructure. (Section 2.8, paragraph 2.8.112)	Assessment of the significance of effects on physical processes receptors is detailed in section 1.9. This includes the potential impacts on tide, waves and sediment transport through the lifetime of the project. The assessment of sediment dynamics presented in section 1.9 was underpinned using the hydrodynamic and spectral wave modelling (Volume 6, Annex 1.1: Physical processes technical report of the Environmental Statement), together with an understanding of the sediment regime detailed in section 1.5.1.
Assessments should also include effects such as the scouring that may result from the proposed development and how that might impact sensitive species and habitats. (Section 2.8, paragraph 2.8.113)	Scour protection as a measure will be adopted as part of the project as detailed in Table 1.16 and defined in Volume 1, Chapter 3: Project description of the Environmental Statement. Development and adherence to an Offshore construction method statement (CMS) will include details of scour protection management to be used around offshore structures and foundations to reduce scour. The scour protection measures will be subject to engineering design to ensure they minimise as much as practical the occurrence of scour and therefore any impacts would relate only to residual/secondary scour which would be very localised and of negligible magnitude, as discussed in section 1.9.5. The assessment of sensitive species is presented in Volume 2, Chapter 2: Benthic subtidal and intertidal ecology of the Environmental Statement.
Applicants should undertake geotechnical investigations as part of the assessment, enabling the design of appropriate construction techniques to minimise any adverse effects. (Section 2.8, paragraph 2.8.114)	Geophysical surveys and other site specific surveying has been carried out to support modelling and assessment, as described in Table 1.10.
Applicant assessment of the effects of installing offshore transmission infrastructure across the intertidal/coastal zone should demonstrate compliance with mitigation measures in any relevant plan-level Habitats Regulations Assessment (HRA) by The Crown	The installation of cables is considered within Volume 1, Chapter 3: Project description of the Environmental Statement. It details the use of trenchless techniques between MHWS and Mean Low Water Springs (MLWS) therefore no open-cut trenching will be undertaken in the intertidal area.

Summary of NPS EN-1 and EN-3 provision	How and where considered in the Environmental Statement
Estate as part of its leasing round, and include information where relevant about: • Any alternative landfall sites that have been considered by the applicant during the design phase and an explanation for the final choice • Any alternative cable installation methods that have been considered by the applicant during the design phase and an explanation for the final choice • Potential loss of habitat • Disturbance during cable installation, maintenance/repairs and removal (decommissioning) • Increased suspended sediment loads in the intertidal zone during installation and maintenance/repairs • Potential risk from invasive and non-native species • Predicted rates at which the intertidal zone might recover from temporary effects, based on existing monitoring data • Protected sites. (Section 2.8, paragraph 2.8.119)	It is noted that changes to bathymetry due to depressions left by jack-up vessels will be very limited and are scoped out of the assessment with justification presented in Table 1.8. Habitat loss and invasive/non-native species are assessed in Volume 2, Chapter 2: Benthic subtidal and intertidal ecology of the Environmental Statement.
The applicant should demonstrate compliance with mitigation measures identified by The Crown Estate in any plan-level HRA produced as part of its leasing round. (Section 2.8, paragraph 2.8.123)	Mitigation measures have been considered during consultation as shown in section 1.3, and included within the assessment. This includes scour/cable protection techniques and cable burial techniques as listed in Table 1.7.
Applicant assessment of the effects on the subtidal environment should include: • Loss of habitat due to foundation type including associated seabed preparation, predicted scour, scour protection and altered sedimentary processes, e.g. sandwave/boulder/Unexploded ordnance (UXO) clearance • Environmental appraisal of inter-array and other offshore transmission and installation/maintenance methods, including predicted loss of habitat due to predicted scour, and scour/cable protection and sandwave/boulder/UXO clearance • Habitat disturbance from construction and maintenance/repair vessels' extendible legs and anchors • increased suspended sediment loads during construction and from maintenance/repairs • Predicted rates at which the subtidal zone might recover from temporary effects • Potential impacts from electromagnetic fields (EMF) on benthic fauna • Potential impacts upon natural ecosystem functioning • Protected sites • Potential for invasive/non-native species introduction.	The assessment of potential construction, operations and maintenance, and decommissioning impacts are described in section 1.9.2 and includes the impact of increased suspended sediment loads and subsequent deposition. Hydrodynamic modelling undertaken for physical processes assessment (refer to Volume 6, Annex 1.1: Physical processes technical report of the Environmental Statement.) It is noted that changes to bathymetry due to depressions left by jack-up vessels will be very limited and are scoped out of the assessment with justification presented in Table 1.8. Habitat loss and invasive/non-native species are assessed in Volume 2, Chapter 2: Benthic subtidal and intertidal ecology of the Environmental Statement, which also includes an assessment of the potential impacts from electromagnetic fields (EMF) on benthic fauna. The potential impacts on natural ecosystem in terms of the physical environment, (i.e. external factors) and protected sites are assessed in section 1.9 whilst ecological features are assessed in Volume 2, Chapter 2: Benthic subtidal and intertidal ecology of the Environmental Statement.

Summary of NPS EN-1 and EN-3 provision	How and where considered in the Environmental Statement
(Section 2.8, paragraph 2.8.126)	
Where a potential offshore wind farm is proposed close to existing operational offshore infrastructure or has the potential to affect activities for which a licence has been issued by Government, the applicants should undertake an assessment of the potential effect of the proposed development on such existing or permitted infrastructure or activities. (Section 2.8, paragraph 2.8.197) The assessment should be undertaken for all stages of the lifespan of the proposed wind farm in accordance with the appropriate policy and guidance for offshore wind farm Environmental Impact Assessments (EIA). (Section 2.8, paragraph 2.8.198) Applicants should use marine plans (paragraph 2.8.17-19 of this NPS and Section 4.5 of EN-1) in considering which activities may be most affected by their proposal and thus where to target their assessment. (Section 2.8, paragraph 2.8.189)	The assessment of potential construction, operations and maintenance, and decommissioning impacts are described in section 1.9 and includes the impact of increased suspended sediment loads and subsequent deposition. Legislative requirements for offshore wind farms are considered within Volume 1, Chapter 2: Policy and legislative context of the Environmental Statement. The CEA was carried out in accordance with these requirements as detailed in section 1.11. The projects identified from the screening processes are presented in Table 1.17 with the CEA assessment presented in section 1.11.
Applicants should engage with interested parties in the potentially affected offshore sectors early in the pre-application phase of the proposed offshore wind farm, with an aim to resolve as many issues as possible prior to the submission of an application. (Section 2.8, paragraph 2.8.190)	Key issues have been raised and discussed during consultation activities, and engagement specific to physical processes has been undertaken through the Evidence Plan Process with a series of EWG meetings through the course of the project development and application process. A summary of the key issues and responses have been provided in section 1.7.
Applicants are expected to have considered the best ecological outcomes in terms of potential mitigation. These might include: • Avoidance of areas sensitive to physical effects • Consideration of micro-siting of both the array and cables • Alignment and density of the array • Design of foundations • Ensuring that sediment moved is retained as locally as possible • The burying of cables to a necessary depth • Using scour protection techniques around offshore structures to prevent scour effects or designing turbines to withstand scour, so scour protection is not required or is minimised. (Section 2.8, paragraph 2.8.224) Applicants should consult the statutory consultees on appropriate mitigation and monitoring. (Section 2.8, paragraph 2.8.225)	During the design process a range of parameters have been considered and, following the mitigation hierarchy to avoid, minimise and mitigate potential impacts measures, will be adopted within the context of the projects as detailed in Table 1.16. Mitigation measures have been considered during consultation as shown in section 1.3, and included within the assessment. This includes scour/cable protection techniques and cable burial techniques as listed in Table 1.7 whilst the measures adopted as part of the Mona Offshore Wind Project are presented in Table 1.16.

Summary of NPS EN-1 and EN-3 provision	How and where considered in the Environmental Statement
Applicants should undertake a review of up-to-date research and all potential avoidance, reduction and mitigation options presented for all receptors. (Section 2.8, paragraph 2.8.215) Landfall and cable installation and decommissioning methods should be designed appropriately to minimise effects on intertidal/coastal habitats, taking into account other constraints. (Section 2.8, paragraph 2.8.227) Where applicable, use of horizontal directional drilling (HDD) should be considered as a method to avoid impacts on sensitive habitats and species. (Section 2.8, paragraph 2.8.228) Where HDD is proposed, the applicant should provide a mitigation plan to account for the possibility that HDD fails. (Section 2.8, paragraph 2.8.229) The applicant should explain their justification for the alternative plan and ensure this is the least impactful method possible. (Section 2.8, paragraph 2.8.230) Where cumulative effects on intertidal habitats are predicted as a result of the cumulative impact of multiple cable routes, applicants of various schemes are encouraged to work together to ensure that the number of cables crossing the intertidal/coastal zone are minimised and installation and decommissioning phases are coordinated to ensure that disturbance is also reasonably minimised. (Section 2.8, paragraph 2.8.231)	Mitigation measures have been considered during consultation as shown in section 1.3, and included within the assessment. This includes scour/cable protection techniques and cable burial techniques as listed in Table 1.7 whilst the measures adopted as part of the Mona Offshore Wind Project are presented in Table 1.16. The installation of cables is considered within Volume 1, Chapter 3: Project description of the Environmental Statement and includes the use of trenchless techniques to avoid open-cut trenching through the intertidal zone. Several trenchless techniques are considered within Volume 1, Chapter 3: Project description of the Environmental Statement. Cable protection is assessed within the CEA, however, there is a commitment that no cable protection is to be placed on the seabed within the intertidal zone, as described in the project design (see Volume 1, Chapter 3: Project description of the Environmental Statement).

Table 1.2: Summary of NPS EN-1 and NPS EN-3 policy on decision making relevant to physical processes.

Summary of NPS EN-1 and EN-3 policy	How and where considered in the Environmental Statement
NPS EN-1	
The Secretary of State should be satisfied that the proposed development will be resilient to coastal erosion and deposition, taking account of climate change, during the project's operational life and any decommissioning period. (Section 5.6 paragraph 5.6.16)	Details of the project design criteria are detailed in Volume 1, Chapter 3: Project description of the Environmental Statement, whilst climate change is discussed in section 1.5.3. Project- wide aspects of climate change are presented in Volume 4, Chapter 2: Climate change of the Environmental Statement.
The Secretary of State should not normally consent new development in areas of dynamic shorelines where the proposal could inhibit sediment flow or have an adverse impact on coastal processes at other locations. Impacts on coastal processes must be managed to minimise adverse impacts on other parts of the coast. Where such proposals are brought forward consent should only be granted where the Secretary of State is	Assessment of sediment dynamics undertaken using the hydrodynamic and spectral wave modelling, together with an understanding of the sediment regime. Refer to Volume 6, Annex 1.1: Physical processes technical report of the Environmental Statement. Predicted changes to the tidal current, wave climate, littoral currents and sediment transport are assessed in Volume 6,

Summary of NPS EN-1 and EN-3 policy	How and where considered in the Environmental Statement
satisfied that the benefits (including need) of the development outweigh the adverse impacts. (Section 5.6 paragraph 5.6.17)	Annex 1.1: Physical processes technical report of the Environmental Statement. Potential impacts have also been identified and the significance of the effects on physical processes receptors has been assessed in section 1.9.
The Secretary of State should examine the broader context of coastal protection around the proposed site, and the influence in both directions, i.e coast on site, and site on coast. (Section 5.6 paragraph 5.6.19)	The project design detailed in Volume 1, Chapter 3: Project description of the Environmental Statement takes consideration of the impacts of physical processes on the infrastructure whilst this chapter considers the effect of the Mona Offshore Wind Project on physical processes.
In addition to this NPS the Secretary of State must have regard to the appropriate marine policy documents in taking any decision which relates to the exercise of any function cable of affecting any part of the UK marine area. (Section 5.6 paragraph 5.6.21) The Secretary of State may also have regard to any relevant SMPs. (Section 5.6 paragraph 5.6.22)	Legislative requirements for offshore wind farms are considered within Volume 1, Chapter 2: Policy and legislative context of the Environmental Statement. Details of the relevant SMPs are presented in Table 1.5.
NPS EN-3	
The Secretary of State should be satisfied that activities have been designed considering sensitive subtidal environmental aspects, and discussions with the relevant conservation bodies have taken place. (Section 2.8 paragraph 2.8.317)	Potential impacts have also been identified and the significance of the effects on physical processes receptors has been assessed in section 1.9. Designated sites and features of importance within and surrounding the physical processes study area have been identified in section 1.4.6. Consultation with relevant bodies is summarised in Table 1.6.
Where adverse effects on site integrity/conservation objectives are predicted the Secretary of State should consider the extent to which the effects are temporary or reversible, and the timescales for recovery. The Secretary of State should also consider the extent to which the effects may impede achievement of the MPA target (including any interim target) set under the Environmental Act 2021. (Section 2.8 paragraph 2.8.305)	Potential impacts have also been identified and the significance of the effects on physical processes receptors has been assessed in section 1.9. This includes both the temporal and spatial magnitude of effects. Designated sites and features of importance within and surrounding the physical processes study area have been identified in section 1.4.6 and have been assessed in section 1.9. No effects which are significant in EIA terms were identified, in terms of physical processes.
As set out in paragraphs 2.8.111 of this NPS, the direct effects on the physical environment can have indirect effects on a number of other receptors. (Section 2.8 paragraph 2.8.297) Where indirect effects are predicted, the Secretary of State should refer to relevant sections of the NPS and EN-1. (Section 2.8 paragraph 2.8.308).	Potential impacts have also been identified and the significance of the effects on physical processes receptors has been assessed in section 1.9.
The Secretary of State must be satisfied that the design of the wind farm, offshore transmission and methods of construction, including use of materials, are such as to reasonably minimise the potential for impact on the physical environment. This could involve, for instance, the exclusion of certain foundations because of their impacts or minimising quantities of rock that are used to	The provision of construction material and methods are considered within Volume 1, Chapter 3: Project description of the Environmental Statement. Best practice techniques will be employed to ensure sediment mobilisation is minimised.

Summary of NPS EN-1 and EN-3 policy	How and where considered in the Environmental Statement
protect cables whilst taking into account other relevant considerations such as safety. (Section 2.8 paragraph 2.8.299)	

1.2.4 Welsh National Marine Plan

1.2.4.1 The physical processes impact assessment has been made with consideration to the specific policies set out in the Welsh National Marine Plan (Welsh Government, 2019). Key provisions are set out in Table 1.3 along with details as how to these have been addressed within the assessment.

Table 1.3: Welsh National Marine Plan policies of relevance to physical processes.

Policy	Key provisions	How and where considered in the Environmental Statement
ENV_01	Proposals should demonstrate how potential impacts on marine ecosystems have been taken into consideration and should, in order of preference: a. avoid adverse impacts; and/or b. minimise impacts where they cannot be avoided; and/or c. mitigate impacts where they cannot be minimised. If significant adverse impacts cannot be avoided, minimised or mitigated, proposals must present a clear and convincing case for proceeding. Proposals that contribute to the protection, restoration and/or enhancement of marine ecosystems are encouraged.	Designated sites and sites of interest due to geological importance within the physical processes study area have been identified in section 1.4.6 Potential impacts have also been identified and the significance of the effects on physical processes receptors has been assessed in section 1.9. During the design process a range of parameters have been considered and following the mitigation hierarchy to avoid, minimise and mitigate potential impacts measures will be adopted within the context of the projects as detailed in Table 1.16.
ENV_02	Proposals should demonstrate how they: • Avoid adverse impacts on individual MPAs and the coherence of the network as a whole; • Have regard to the measures to manage MPAs; and • Avoid adverse impacts on designated sites that are not part of the MPA network.	Designated sites and sites of interest due to geological importance within the physical processes study area have been identified in section 1.4.6.
SOC_09	Proposals should demonstrate how they: • Avoid significant adverse impacts upon coastal processes; and • Minimise the risk of coastal change and flooding;	The assessment of sediment dynamics presented in section 1.9 was underpinned using the hydrodynamic and spectral wave modelling (Volume 6, Annex 1.1: Physical processes technical report of the Environmental Statement), together with an understanding of the sediment regime detailed in section 1.5.1. Details of the relevant SMPs are presented in Table 1.5.

Policy	Key provisions	How and where considered in the Environmental Statement
	• Proposals that align with the relevant SMP(s) and its policies are encouraged.	
GOV_01	Proposals should demonstrate that they have assessed potential cumulative effects and should, in order of preference: a. Avoid adverse effects; and/or b. Minimise effects where they cannot be avoided; and/or c. Mitigate effects where they cannot be minimised. If significant adverse effects cannot be avoided, minimised or mitigated, proposals must present a clear and convincing case for proceeding. Proposals that contribute to positive cumulative effects are encouraged.	A CEA has been undertaken and is outlined in section 1.10. Potential impacts from the CEA have also been identified and the significance of the effects on physical processes receptors has been assessed in section 1.11.

1.2.5 North West Inshore and North West Offshore Coast Marine Plans

1.2.5.1 The assessment of potential changes to physical processes has also been made with consideration to the specific policies set out in the North West Inshore and North West Offshore Coast Marine Plans (MMO, 2021). Key provisions are set out in Table 1.4 along with details as to how these have been addressed within the assessment.

Table 1.4: North West Inshore and North West Offshore Marine Plan policies of relevant to physical processes.

Policy	Key provisions	How and where considered in the Environmental Statement
NW-CAB-1	Preference should be given to proposals for cable installation where the method of protection is burial. Where burial is not achievable, decisions should take account of protection measures for the cable that may be proposed by the applicant. Where burial or protection measures are not appropriate, proposals should state the case for proceeding without those measures.	Details of the project design criteria are detailed in Volume 1 Chapter 3: Project description of the Environmental Statement. This includes scour/cable protection techniques and cable burial techniques as listed in Table 1.7 whilst the measures adopted as part of the Mona Offshore Wind Project are presented in Table 1.16.
NW-MPA-1	Proposals that may have adverse impacts on the objectives of MPAs must demonstrate that they will, in order of preference: a. Avoid b. Minimise c. Mitigate - adverse impacts, with due regard given to statutory advice on an ecologically coherent network.	Designated sites and features of importance within the physical processes study area have been identified in section 1.4.6. Potential impacts have also been identified and the significance of the effects on physical processes receptors has been assessed in section 1.9.

Policy	Key provisions	How and where considered in the Environmental Statement
NW-MPA-4	Proposals that may have significant adverse impacts on designated geodiversity must demonstrate that they will, in order of preference: a. Avoid b. Minimise c. Mitigate - adverse impacts so they are no longer significant.	Designated sites and sites of interest due to geological importance within the physical processes study area have been identified in section 1.4.6. Potential impacts have also been identified and the significance of the effects on physical processes receptors has been assessed in section 1.9.
NW-BIO-1	Proposals that may have significant adverse impacts on the distribution of priority habitats and priority species must demonstrate that they will, in order of preference: a. Avoid b. Minimise c. Mitigate - adverse impacts so they are no longer significant d. Compensate for significant adverse impacts that cannot be mitigated.	Sites identified as habitat directive annex 1 habitats within the physical processes study area have been identified in section 1.4.6. Potential impacts have also been identified and the significance of the effects on physical processes receptors has been assessed in section 1.9.
NW-CE-1	Proposals which may have adverse cumulative effects with other existing, authorised, or reasonably foreseeable proposals must demonstrate that they will, in order of preference: a. Avoid b. Minimise c. Mitigate - adverse cumulative and/or in-combination effects so they are no longer significant.	A CEA has been undertaken and is outlined in section 1.10. Potential impacts from the CEA have also been identified and the significance of the effects on physical processes receptors has been assessed in section 1.11.
NW-CE-1	Proposals which may have adverse cumulative effects with other existing, authorised, or reasonably foreseeable proposals must demonstrate that they will, in order of preference: a. Avoid b. Minimise c. Mitigate - adverse cumulative and/or in-combination effects so they are no longer significant.	A CEA has been undertaken and is outlined in section 1.10. Potential impacts from the CEA have also been identified and the significance of the effects on physical processes receptors has been assessed in section 1.11.

1.2.6 North West Shoreline Management Plan

1.2.6.1 The assessment of potential changes to physical processes has been made with consideration to the specific policies set out in the North West SMP (Halcrow Group Ltd, 2010). Key provisions are set out in Table 1.5 along with details as to how these have been addressed within the assessment where appropriate.

Table 1.5: Summary of SMP Policies Relevant to Physical Processes.

Policy	Key provisions	How and where considered in the Environmental Statement
Great Ormes Head to Little Ormes Head (11a1)	The SMP recommends a policy of No Active Intervention across a majority of the coastline in the short to long term in order to allow natural processes to continue and support features of designated sites. However, at Llandudno a policy of Hold the Line via beach recharge and defence maintenance is recommended in the short to long term to defend from coastal flood risk.	Impacts associated with changes in Suspended Sediment Concentrations (SSCs) and water quality have no pathway to impact on SMP policies.
Little Ormes Head to Clwyd Estuary (11a2)	The SMP recommends a policy of Hold the Line via maintenance and improvement of defences across the subcell in the short to long term in order to defend against flood risk to the community and infrastructure.	
Clwyd Estuary (11a3)	The SMP recommends a policy of Hold the Line via the maintenance and improvement of defences across the subcell, up to 2030. In the longer term, a policy of Managed Realignment is recommended at Forydd Railway Bridge to Rhuddlan Road Bridge Clwyd Estuary (East and West) in the interests of future habitat creation.	
Clwyd Estuary to Point of Ayr (11a4)	The SMP recommends a policy of Hold the Line via the maintenance and improvement of defences across a majority of the subcell. However, a provision of Managed Realignment is made for Barkby Beach to Point of Ayr, to allow natural processes to govern movement of the present dune system.	

1.3 Consultation

1.3.1 Evidence Plan

1.3.1.1 A summary of the key issues raised during consultation activities undertaken to date specific to physical processes is presented in Table 1.6 below, together with how these issues have been considered in the production of the chapter.

1.3.1.2 The purpose of the Evidence Plan process is to agree the information the Mona Offshore Wind Project needs to supply to the Secretary of State, as part of a DCO application for the Mona Offshore Wind Project. The Evidence Plan seeks to ensure compliance with the HRA and EIA. The development and monitoring of the Evidence Plan and its subsequent progress is being undertaken by the Steering Group. The Steering Group comprises the Planning Inspectorate, the Applicant, NRW, Natural England, the Joint Nature Conservation Committee (JNCC) and the MMO as the key regulatory bodies and SNCBs. To inform the EIA and HRA process during the pre-application stage of the Mona Offshore Wind Project, EWGs were also set up to discuss and agree topic specific issues with the relevant stakeholders.

Table 1.6: Summary of key consultation issues raised during consultation activities undertaken for the Mona Offshore Wind Project relevant to physical processes.

Date	Consultee and type of response	Issues raised	Response to issue raised and/or where considered in this chapter
17 February 2022	Benthic ecology, fish and shellfish and physical processes EWG Attendees: Natural England, MMO, JNCC, Environment Agency, NRW, Centre for Environment Fisheries and Aquaculture Science (Cefas)	An overview of the physical processes modelling and assessment strategy was presented. This included data requirements and sources, model development, calibration and application. The available project specific surveys and datasets were also presented. The need to consider stratification was noted with additional reference material provided by NRW post meeting. No issues significant issues or concerns were raised.	
17 February 2022	NRW: Benthic ecology, fish and shellfish and physical processes EWG	Has there been a gap analysis done for characterisation of bathymetry and sandwave fields in the area?	Bathymetry data has been sourced from a number of resources as detailed in Table 1.9 and project specific datasets as detailed in Table 1.10 with seabed features illustrated in Figure 1.9. Further detail is provided in Volume 6, Annex 1.1: Physical processes technical report of the Environmental Statement.
17 February 2022	NRW: Benthic ecology, fish and shellfish and physical processes EWG	Will the model be high resolution (i.e. capable of modelling cable and scour protection)?	The model will have high enough resolution to account for cable and scour protection as detailed in Volume 6, Annex 1.1: Physical processes technical report of the Environmental Statement.
17 February 2022	NRW: Benthic ecology, fish and shellfish and physical processes EWG	What model are you using? Will the model be 2D or 3D? Would the model be updated to be 3D if impacts extended into the Dee Estuary?	The study was undertaken in 2D, as anticipated impacts have been quantified as localised and of negligible magnitude therefore further detailed modelling was not necessary. The MIKE modelling software utilised is described in Volume 6, Annex 1.1: Physical processes technical report of the Environmental Statement.
May 2022	NRW: Scoping opinion	Suggested that seabed levelling; potential of dredge and disposal activities; removal of sediment through seabed clearance; secondary scour; and impacts to sediment transport and sediment pathways at the export cable	Seabed levelling, dredging, disposal activities and seabed clearance is included within the assessment presented in section 1.9 as defined by the project description outlined in Volume 1, Chapter 3: Project description of the Environmental Statement.

Date	Consultee and type of response	Issues raised	Response to issue raised and/or where considered in this chapter
		landfall, are scoped into the project assessment. NRW advised that impacts on Habitats Directive Annex 1 habitats outside of protected sites should be considered as far as reasonably possible. In addition, NRW strongly encouraged the use of HDD where feasible, to minimise the environmental impact of trenching on conservation features.	Development and adherence to an Offshore CMS will include details of scour protection management to be used around offshore structures and foundations to reduce scour. The scour protection measures will be subject to engineering design to ensure they minimise as much as practical the occurrence of scour and therefore any impacts would relate only to residual/secondary scour as discussed in section 1.9.5. Both designated sites and Annex 1 habitats outside of designated sites, such as Constable Bank, have been identified and considered in the assessment of physical processes, as listed in Table 1.11. The use of trenchless techniques at the landfall between MHWS and MLWS means that there will be no open-cut trenching in the intertidal area, and no cable protection in the intertidal area, as detailed in Volume 1, Chapter 3: Project description of the Environmental Statement.
May 2022	NRW: Scoping opinion	Require more information about the nature and extent of the ground preparation and the potential impact from dredging and disposal at an appointed dredge disposal site.	Seabed preparation such as sandwave clearance will involve movement of material within close proximity to the installation of the project infrastructure, as detailed in Volume 1, Chapter 3: Project description of the Environmental Statement. No material will be disposed of beyond the Mona Array Area or Mona Cable Corridor and Access Areas.
May 2022	NRW: Scoping opinion	NRW do not agree that temperature effects from cabling, or contaminated sediments should be scoped out of the project assessment.	These aspects will be covered under water quality within Volume 6: Annex 2.2: Water Framework Directive coastal waters assessment of the Environmental Statement with the support of the physical processes assessment as appropriate.
May 2022	NRW: Scoping opinion	Seek clarification on what was used to define one tidal excursion for the Zone of Influence (ZOI) that defined the study boundary for physical processes.	The physical processes study area has been defined by the application of calibrated numerical models, the detail of which is provided in Volume 6, Annex 1.1: Physical processes technical report of the Environmental Statement. It is defined as one spring tidal excursion which is the distance suspended sediment is transported prior to being carried back on the returning tide. Further information is provided in section 1.4.4.

Date	Consultee and type of response	Issues raised	Response to issue raised and/or where considered in this chapter
May 2022	NRW: Scoping opinion	Assessment of the scales and magnitudes of processes controlling sediment transport rates and pathways. Clarification as to whether there are any mobile or stable sand wave features present within the area.	Previous experience in offshore wind developments has indicated that changes in physical processes are generally limited in magnitude and spatial extent. For the purposes of identifying significant impacts a comparative study has been undertaken assessing potential changes in physical process drivers (i.e. tidal currents and waves). No significant effects were identified, as summarised in Table 1.19, therefore further studies were not required and reference was made to published characteristics (i.e. Brooks *et al*., 2018) and noted sensitivities.
May 2022	NRW: Scoping opinion	Include a map showing the location of the metocean buoys. To better understand the current flood and ebb tide patterns. It would also be useful if tidal stream current vectors are produced to describe the baseline hydrodynamics for the Mona study area using the numerical model proposed and using up to date high resolution bathymetric coverage.	This location of the metocean buoys is provided within the Volume 6, Annex 1.1: Physical processes technical report of the Environmental Statement, Figure 1.8. The supporting study detailed within this document also simulates the tidal flow field, calibrated to field data and presents flow patterns during both ebb and flood tides.
May 2022	NRW: Scoping opinion	NRW advise that a thorough baseline understanding is required to inform any potential impacts to the seabed morphodynamics, and the sediment transport processes caused by the project activities offshore, nearshore and across the intertidal. Particular reference is made to Constable Bank, which is an Annex 1 habitat that supports a wide range of species upon which the conservation objectives of a SAC may be based, all of which can be sensitive to disturbance and changes in morphology.	A representative sediment map derived from seabed classification and sediment data from the British Geological Survey (BGS) was implemented in the modelling to illustrate transport patterns. A comparative study was then undertaken to quantify the impact of wind turbine structures and scour protection on these routes as detailed in Volume 6, Annex 1.1: Physical processes technical report of the Environmental Statement. Seabed material disturbed in the process of seabed preparation will not be removed from the sediment cell. Sandwave clearance will involve relocation of material from sand wave crests with graded slopes (along pathway). Therefore, reducing the amount of levelling required, maintaining sediment source and minimising bathymetric changes. No cable protection will be installed within Constable Bank (as noted in Table 1.16).
May 2022	NRW: Scoping opinion	NRW advise that seabed levelling is scoped in for both the construction and operational phase and for both Generation and Transmission Assets.	Supporting studies include the dredging and fate of material mobilised in sandwave clearance operations undertaken during the construction phase of the project, with no seabed levelling being undertaken during the operational phase. Secondary impacts

Date	Consultee and type of response	Issues raised	Response to issue raised and/or where considered in this chapter
			due to seabed preparation are not included in the modelling (i.e. with post seabed preparation bathymetry prior to the installation of the infrastructure) for two reasons, principally because in areas of active sediment transport this is a temporary condition and sandwaves will recover, and secondly the precise location of preparation activities would be determined during detailed design stages and micro-siting. The Habitats Directive Annex 1 habitats outside of protected sites are considered where relevant to physical processes in Table 1.11.
May 2022	NRW: Scoping opinion	NRW seek further clarification on which methods will be employed to quantitatively determine the depth of secondary scour that may arise around the cable protection on the seabed.	Cable protection, particularly in the Mona Array Area and at cable crossings, is included within the supporting studies and impacts on physical processes is included in Volume 6, Annex 1.1: Physical processes technical report of the Environmental Statement. There is a commitment to provide scour protection around offshore structures and foundations to reduce scour, as outlined in Table 1.16. The scour protection measures will be subject to engineering design to ensure they minimise as much as practical the occurrence of scour and therefore any impacts would relate only to residual/secondary scour which would be very localised and of negligible magnitude as discussed in section 1.9.5.
May 2022	NRW: Scoping opinion	Impacts to sediment transport and sediment pathways at the export cable landfall. The cable and/or cable protection measures may not only disturb or disrupt the intertidal sediment transport at the seabed through blockage effects, but cable protection on the seabed will also reduce the water depth locally, and whether located in the nearshore or intertidal can potentially alter the hydrodynamics (wave approach and currents) and sediment transport, with potential for associated morphological impacts.	In line with best practice cable burial depths are such that beach levels are maintained as detailed in Volume 1, Chapter 3: Project description of the Environmental Statement. Cable installation in the intertidal region will be undertaken using trenchless techniques between MHWS and MLWS. As such no material will be placed above the surface in the intertidal region therefore there will be no disruption to sediment transport pathways or impedance to tidal flow in the intertidal area. There is a commitment that no more than 5% reduction in water depth (referenced to Chart Datum) will occur at any point along the Mona offshore cable corridor without prior written approval from the Licensing Authority in consultation with the Maritime Coastguard Agency (MCA). This will ensure any cable protection is sufficiently low profile to cause minimal

Date	Consultee and type of response	Issues raised	Response to issue raised and/or where considered in this chapter
			changes to wave, tide and sediment transport.
June 2022	Conwy County Borough Council: Scoping opinion	The Environmental Statement should address the impact of the construction, operations and decommissioning phases on coastal defence works, including the proposed Llanddulas to Kinmel Bay coastal defence scheme.	A cumulative impact assessment is undertaken for physical process with screening for all relevant projects in section 1.10.2.
June 2022	JNCC: Scoping opinion	Overall JNCC agree with the potential impacts that will be scoped in and will require further assessment at the EIA stage. However, we would like to highlight that impacts resulting from scour should be considered here.	Scour protection is provided within the project infrastructure. The project description, Volume 1, Chapter 3: Project description of the Environmental Statement, details that the provision made is adequate/proportionate. The physical processes assessment includes provision of scour protection as an integral part of the design.
June 2022	JNCC: Scoping opinion	JNCC are of the opinion that projects which are built and operational and have residual impacts would need to be considered in CEA.	A cumulative impact assessment is undertaken for physical process with screening for all relevant projects in section 1.10.2. This includes operational projects with ongoing impacts such as those related to maintenance activities. In accordance with The Planning Inspectorate advice, where other projects are expected to be completed before construction of the proposed NSIP and the effects of those projects are fully determined, effects arising from them should be considered as part of the baseline and may be considered as part of both the construction and operational assessment.
June 2022	Natural England: Scoping opinion	We advise that there may be additional data available from, Channel Coast Observatory, North West and North Wales SMP, and Environment Agency LiDAR data. Review and include in the Environmental Statement.	These datasets have indeed been used in the supporting study to supplement those cited in the scoping report, outlined in Table 1.9.
June 2022	The Planning Inspectorate: Scoping opinion	The Scoping Report also proposes to scope out impacts from jack-up vessel spud-cans and jack-up vessel footprints on the sedimentary regime. No explicit justification for this conclusion has been provided in the Scoping Report and there is no evidence that additional scour from the depressions would not give rise to significant effects. The Inspectorate therefore does not agree this matter can be scoped out.	The bathymetry and sediment transport parameters are intrinsically linked, and further information is provided to justify scoping out of effects of depression on sediment regime in Table 1.8.Table 1.8
June 2022	The Planning Inspectorate: Scoping opinion	The Environmental Statement should assess any likely significant secondary effects that this may have on changes to the current/flow regime, wave regime and sediment transport regime and any	Supporting studies, Volume 6, Annex 1.1: Physical processes technical report of the Environmental Statement, include the dredging and fate of material mobilised in sandwave clearance. The

Date	Consultee and type of response	Issues raised	Response to issue raised and/or where considered in this chapter
		morphological changes. Impacts from dredging and disposal of material should also be assessed, where significant effects are likely to occur.	impact assessment presented in section 1.9 and summarised in Table 1.19 found no significant impacts. Furthermore, secondary impacts due to seabed preparation are not currently included in the modelling post construction bathymetry for two reasons, firstly in areas of active sediment transport this is a temporary condition and sandwaves will recover, and secondly the uncertainty on scale and location of preparation activities. Sandwaves will recover quickly because it is a dynamic environment.
29 November 2022	Benthic ecology, fish and shellfish and physical processes EWG Attendees: MMO, Natural England, JNCC, NRW, Cefas, Isle of Man	The physical processes study objectives and approach were presented. Baseline modelling of tides, waves and sediment transport was shown, along with preliminary modelling output. A discussion included potential use of cable protection. It was noted that the parameters included within the PEIR did not consider engineering considerations which were included within the modelling. These considerations have been included within this assessment and form some of the measures adopted as part of the Mona Offshore Wind Project, as outlined in section 1.8. This includes that there will be no more than a 5% reduction in water depth (referenced to Chart Datum) at any point along the Mona offshore cable corridor without prior written approval from the Licensing Authority in consultation with the MCA. No additional significant issues or concerns were raised.	
June 2023	NRW: S42 response	The design and installation of the cable to landfall should take account of the natural envelope of beach profile change and the future erosion of the backshore. It is fundamental that the depth of installation across the intertidal is sufficient to minimise any future risk of exposure over the life of the wind farm due to short-term beach draw-down during storms or long-term beach erosion.	In line with best practice cable burial depths the risk of cable exposure is minimised as detailed in Volume 1, Chapter 3: Project description of the Environmental Statement. There is a commitment to development and adherence to a Landfall Method Statement which commits to the installation of Mona export cables via trenchless techniques under the intertidal area from below MLWS, where the exit pits will be located, to onshore.
June 2023	NRW: S42 response	NRW advise that the seabed morphological features either side of the cable corridor and in the nearshore zone are mapped and presented. It is important to understand the migratory routes of the sand wave systems, which will define the net direction of sediment transport.	A review of sandwave features and migration is presented for Constable Bank, the shallow water regions to the south of the Bank and in the nearshore area as detailed in section 1.5.1.
June 2023	NRW: S42 response	NRW are concerned by the large extent of sand wave clearance (33,072,196 m^3) required to install the cables and infrastructure at the array site and install cable along the export cable corridor to landfall. NRW note that the seabed will be flattened (i.e. sand wave lowered and sediment deposited in an adjacent trough). Whilst we appreciate that the sand will remain locally within the same	Project refinement has been undertaken; corridor widths have been refined and the volumes of sandwave clearance have been significantly reduced, as detailed in Table 1.15. It should be clarified that sandwaves will not be flattened; sand waves will be reduced in height in order to allow passage of the burial tool to enable cable burial to a sufficient target depth. Material will be

Date	Consultee and type of response	Issues raised	Response to issue raised and/or where considered in this chapter
		sediment cell, we are concerned that the seabed morphology will not be able to recover and regenerate its migratory pattern of bedload sediment transport for many years.	sidecast in the vicinity of the sandwave therefore making this material readily available for redistribution and sandwave recovery.
June 2023	NRW: S42 response	NRW strongly advise that cable protection measures are minimised as much as possible. It is not clear from the PEIR where the cable protection will be required. Once the locations are known, an assessment should be carried out to determine how the cable protection will affect the bed load sediment transport processes. This is of particular importance if located on Annex 1 sand bank systems in nearshore.	Cable protection will only be used where sufficient trenching depths cannot be achieved and is detailed in section 1.7.1 and assessed in section 1.9. Project commitments, presented in Table 1.16, outline that no cable protection will be installed within Constable Bank whilst no cable protection higher than 70 cm will be installed within in the Menai Strait and Conwy Bay SAC. Additionally, the percentage of export cable requiring cable protection will not exceed 10% of the total length of the export cable within the Conwy Bay and Menai Straits SAC. No more than 5% reduction in water depth (referenced to Chart Datum) will occur at any point along the Mona offshore cable corridor without prior written approval from the Licensing Authority in consultation with the MCA. This will ensure any cable protection is sufficiently low profile to cause minimal changes to wave, tide and sediment transport.
June 2023	NRW: S42 response	Cable installation to landfall HDD – no assessment has been carried out to determine the impacts caused by the HDD option for cable connection to landfall. There is the potential for bentonite clay to be released and advected from the drilling location potentially much further than the coarser intertidal seabed sediments. Exit pits located in the intertidal may also require cable protection, which could then interrupt the longshore sediment transport processes and reduce the sediment supply down coast, potentially leading to coastal erosion.	The volume of bentonite release for the cable installation using trenchless techniques punch out will be controlled and will be limited depending on the method adopted for conduit insertion. This controlled Bentonite release will only occur during the punch out for each drill shot, so this is limited to four occasions, one per drill shot, and over a short duration with an indicative period of up to 12 hours per location. Volumes released are far smaller than other operations – noting that modelled nearshore releases all included at least 10% silt, therefore dispersion and fate of material may be inferred from these modelled scenarios for the assessment presented in section 1.9.2. There is a commitment that no cable protection will be placed on the seabed in the intertidal zone with trenchless techniques being undertaken between MHWS and MLWS as noted in Table 1.16.
June 2023	NRW: S42 response	Secondary Scour – no consideration has been given to the potential for	There is a commitment to provide scour protection around offshore structures

Date	Consultee and type of response	Issues raised	Response to issue raised and/or where considered in this chapter
		secondary scour to arise around the scour and cable protection during the 35 year operational phase of the wind farm.	and foundations to reduce scour, as outlined in Table 1.16. The scour protection measures will be subject to engineering design to ensure they minimise as much as practical the occurrence of scour and therefore any impacts would relate only to residual/secondary scour which would be very localised and of negligible magnitude, as discussed in section 1.9.5.
June 2023	NRW: S42 response	NRW request confirmation that there is sufficient bathymetry baseline data to characterise the nearshore zone and North Wales coast where the cable is proposed to make landfall.	The bathymetry data coverage is presented in Volume 6, Annex 1.1: Physical processes technical report of the Environmental Statement. In addition to site specific surveys undertaken within the cable corridor, shown in Figure 1.3, the assessment includes coverage up to the shoreline with data from Marine Environmental Data Information Network (MEDIN), (Marine Environmental Data Information Network, 2021) and further data was sourced from the Department for Environment Food and Rural Affairs (Defra) Survey Data Download site (Department for Environment Food and Rural Affairs, 2022). Locations of additional sediment sample data collected as part of the project is also presented in Figure 1.10.
June 2023	NRW: S42 response	It would benefit baseline understanding of the sediment transport processes, if the residual current vectors were overlain with a high-resolution bathymetric map showing sand wave fields, sand bank systems, rock reefs etc. Rate and direction of sand wave migration is also important in understanding the seabed morphodynamics for the study area. Furthermore, it is not clear from the model outputs that the region is a sediment sink. This assumption requires further evidence and explanation.	Additional baseline information is presented in section 1.5.1.
June 2023	NRW: S42 response	Sediment transport, in order to fully understand the bed load sediment transport processes coupled with waves, the residual currents approaching from the North-West, North and East for 1:1 and 1:20 year events should be presented to determine whether there is a reversal in sediment transport during extreme storm events.	The baseline data presented in section 1.5.1 provides an overview of prevailing conditions. Assessment of potential impacts on sediment transport processes, detailed in section 1.9 , indicated no significant impacts therefore further investigation was not required. In terms of interruption of existing sediment transport regimes cable protection will only be used where sufficient trenching depths cannot be achieved. Project commitments, presented in Table 1.16, outline that no cable protection is

Date	Consultee and type of response	Issues raised	Response to issue raised and/or where considered in this chapter
			required within Constable Bank whilst within Menai Strait and Conwy Bay SAC and nearshore areas cable protection will cause no more than a 5% reduction in water depth (referenced Chart Datum) at any point along the Mona offshore cable corridor without prior written approval from the Licensing Authority in consultation with the MCA. This will ensure any cable protection is sufficiently low profile to cause minimal changes to wave, tide and sediment transport.
June 2023	NRW: S42 response	We recommend that a scale-bar is added to all modelled simulation outputs. Furthermore, to aid in the assessment of physical processes impacts on sensitive sites, NRW advise that designated SACs and Annex 1 habitats such as Constable Bank are overlaid on the model simulation map outputs.	The modelled output presented in Volume 6, Annex 1.1: Physical processes technical report of the Environmental Statement includes scale bars and the applicable designated areas to aid in the interpretation of findings.
June 2023	NRW: S42 response	Nothing has been presented in the PEIR or supporting technical reports to show where the cable protection will be located along the export cable corridor. It is therefore not clear that the hydrodynamic simulations accurately predict the total change that could arise along the cable corridor, particularly if the cable protection is located in shallow water of the nearshore zone where wave impacts will be greater.	The indicative layout used within the modelling study applied cable protection to a height of 3 m in regions where trenching depth may not be achieved. Seabed classification was used to identify these areas (i.e. in the vicinity of moraines). In nearshore areas the use of cable protection will be minimised and influence on physical processes will be reduced as no more than 5% reduction in water depth (referenced to Chart Datum) will occur at any point along the Mona offshore cable corridor without prior written approval from the Licensing Authority in consultation with the MCA, as outlined in Table 1.16. This will ensure any cable protection is sufficiently low profile to cause minimal changes to wave, tide and sediment transport.
June 2023	NRW: S42 response	There is a degree of uncertainty where the cable protection will be placed along the cable corridor and it cannot be assumed at this stage that there will be no cable protection located in the nearshore zone, on the Constable Bank system, in the Menai Strait and Conwy Bay SAC, or across the intertidal, particularly if HDD is the chosen option for cable landfall, which could potentially require exit pits cable protection if located between MHWS and MLWS. As such, until the cable locations are known for certain, NRW cannot agree that the changes to wave climate would be	Cable protection will only be used where sufficient trenching depths cannot be achieved. Project commitments, presented in Table 1.16, outline that no cable protection will be installed within Constable Bank whilst no cable protection higher than 70 cm will be installed within in the Menai Strait and Conwy Bay SAC. Additionally, the percentage of export cable requiring cable protection will not exceed 10% of the total length of the export cable within the Conwy Bay and Menai Straits SAC. No more than 5% reduction in water depth (referenced to Chart Datum) will

Date	Consultee and type of response	Issues raised	Response to issue raised and/or where considered in this chapter
		indiscernible from the baseline wave climate and would not have an impact on the shoreline or nearshore banks.	occur at any point along the Mona offshore cable corridor without prior written approval from the Licensing Authority in consultation with the MCA. This will ensure any cable protection is sufficiently low profile to cause minimal changes to wave, tide and sediment transport. There is also a commitment that no cable protection will be placed on the seabed in the intertidal zone with the installation of Mona export cables via trenchless techniques under the intertidal area from below MLWS, where the exit pits will be located, to onshore as noted in Table 1.16.
June 2023	NRW: S42 response	NRW (A) request confirmation whether the currents generated by the model include wave induced currents (alongshore currents which are generated by wave breaking at an angle to the shore) as well as tide driven currents? The transport of SSC during intertidal trenching and the sediment deposition will be strongly dependent on the wave conditions at the time of trenching in addition to the tidal state (spring or neap, flood or ebb). Please justify why tide only currents are chosen to simulate suspended sediment transport across the intertidal if this is the case.	It is recognised that the dispersion and subsequent deposition may be affected by a range of factors including tidal phase and meteorological conditions. Significant wind and/or wave driven currents have the potential to increase the size of a sediment plume produced by seabed preparation or installation operations. However, these conditions would also inherently decrease SSC and deposition levels as a direct consequence of increased dispersion. It is noted that during adverse weather background turbidity levels would be increased and it is also unlikely that marine based works would be undertaken for operational safety reasons. The modelling of sediment release was therefore undertaken under tide only conditions using a variety of tidal ranges to provide an indication of potential SSC and deposition levels. There is also a commitment that the installation of Mona export cables will be undertaken via trenchless techniques under the intertidal area from below MLWS, where the exit pits will be located, to onshore. There will be no open-cut trenching or placement of cable protection within the intertidal area, as noted in Table 1.16.
June 2023	NRW: S42 response	NRW advise that suspended sediment transport will be driven by the prevailing wind direction and wave activity as well as the flood and ebb tidal excursion. If, for example, the trenching occurred during a northerly wind then the SSC would also be driven towards the coast in the surface waters affected by the wind driven circulation. The modelling is conducted for tide only conditions and	It is recognised that the dispersion and subsequent deposition may be affected by a range of factors including tidal phase and meteorological conditions. Significant wind and/or wave driven currents have the potential to increase the size of a sediment plume produced by seabed preparation or installation operations. However, these conditions would also inherently decrease SSC and

Date	Consultee and type of response	Issues raised	Response to issue raised and/or where considered in this chapter
		does not include the effect of wind driven circulation, which will be important closer to the coast as the water depth shallows and the waves play a more prominent role. NRW recommend revisiting the modelling and including wave effects, particularly from the northwest and North.	deposition levels as a direct consequence of increased dispersion. It is noted that during adverse weather background turbidity levels would be increased and it is also unlikely that marine based works would be undertaken for operational safety reasons. The modelling of sediment release was therefore undertaken under tide only conditions using a variety of tidal ranges to provide an indication of potential SSC and deposition levels. The tidal conditions are described further in section 1.5.1 with tidal ellipses presented in Figure 1.7. This is an approach which is consistent with modelling strategies undertaken for adjacent offshore wind farms which have been through the DCO process, such as Awel y Môr (Awel y Môr, 2022).
June 2023	NRW: S42 response	Impacts to temperature and salinity stratification due to the presence of infrastructure, the assessment of stratification is incorrect as it assumes there is only stratification in estuaries, particularly the Dee estuary. The stratification in Liverpool Bay has been shown to reach as far West from the Mersey and Dee as 4º West, can be semi-diurnal in nature (for example see Simpson *et al*.,(1990)) or can be more enduring in nature (> 1 tidal cycle). As the wind farm structures will be East of 4º West, the wind farm will interact with the stratification. However, the impact is likely to be a positive one, acting to inject further turbulence and break down the stratification.	It is noted that the stratification within the Bay is less marked and more transient that that within the estuaries and the baseline characterisation, and section 1.5.1 has been updated to reflect the information provided.
June 2023	Natural England: S42 response	Natural England notes that many of the thematic areas require additional monitoring, surveys and data analysis prior to submission.	All site specific survey data and data analysis has been taken into account in the Environmental Statement to inform the physical processes assessment. As an example the sediment grading properties applied within the modelling was derived from BGS datasets and included both generalised Folk classification from borehole logs and detailed particle analysis data. This data was verified against Particle Size Analysis (PSA) of sediment samples collected during site specific surveys the analysis of which was provided following completion of the modelling study, illustrated in Figure 1.10.
June 2023	Wildlife Trust Wales: S42 response	It has been observed that suspended particulate matter (SPM) in the wake of OWF infrastructure to be higher than in	Changes in tidal currents and sediment transport as a result of the presence of infrastructure have been quantified in the

Date	Consultee and type of response	Issues raised	Response to issue raised and/or where considered in this chapter
		surrounding waters suggesting increased turbulent mixing and upwelling as a consequence. The impact of which may cause changes in the distribution of heat and salinity, and resuspension of heavily polluted sediments.	modelled output presented in Volume 6, Annex 1.1: Physical processes technical report of the Environmental Statement. Analysis of seabed sediments and contaminant levels is presented in Volume 6, Annex 2.1: Benthic subtidal and intertidal ecology technical report of the Environmental Statement.
11 July 2023	Benthic ecology, fish and shellfish and physical processes EWG Attendees: JNCC, Natural England, NRW, Isle of Man, MMO, Cefas	The S42 consultation responses were summarised. Discussions included clarification of cable installation and protection measures, noting that the parameters presented in the PEIR were maximum values. The modelling encompassed a realistic scenario taking into account engineering considerations. Noting the Applicant has a commitment to minimise cable protection, as detailed in section 1.8. Sandwave clearance was also covered with reference to ongoing design work to refine parameters and which subsequently resulted in a significant reduction in overall clearance volumes and project commitments, as detailed in section 1.8. No additional significant issues or concerns were raised.	
14 August 2023	Technical Note issued to the Benthic ecology, fish and shellfish and physical processes EWG	Technical note detailing the physical processes modelling strategy was issued. It outlined the use of PEIR modelling to support Environmental Statement in view of changes to the project description. The technical note entitled “Physical Processes Environmental Statement Modelling Strategy” is included within the Consultation Report (Document Reference E.3).	No issues were raised with the application of the existing PEIR numerical modelling study as supporting evidence for Environmental Statement.
18 August 2023	NRW meeting: follow up to Technical Note	A follow up meeting was held with NRW to discuss the physical processes Technical Note where the project refinement and commitments on reducing cable protection both within the SAC and in nearshore areas of the export cable route were discussed. It was agreed that no re-modelling would be required provided the PEIR modelling assumptions (i.e. relating to those commitments) are reflected in the revised project description as detailed in the S42 responses.	Further project design, definition and commitments have been made with regards to cable installation methods and on reducing cable protection both within the SAC and in nearshore areas of the export cable route. These are detailed in Table 1.16 and are in line with those engineering considerations included with the modelling study presented in Volume 6, Annex 1.1: Physical processes technical report of the Environmental Statement.
7 December 2023	Benthic ecology, fish and shellfish and physical processes EWG Attendees: Wildlife Trust, JNCC, Natural England, NRW, Isle of Man, MMO, Cefas	The physical processes modelling strategy review was presented. This included clarification of how outstanding Section 42 responses are being addressed. The project refinements and commitments were presented, as detailed in Table 1.16. The potential harvesting of site preparation material for ballast in gravity base foundations was discussed.	
7 December 2023	NRW: Benthic ecology, fish and shellfish and	It was reiterated that the impacts of sandwave clearance on the system should be considered in the assessment	The potential impact of sandwave clearance is discussed in section 1.9.5

Date	Consultee and type of response	Issues raised	Response to issue raised and/or where considered in this chapter
	physical processes EWG	both in terms of recovery and in combination with Morgan Generation Assets. It was stated that secondary scour should be scoped into the assessment. Further information should be provided with respect to the impact of harvesting ballast for gravity foundations. Information should be provided on tidal flow orientation within the Mona Offshore Cable Corridor.	whilst cumulative impacts are presented in section 1.11.5. Secondary scour is discussed and assessed in section 1.9.5 which also includes an assessment of the potential impact of harvesting material for ballast. Tidal ellipses for the Mona Offshore Cable Corridor are presented in Figure 1.7.

1.4 Baseline methodology

1.4.1 Relevant guidance

1.4.1.1 Specific to the physical processes baseline, the following guidance documents have also been considered.

- Guidelines in the use of metocean data through the lifecycle of a marine renewable's development (Cooper *et al.,* 2008)
- Physical processes guidance to inform EIA baseline survey, monitoring and numerical modelling requirements for major development projects with respect to marine, coastal and estuarine environments, GN041, Natural Resources Wales, Marine Programming Planning and Delivery Group (NRW, 2020)
- Guidance on Marine Baseline Ecological Assessments and Monitoring Activities for Offshore Renewable Energy Projects Parts 1 and 2, Department of the Environment, Climate and Communications, (DECC, 2018)
- Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards, Natural England, (Natural England, 2022)
- Nature considerations and environmental best practice for subsea cables in English inshore and UK offshore waters, (Natural England and JNCC, 2022)
- Collaborative Offshore Wind Energy Research into the Environment (COWRIE) - Coastal Process Modelling for Offshore Wind Farm EIA (Lambkin *et al*., 2009)
- Advice to Inform Development of Guidance on Marine, Coastal and Estuarine Physical Processes Numerical Modelling Assessments. NRW Report No 208, 139pp, Natural Resources Wales. (Pye *et al.,* 2017)
- Guidance on Best Practice for Marine and Coastal Physical Processes Baseline Survey and Monitoring Requirements to inform EIA of Major Development Projects, NRW Report No: 243, 119 pp, Natural Resources Wales, Cardiff. (Brooks *et al*., 2018).

1.4.2 Scope of the assessment

1.4.2.1 The scope of the Environmental Statement has been developed in consultation with relevant statutory and non-statutory consultees as detailed in Table 1.7. The potential effects scoped into the physical processes assessment can largely be broken down into two main groups; those related to the installation and maintenance of the infrastructure which are associated with increased SSC and those related to the presence of the infrastructure which are related to changes in physical processes, e.g. tides, waves and sediment transport. During the construction phase the potential changes to physical processes will gradually increase as the site is built out.

1.4.2.2 Taking into account the scoping and consultation process, Table 1.7 summarises the issues considered as part of the assessment.

Table 1.7: Issues considered within this assessment.

Activity	Potential effects scoped into the assessment
Construction phase	
Site preparation and sandwave clearance	Increase in SSC and subsequent deposition
Foundation installation	
Cable installation	
Presence of infrastructure • Wind turbines • Offshore Substation Platforms (OSPs) • Cable protection • Scour protection.	Change to the tidal regime Change to the wave regime Change to sediment transport and sediment transport pathways Change to temperature and salinity stratification
Operations and maintenance phase	
Cable repair and reburial	Increase in SSC and subsequent deposition
Presence of infrastructure • Wind turbines • OSPs • Cable protection • Scour protection.	Change to the tidal regime Change to the wave regime Change to sediment transport and sediment transport pathways Change to temperature and salinity stratification
Decommissioning phase	
Cable removal	Increase in SSC and subsequent deposition
Foundation removal – suction caissons	
Presence of infrastructure • Cable protection • Scour protection.	Change to the tidal regime Change to the wave regime Change to sediment transport and sediment transport pathways Change to temperature and salinity stratification

1.4.2.3 Effects which are not considered likely to be significant have been scoped out of the assessment. A summary of the effects scoped out, together with justification for scoping them out and whether the approach has been agreed with key stakeholders through either scoping or consultation, is presented in Table 1.8.

Table 1.8: Impacts scoped out of the assessment for physical processes.

Potential impact	Justification
Changes to bathymetry due to depressions left by jack-up vessels.	The potential for jack-up vessel feet to affect the sediment regime has been scoped out of the assessment. Jack-up footprint depressions would occur in sandy/loose material as the equipment is installed. The maximum area per foot is 350 m^2 where the vessel may have four to six legs. The penetration range is 3 m to 10 m. On removal the depression would be partially infilled by gravity and then, over time, be infilled by the mobile seabed sediments. The extent of temporary depressions, following completion of jack-up operations, would be limited to the immediate area of the jack-up footprint therefore, short term changes to bathymetry would have negligible impacts on tidal currents and sediment transport regimes. Monitoring at the Barrow offshore wind farm showed depressions were almost entirely infilled 12 months after construction (BOWind, 2008). Although the monitoring study was undertaken during the first year of operation of Barrow Offshore Wind Farm (post construction monitoring initiated July 2006) it included oceanography, seabed morphology (scour etc.) and bathymetry. The wind farm is located in the eastern Irish Sea near Barrow-in Furness and therefore provides relevant, applicable datasets in compliance with regulatory standards.
Changes to sediment transport due to depressions left by jack-up vessels.	Changes to bathymetry and hydrography are intrinsically linked to sediment transport. When jack-up barges are removed the source of scour is also eradicated. The gradual infilling is not anticipated to have significant implications for the sediment regime, due to the small scale and nature. It is also noted that although the impact of jack-up vessels is scoped out of the physical processes assessment it is assessed in terms of benthic ecology in Volume 2, Chapter 2: Benthic subtidal and intertidal ecology of the Environmental Statement.
Scour of seabed sediments during the construction, operations and maintenance phases.	Interaction between the waves and current and the Mona Offshore Wind Project generation infrastructure has the potential to cause localised scouring of seabed sediment. Scour protection will be a measure adopted as part of the project to prevent scour from occurring, as detailed in Table 1.16. The Applicant has committed to development of and adherence to an Offshore CMS which will include details of scour protection management to be used around offshore structures and foundations to reduce scour. Scour protection will be installed at the same time as the infrastructure. The scour protection measures will be subject to engineering design to ensure they minimise as much as practical the occurrence of scour and therefore any impacts would relate only to residual/secondary scour which is considered in section 1.9.5.

1.4.3 Methodology to inform baseline

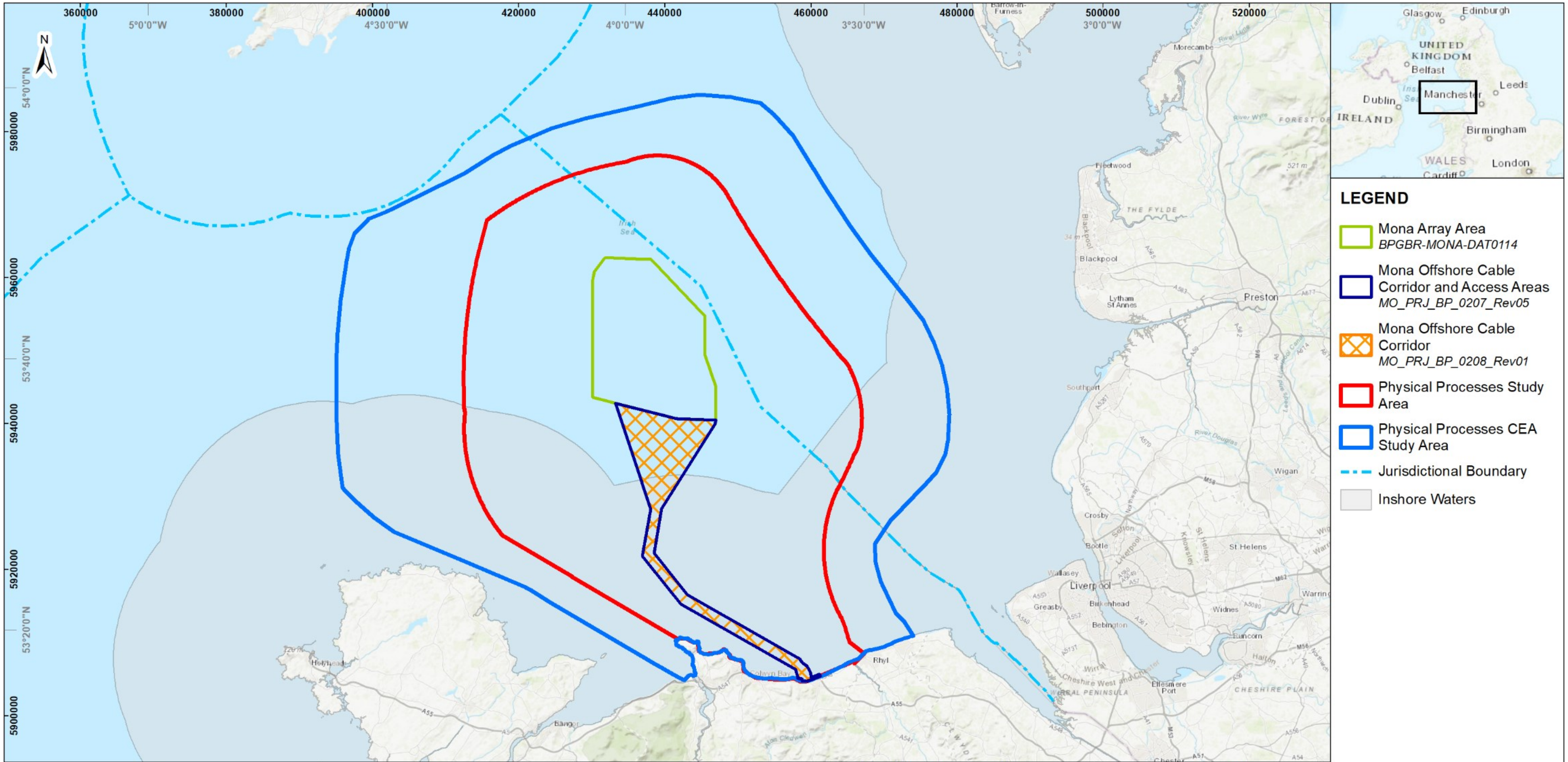
1.4.3.1 The baseline environment was established by undertaking a desktop study utilising existing studies and datasets as described in the following section.

1.4.4 Study area

1.4.4.1 The physical processes study area is illustrated in Figure 1.2 and encompasses the:

- Mona Array Area (i.e. the area within which the wind turbines, foundations, inter-array cables, interconnector cables, offshore export cables and OSPs forming part of the Mona Offshore Wind Project will be located)
- Mona Offshore Cable Corridor and Access Areas (i.e. the corridor located between the Mona Array Area and the landfall up to MHWS, in which the offshore export cables will be located)
- Landfall area
- Seabed and coastal areas that may be influenced by changes to physical processes due to the Mona Offshore Wind Project defined as one spring tidal excursion which is the distance suspended sediment is transported prior to being carried back on the returning tide.

1.4.4.2 It is however noted that the physical processes study area forms the focus for the assessment and that the numerical modelling study undertaken to support the assessment is not limited to this region, as detailed in Volume 6, Annex 1.1: Physical processes technical report of the Environmental Statement. The physical processes modelling study therefore also identifies any potential impacts beyond the physical processes study area. The physical processes study area for the CEA presented in section 1.10 is defined as two spring tidal excursions which represents where study areas for adjacent projects and developments, defined in a similar way, may intersect.



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community	**Data Sources:**	**Geodetic Information:** Datum: ETRS 1989. Projection: ETRS 1989 UTM Zone 30N. Scale@ 271.5mm x 154mm: 1:800,000	0 2.5 5 10 nm; 0 5 10 20 km
Project Name: MONA OFFSHORE WIND PROJECT	**Drawing Title:** Physical Processes Study Area	**Drawing Number:** RPSC-IBE1919-Mona-ES-01	

VER	DATE	DETAILS	BY	CHECK
01	04/08/23	First Issue	R.M	N.S
02	27/09/23	Final ES	R.McK	N.S

Figure 1.2: Physical processes study area and CEA study area.

1.4.5 Desktop study

1.4.5.1 Information on physical processes within the physical processes study area was collected through a detailed desktop review of existing studies and datasets. These are summarised at Table 1.9 below. The baseline was characterised by a combination of literature review of the reports and numerical modelling using the datasets. Full details of the analysis undertaken to develop the physical processes baseline is provided in the Volume 6, Annex 1.1: Physical processes technical report of the Environmental Statement.

Table 1.9: Summary of key desktop reports.

Title	Source	Year	Author
Mona Offshore Wind Project PEIR.	https://www.morganandmona.com/en/	2023	Mona Offshore Wind Limited
Morgan Offshore Wind Project PEIR.	https://morecambeandmorgan.com/morgan/	2023	Morgan Offshore Wind Limited
Geological Ground Model Mona Windfarm Development Irish Sea	Mona Offshore Wind Limited	2023	bp
Assessment of Seabed Level Vertical Variability for Mona Offshore Wind Farm, Morphodynamic Characterisation, Morphological Analysis and Prediction of Future Seabed Levels	Mona Offshore Wind Limited	2023	ABPmer
European Marine Observation and Data Network (EMODnet) – Seabed classification	https://www.emodnet-geology.eu/	2022	EMODnet
EMODnet – Bathymetry data	https://www.emodnet-bathymetry.eu/	2022	EMODnet
EMODnet – Metocean data	https://map.emodnet-physics.eu/	2022	EMODnet
Defra – Bathymetry data	https://environment.data.gov.uk/DefraDataDownload	2022	Defra
The Environment Agency National LiDAR Programme	National LIDAR Programme - data.gov.uk	2022	Environment Agency
National Oceanic and Atmospheric Administration (NOAA) –Atmospheric data	DHI Metocean Data Portal	2022	NOAA
National Network of Regional Coastal Monitoring Programmes	https://coastalmonitoring.org/cco/	2022	Coastal Channel Observatory
Centre for Environment, Fisheries and Aquaculture Science (CEFAS) – wave data	https://wavenet.cefas.co.uk/map	2022	CEFAS
ABPmer Data explorer	https://www.seastates.net/explore-data/	2022	ABPmer
Hydrography of the Irish Sea, SEA6 Technical Report	UK Government	2005	Howarth M.J.
Manx Marine Environmental Assessment: Chapter 2 – Physical Environment	https://www.gov.im/about-the-government/departments/infrastructure/harbours-information/territorial-	2018	Kennington, K. and Hiscott, A.

Title	Source	Year	Author
	seas/manx-marine-environmental-assessment/		Department of Environment, Food and Agriculture: Isle of Man
Atlas of UK Marine Renewable Energy Resources	https://www.renewables-atlas.info/	2022	ABPmer
Geology of the seabed and shallow subsurface: The Irish Sea.	BGS	2015	Mellett *et al.*
BGS – sediment sample data	https://mapapps2.bgs.ac.uk/geoindex_offshore	2022	BGS
Suspended Sediment Climatologies around the UK.	Department for Business, Energy & Industrial Strategy (BEIS)	2016	Cefas
Metocean Data collection for the Ormonde offshore wind project.	Marine Data Exchange	2011	Geotechnical Engineering and Marine Surveys (GEMS)
Irish Sea Zone Hydrodynamic measurement campaign	Marine Data Exchange	2010 to 2013	EMU Ltd (now Fugro Ltd)
Admiralty Tide Tables	United Kingdom Hydrographic Office (UKHO)	2022	UKHO
Marine Environmental Data Information Network (MEDIN) Seabed Mapping Programme	Admiralty Marine Data Portal	2022	MEDIN
Integrated Mapping for the Sustainable Developments of Ireland's Marine Resource (INFOMAR) Seabed Mapping Programme	Geological Survey Ireland (GSI) and Marine Institute	2022	INFOMAR
Long term wind and wave datasets	European Centre for Medium-range Weather Forecast (ECMWF)	2022	ECMWF
UK tide gauge network and database of current observation	British Oceanographic Data Centre (BODC)	2021	BODC
UK Climate Projections (UKCP)	Met Office	2018	Met Office
A user-friendly database of coastal flooding in the UK from 1915-2014	Scientific Data (journal)	2015	Haigh *et al.*
BODC	National Oceanography Centre	various	National Oceanography Centre
Review of aggregate dredging off the Welsh coast	HR Wallingford	2016	HR Wallingford
Designated sites (SPAs and SACs)	JNCC mapping data (https://jncc.gov.uk/mpa-mapper/)	2022	JNCC
Designated sites (SSSIs)	Defra Spatial Data Download	2022	Defra
Designated Ramsar sites	Map (ramsar.org)	2022	Ramsar

1.4.6 Identification of designated sites

1.4.6.1 All designated sites within the physical processes study area and qualifying interest features that could be affected by the construction, operations and maintenance, and decommissioning phases of the Mona Offshore Wind Project were identified using the three-step process described below:

- Step 1: All designated sites of international, national and local importance within the physical processes study area were identified using a number of sources. These sources included JNCC website (https://jncc.gov.uk/mpa-mapper/), the Ramsar website (ramsar.org) and Defra website (https://environment.data.gov.uk/)
- Step 2: Information was compiled on the relevant geomorphological/coastal features for each of these sites
- Step 3: Using the above information and expert judgement, sites were included for further consideration if:
  - A designated site directly overlaps with the Mona Array Area or Mona Offshore Cable Corridor and Access Areas and therefore has the potential to be directly affected by the Mona Offshore Wind Project; or
  - Sites and associated qualifying interests were located within the potential ZOI for impacts associated with the Mona Offshore Wind Project.

1.4.7 Site specific surveys

1.4.7.1 In order to inform this chapter, offshore site-specific surveys were undertaken, and the survey plan was discussed and agreed with NRW, JNCC and Natural England. A summary of the surveys undertaken to inform the physical processes impact assessment is outlined in Table 1.10 below.

Table 1.10: Summary of site-specific survey data.

Title	Extent of survey	Overview of survey	Survey contractor	Date	Reference to further information
Environmental Baseline Surveys and Habitat Assessments	Mona Array Area	Geophysical survey to determine characteristics of seabed sediment, characterise benthic communities (infauna and epifauna) and identification of any environmentally significant habitats (e.g. potential Habitats Directive Annex I and priority marine features). Deployment included multi-beam echo sounder (MBES), digital sound velocity (DSV) sensor, side scan sonar (SSS) system, Sub-Bottom Profiler (SBP) & 2D Ultra High Resolution Seismic (2D UHRS) sensor. Additionally, seabed imagery was collected along with grab samples and cone penetration testing (CPT).	Gardline Ltd	2021	Gardline (2022)

Title	Extent of survey	Overview of survey	Survey contractor	Date	Reference to further information
Geophysical survey	Mona Array Area	Geophysical survey to establish bathymetry, seabed sediment and identify seabed features. Deployment included MBES with multibeam backscatter.	XOCEAN Ltd	2022	XOcean (2022)
Geophysical survey	Mona Offshore Cable Corridor and Access Areas – south section	Geophysical survey to establish bathymetry, seabed sediment and identify seabed features. Deployment included MBES.	Gardline Ltd	2022	Gardline (2022)
Geophysical survey	Mona Offshore Cable Corridor and Access Areas – north section	Geophysical survey to establish bathymetry, seabed sediment and identify seabed features. Deployment included MBES.	XOCEAN Ltd	2022	XOcean (2022)
Metocean survey	Morgan and Mona Array Area	Metocean and FLidar deployments to ascertain wind, wave and tidal currents.	Fugro	2022	Fugro (2022)
Environmental Baseline Surveys and Habitat Assessments	Morgan and Mona Array Areas and Mona Offshore Cable Corridor and Access Areas	Deployment included multi-beam echo sounder (MBES), DSV sensor, SSS-system, SBP & 2D UHRS sensor. Additionally, seabed imagery was collected along with grab samples (Particle Size Analysis PSA)) and CPT.	Gardline Ltd	2022	Ocean Ecology (2023)

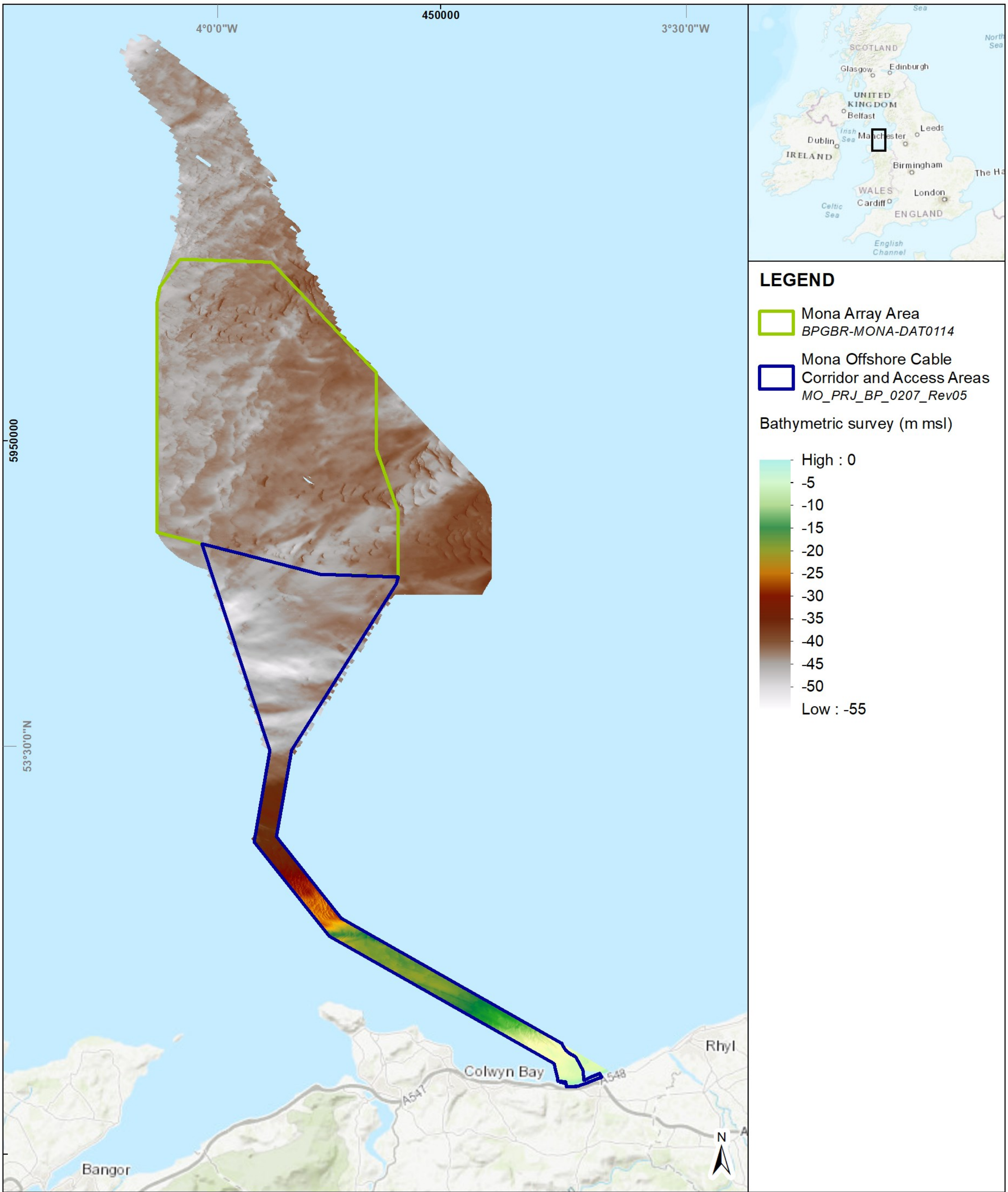
1.5 Baseline environment

1.5.1 Baseline characterisation

1.5.1.1 A summary of the physical processes baseline environment is provided in the following sections. Full details of the analysis undertaken to develop the physical processes baseline for the supporting modelling study is provided in Volume 6, Annex 1.1: Physical processes technical report of the Environmental Statement, which includes information on model development, resolution, calibration, and the modelling techniques implemented to develop the baseline characteristics.

Bathymetry

1.5.1.2 Seabed levels across the Mona Array Area vary from a minimum depth of 36 m below Mean Sea Level (MSL) on the southeast of the Mona Array Area to a maximum depth of circa 53 m below MSL in the north of the Mona Array Area, as illustrated Figure 1.3. The Mona Offshore Cable Corridor has a relatively variable bathymetry ranging from the low water mark to a depth of 53 m below MSL. With shallower depths observed on the east of the Mona Array Area which is closest to the shoreline.



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community	**Data Sources:** Gardline (2022), XOcean (2022)	
Project Name: MONA OFFSHORE WIND PROJECT	0 2.5 5 nm 0 5 10 km	**Drawing Number:** RPSC-IBE1919-Mona-ES02
Drawing Title: Bathymetric Survey Coverage	**Geodetic Information:** Datum: ETRS 1989 Projection: ETRS 1989 UTM Zone 30N Scale@160mmx220mm: 1:450,000	

VER	DATE	DETAILS	BY	CHECK
00	16/08/23	First Issue	R.M	N.S
01	27/09/23	Final ES	R.McK	N.S

Figure 1.3: Mona Offshore Wind Project bathymetric surveys undertaken by Gardline 2022 and XOCEAN 2022.

Constable Bank

1.5.1.3 The Constable Bank is a sandbank of geomorphological and geological importance on the outskirts of Liverpool Bay. Although Constable Bank is not a designated site, it is a site of importance as it is a sandbank which meets the Annex 1 habitat criteria of the EC Habitats Directive highlighted in Table 1.11. The main body of the sandbank is located to the east of the Mona Offshore Cable Corridor and Access Areas as shown in Figure 1.4. The figure presents survey data from 2019-2020, derived from UKHO data portal, overlaid with data collected in 2022 for this project. The 2022 survey was undertaken over the extent of the cable corridor and Access Areas. It indicates that although the Mona Offshore Cable Corridor and Access Areas does not pass through the main body of the bank it crosses the 'tail' of the bank feature to the west. Resembling a storm generated ridge, long and narrow extending to the coast, Constable Bank is the outermost part of the embayment that forms the approach to Liverpool (Kenyon and Cooper, 2005). Constable bank is over 20 km in length and 2 km wide which increases progressively towards the coast, at a height of 10 m. All of the seafloor is covered in sand apart from the west corner where coarser sediment is found (Kenyon and Cooper, 2005).

1.5.1.4 Sandbanks can be highly mobile driven by tides rather than waves and the formation is reliant on the availability of sediment. Active sandwaves were being transported east over a sedimentary layer of basal conglomerate. The Constable Bank is understood to influence the exchange of sediments with the adjacent coastline and the wave climate approaching the coastline (subsequent flood risk).

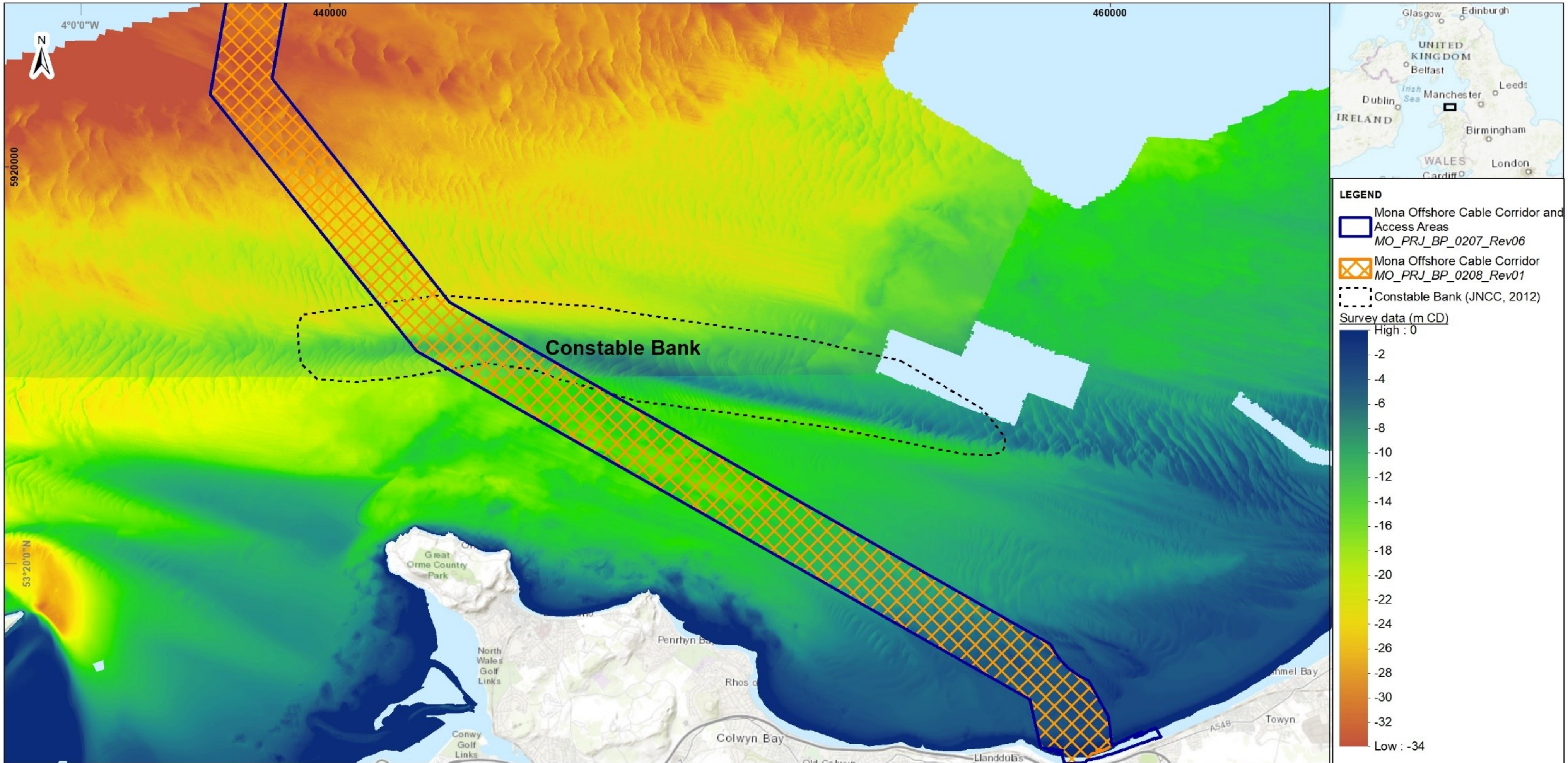
1.5.1.5 Kenyon and Cooper (2005) found that there was an unusual pattern of bedload movement in the same direction on both sides of the bank which would result in the shortening of the bank and eventual disappearance if maintained. However, it is not known whether a change in sand transport occurs at other stages of the tide. If there is no opposing transport path to maintain the sandbank it is estimated that it may not survive more than a few hundred years.

1.5.1.6 As part of the physical processes baseline study a rudimentary assessment was undertaken to investigate the stability of Constable Bank using the available bathymetric data. Three sets of data were available for the assessment:

- Mona Offshore Cable Corridor and Access Areas survey at 1 m resolution, Gardline 2022
- Three surveys from MEDIN at 2 m resolution, data logs indicated data was collected 2019
  - HI1571 Red Wharf Bay to Gwynt y Môr
  - HI1572 Little Ormes Head Hilbre Point
  - HI1573 Point Lynas Little Ormes Head
- A further survey from MEDIN at irregular spacing dated 1987
  - HI357 Skerries to the River Dee.

1.5.1.7 The first comparison was made between the most recent datasets across the intersection of Constable Bank with the Mona Offshore Cable Corridor and Access Areas. Figure 1.5 shows the 2019 data in the background (using a colour palette to accentuate the sandwaves) with the change to 2022 in the corridor area overlaid. The inset figures show regions at the survey boundaries in order that the progress of specific sandwave features may be quantified. The sandwaves, both north and south, appear to have migrated approximately 15 m to the east over the three year period. This corroborates the observations of Kenyon and Cooper (2005).

1.5.1.8 In a similar manner, the changes between 1987 and 2019 were investigated. As previously, Figure 1.6 shows the 2019 dataset in the background and the change from the 1987 data to this point is overlaid, therefore the offset of features due to migration is in the opposite sense. The inset figure shows the comparison through specific sandwave features and, although it is more difficult to compare individual sandwave features, the migration is apparent. The 1987 dataset is sparser, however it is sufficient to indicate that, over this prolonged period, the changes in bed level (both increases and decreases) correlate with the height of the sandwave features. This indicates that although the waves migrate along the bank the underlying bank is stable over this timeframe. This theory is supported by the average change in level over the bank area which is approximately 0 m.



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Data Sources: UKHO Marine Data Portal, XOcean (2022), JNCC

Geodetic Information:
Datum: ETRS 1989. Projection: ETRS 1989 UTM Zone 30N.
Scale@ 271.5mm x 154mm: 1:150,000

Project Name:
MONA OFFSHORE WIND PROJECT

Drawing Title:
Bathymetry of Constable Bank

Drawing Number:
RPSC-IBE1919-Mona-ES03

VER	DATE	DETAILS	BY	CHECK
00	04/08/23	First Issue	RMM	NRS
02	19/12/23	Final ES	NG	KH

Figure 1.4: Location of Constable Bank sandbank in relation to the Mona Offshore Cable Corridor and Access Areas.

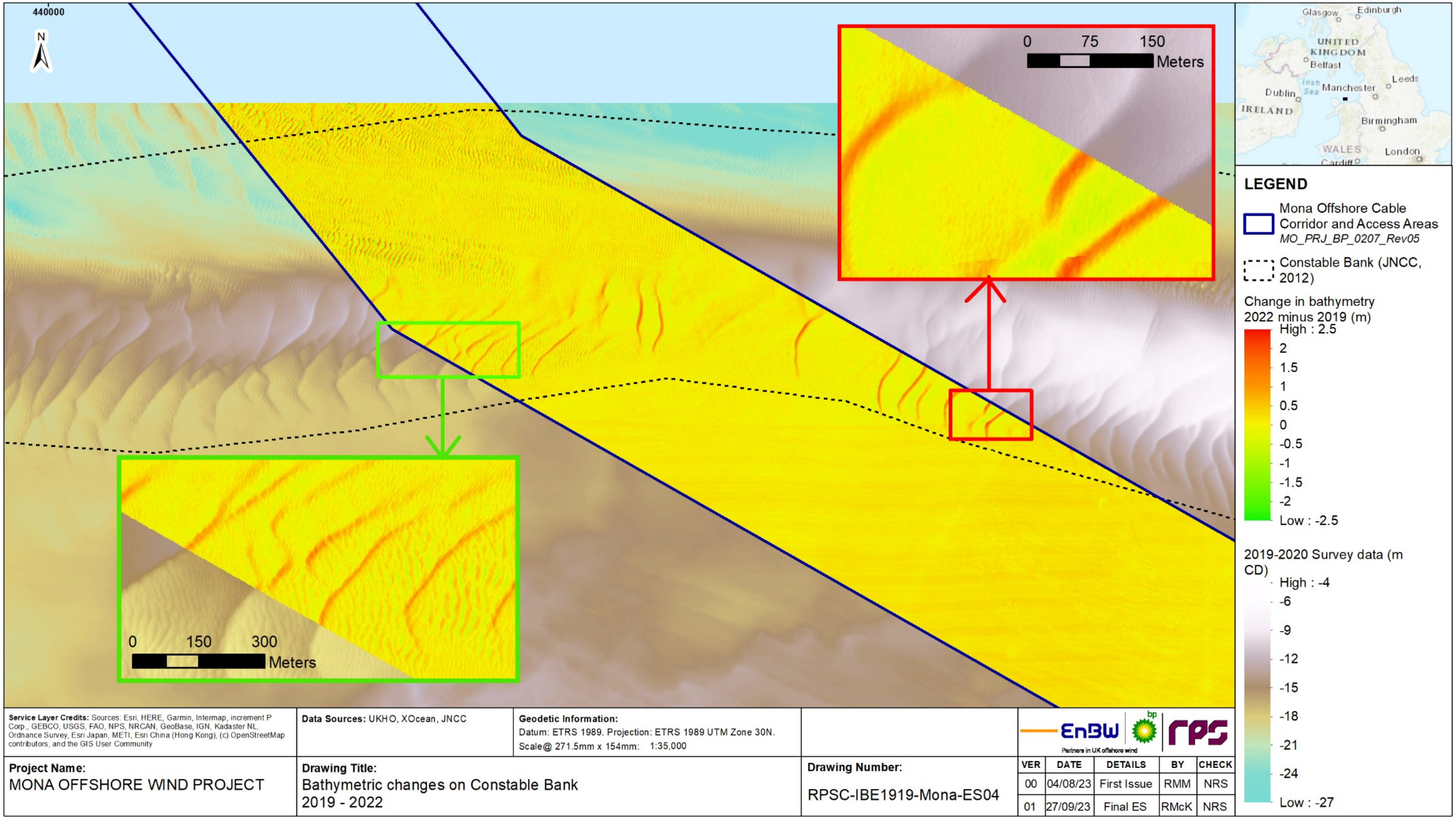


Figure 1.5: Bathymetric changes on Constable Bank 2019 - 2022.

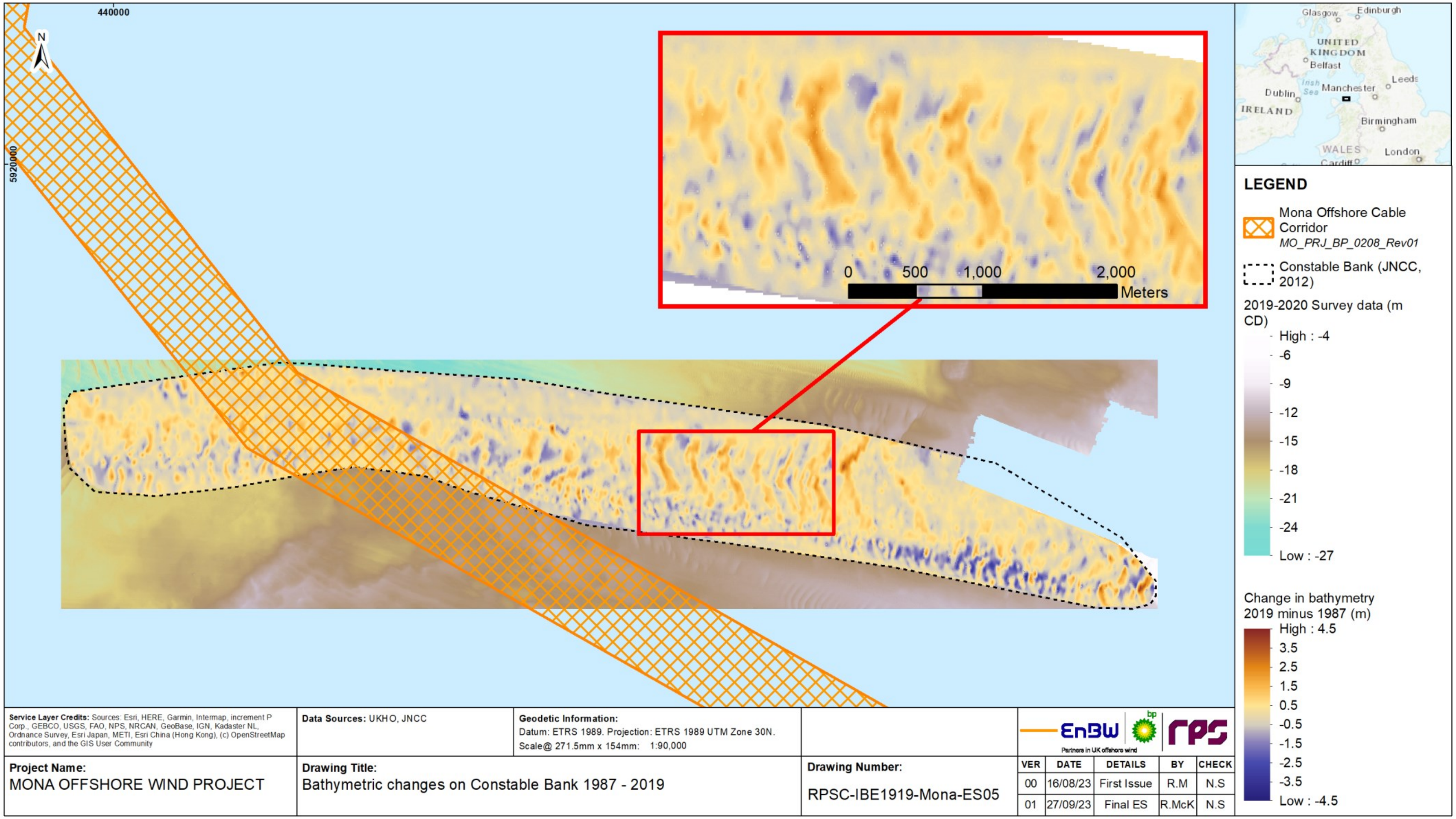


Figure 1.6: Bathymetric changes on Constable Bank 1987 - 2019.

Hydrography

1.5.1.9 The Mona Array Area has an average tidal range of 5.4 m as published by Admiralty (UKHO) at Llandudno. This port is one of a number in the proximity of the study area and was used as a calibration point alongside several other reference points taken across the model domain, as detailed in Volume 6, Annex 1.1: Physical processes technical report of the Environmental Statement.

1.5.1.10 Semi-diurnal tides are the dominant physical process in the Irish Sea coming from the Atlantic Ocean through both the North Channel and St Georges Channel. The tidal range in the Irish Sea is highly variable with a range greater than 10 m on the largest spring tides, the second largest in Britain.

1.5.1.11 Across the Mona Array Area, the tidal current floods to the east and ebbs to the west. The flows are relatively strong during spring tides with tidal current speeds typically between 1.0 m/s and 1.1 m/s during flood and ebb currents between 0.8 m/s and 0.9 m/s. Tidal flow fields for the east Irish Sea are presented in Volume 6, Annex 1.1: Physical processes technical report of the Environmental Statement.

1.5.1.12 The orientation of tidal currents is transformed from an east to west alignment offshore to a southeast to northwest alignment as flows are influenced by the presence of Great Ormes Head within Colwyn Bay. Figure 1.7 shows the tidal excursion along the Mona Offshore Cable Corridor and demonstrates that the tidal ellipse during a spring tide cycle is aligned with the cable trenching route in shallower and nearshore areas within the Colwyn Bay.

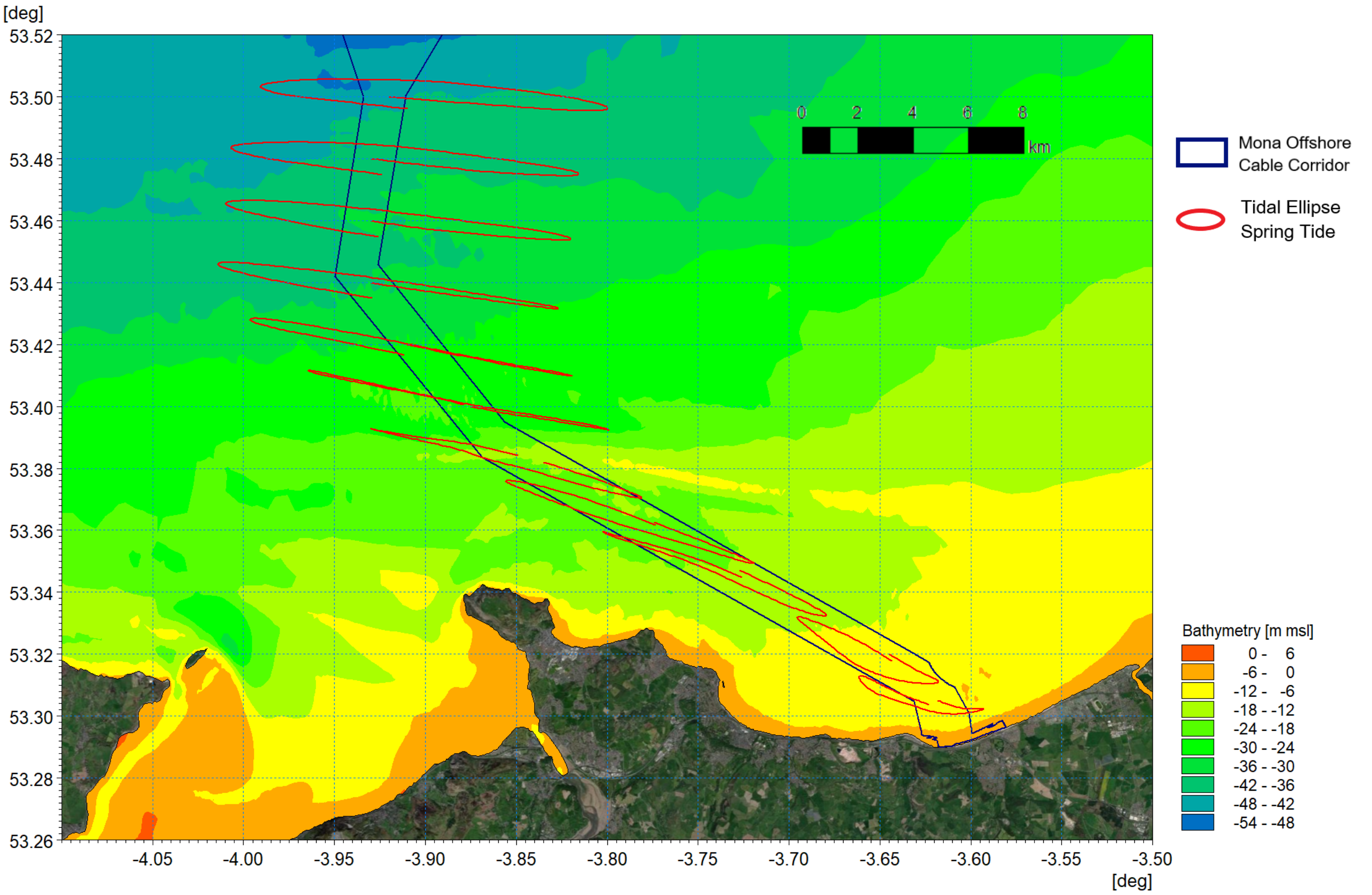


Figure 1.7: Tidal excursion relating to the Mona Offshore Cable Corridor: tidal ellipse spring tide.

Wave climate

1.5.1.13 Characteristic of the east Irish Sea, waves are generated by either local winds or from remote winds (swell waves). At the centre of the Mona Array Area, the largest proportion of waves approach from the westerly sectors, typically combined wind and swell for the Irish Sea. However, a wave field can also develop from the east of the Mona Array Area as there is a sufficient fetch length.

1.5.1.14 The highest mean annual significant wave height of 1.39 m was recorded between the Isle of Man and Anglesey with the significant wave height reducing closer to the coast with a low of 0.73 m recorded to the west of the Dee Estuary (ABPmer, 2008).

1.5.1.15 Within the Mona Offshore Wind Project mean annual wave height ranges from 1.1 m to 1.3 m. Over 40% of waves arise from the southwest and all significant wave heights greater than 4 m originate from the southwest or west, as illustrated in Figure 1.8 (ABPmer, 2018).

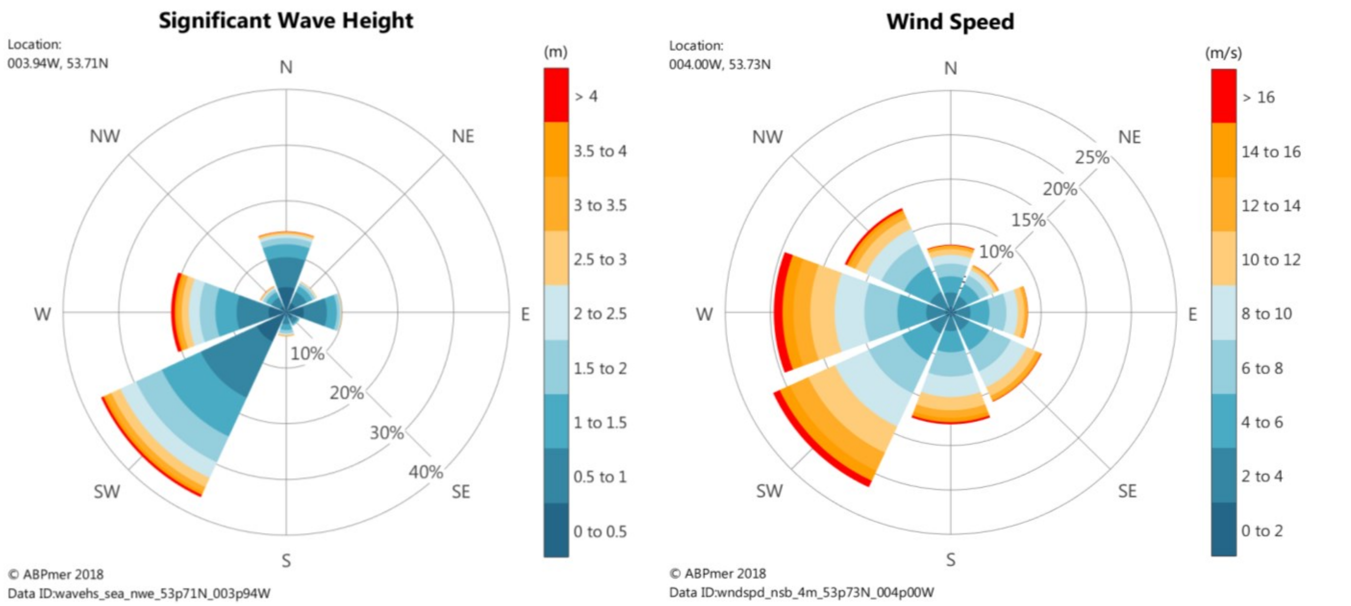


Figure 1.8: Significant wave height (left) and wind speed (right) Mona Array Area.

1.5.1.16 Further detail on the wave climate analysis is provided in Volume 6, Annex 1.1: Physical processes technical report of the Environmental Statement.

Littoral currents

1.5.1.17 Littoral currents are driven by tides, waves, and meteorological events. The littoral currents were modelled from the westerly sector during a 1 in 1 year storm event, resulting in the increase of currents on the peak flood tide to circa 1.1-1.2 m/s and reducing to 0.9-1 m/s during the peak ebb within the Mona Array Area. With the largest and most prevalent waves approaching from the west, these waves cause an increase in currents during the flood tide and a decrease on the ebb tide.

Sedimentology

1.5.1.18 Across the Mona Array Area, the underlying geology consists of bedrock lithologies in the region are Triassic mudstone (Mellett *et al*., 2015). The geophysical features and sediment characteristics are evidenced of the glacial activity in the Celtic Sea, (Van Landeghem *et al*., 2020). Potential weathering during the last glacial period may have weakened the uppermost surface of underlying bedrock (Mellett *et al.,* 2015). Quaternary sediment thickness in the central Irish Sea is <20 m although in short distances this can increase to >100 m due to the presence of glacial valleys. However, in the east and west of the Irish Sea sediment thickness is circa 50 m (Mellett *et al.,* 2015).

1.5.1.19 In the Irish Sea, there is a high variability in the bedforms ranging from very small ripples (5 cm high) to very large sediment waves (>10 m high). The seafloor morphology of the Mona Array Area also includes several distinct features such as sandwaves, megaripples, sediment waveforms and glacial features, as illustrated in Figure 1.9, (XOCEAN, 2022). Seabed substrate within the Mona Array Area ranged from sand, sandy gravel, and gravelly sand which was confirmed with grab sample PSA analysis. The location and principal sediment type at grab samples are shown in Figure 1.10 which corroborated the data provided from the BGS sample data utilised in the modelling study.

1.5.1.20 Across the Mona Array Area, the north section is described as generally flat but locally rugose, however the presence of sandwaves and megaripples was observed on the south section (Gardline, 2022).

1.5.1.21 A detailed analysis was undertaken of the geophysical and geotechnical data collected during the site-specific surveys undertaken for the project (bp, 2023). It concluded that the Mona Array Area is comprised of two regions; a glacial floodplain to the north dominated by sand and a clay dominated area to the south associated with glacial lake deposition where ribbons of mobile bedforms are present. Gravels cobbles and boulders are common, particularly in the north, as anticipated due to the glacial origin of sediment. This is consistent with the Devensian Glacial which has been developed and verified by the BGS as being consistent with the Regional Glacial Model.

1.5.1.22 The Mona Offshore Cable Corridor and Access Areas is dominated by circalittoral course sediments, circalittoral mixed sediments, circalittoral rock and circalittoral sand. To the west of the Mona Offshore Cable Corridor and Access Areas lies Constable Bank; an important sandbank feature. Further towards the North Wales coast and close to the landfall site at Bodelwyddan, the composition of sediment is predominantly fine sand and muddy sand (EMODnet, 2022).

1.5.1.23 A section of the intertidal zone along the proposed landfall location is designated as a SSSI (Traeth Pensarn) of botanical interest for its vegetated shingle beach. The shingle ridges are mostly composed of locally derived Carboniferous Limestone together with a mixture of calcareous sand within the shingle and non-limestone material from the Irish Sea glacial till. Seaward of the shingle bank the intertidal zone is predominantly composed of medium to coarse sand with the presence of parallel sand banks in the nearshore.

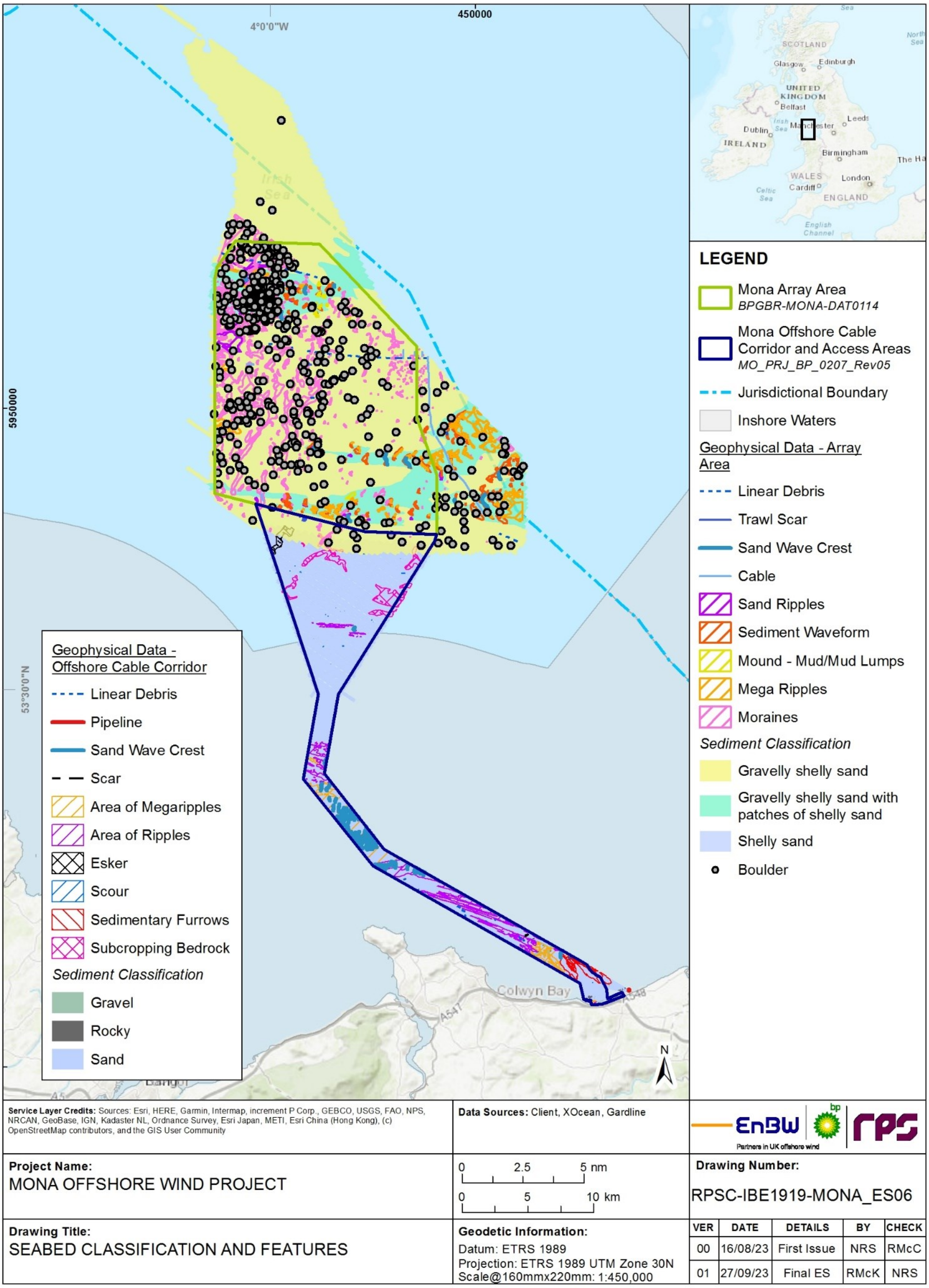
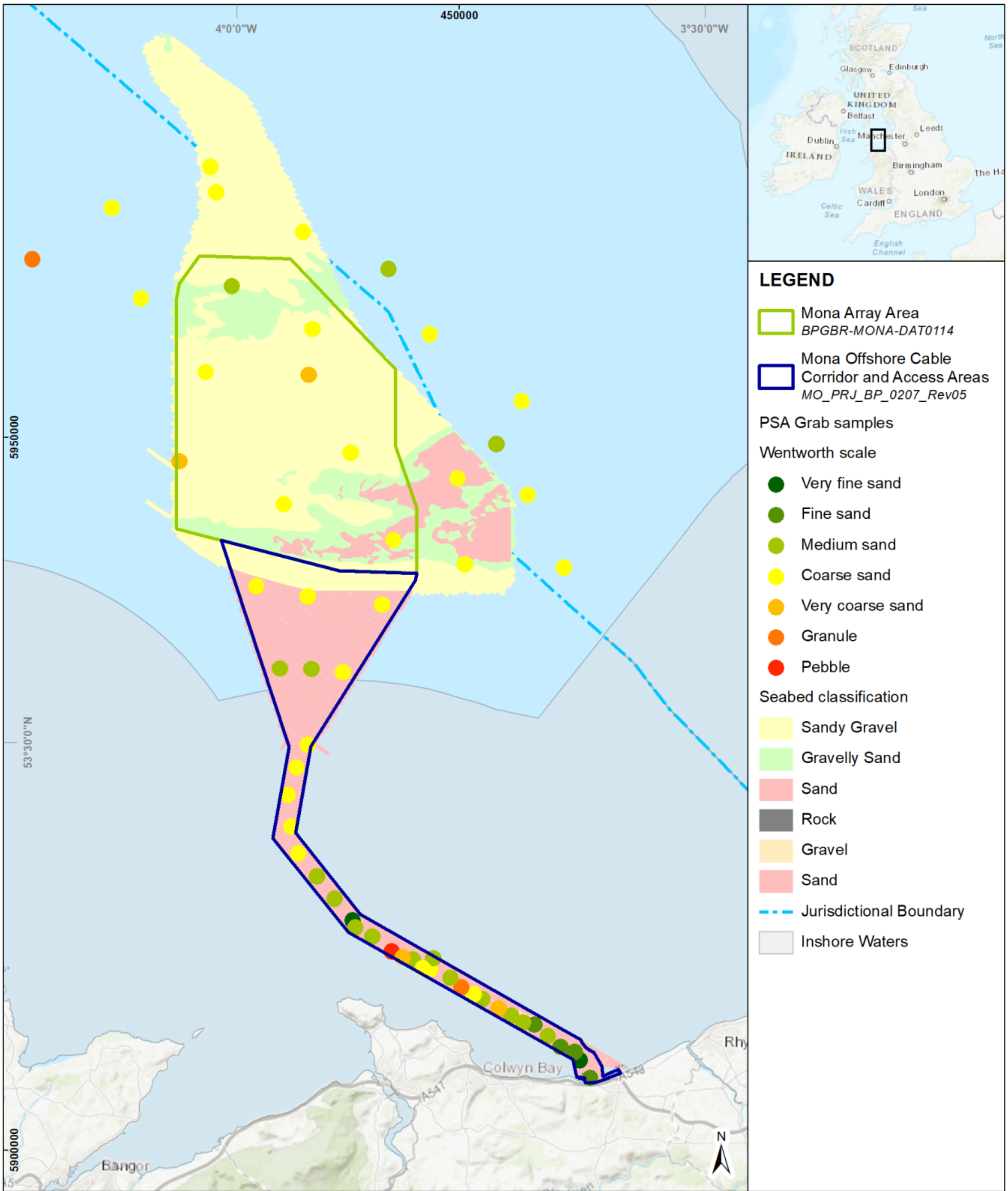


Figure 1.9: Mona Offshore Wind Project sediment classification and seabed features characterised from Gardline Ltd. (2022) and XOCEAN (2022).



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Data Sources: **References for all data shown in the map to be added here**

Project Name:
MONA OFFSHORE WIND PROJECT

0 2.5 5 nm
0 5 10 km

Drawing Number:
RPSC-IBE1919-MONA_ES11

Drawing Title:
SEABED CLASSIFICATION AND PSA SAMPLE LOCATIONS

Geodetic Information:
Datum: ETRS 1989
Projection: ETRS 1989 UTM Zone 30N
Scale@160mmx220mm: 1:450,000

VER	DATE	DETAILS	BY	CHECK
00	16/08/23	First Issue	NRS	RMcC
01	27/09/23	Final ES	RMcK	NRS

Figure 1.10: Mona Offshore Wind Project sediment classification and PSA sample locations by Gardline Ltd. (2022) and XOCEAN (2022).

Stratification

1.5.1.24 In the east Irish Sea, the temperature distribution is dominated by vertical exchanges and the input of heat at the sea surface leading to seasonal cycle resulting in the coolest waters in February to March (Howarth, 2005). Temperature decreases from the deeper channels towards the coast where sea temperature is below 5 °C between the Solway Firth and Liverpool Bay (Howarth, 2005). During the month of August water temperatures close to the coast can exceed 16 °C in Liverpool Bay (Howarth, 2005).

1.5.1.25 There is often a substantial change in salinity travelling from north to south on the east Irish Sea on the west side of Isle of Man (Foster *et al.,* 1985). Seasonal changes in salinity are much less defined than for temperature away from the coast (Howarth, 2005).

1.5.1.26 Across the east side of the Irish Sea region most of the water column becomes thoroughly mixed due to the occurrence of sufficiently intense tidal mixing throughout the year (Howarth, 2005). To the east of Isle of Man marginal stratification occurs during hot, calm conditions yet can be mixed away with easily by storms or spring tides (Howarth, 2005). Stratification of the water column can occur in estuaries and especially in Liverpool Bay and the Dee Estuary as fresh water is lighter than salty water. These conditions are mostly characteristic of neap tides with calm conditions and river discharges (Howarth, 2005). Within the physical processes study area, the difference between the salinity at the bed and surface may reach 1.5 Practical Salinity Unit equivalent to ‰ (PSU) and is generally semidiurnal in nature but may persist for up to three days during neap tides when lower current speeds reduce mixing (Sharples *et al*, 1993).

Sediment transport

1.5.1.27 The physical processes study area largely coincides with Solway Firth sediment cell and sub-cell 11a Great Orme's Head to Southport Pier. In the sub-cell 11a the general direction of sediment transport is west to east. This direction of travel supplies the southeast shoreline with sediment (Price *et al.,* 2010).

1.5.1.28 Within the Mona Array Area, the residual current speeds are several orders of magnitude smaller than those along the coastline. Residual currents are the net flow over a full tidal cycle and drive the sediment transport. Residual current flow into the east Irish Sea from the north of the Isle of Man and west around Anglesey correlates with this region being a sediment sink. In the Mona Array Area, sediment transport rates are highest during springs, peak flood tide with total sediment loads of up to 0.001 m^3/s/m and 0.0005 m^3/s/m on the peak of the ebb tide. Net sediment transport rates are typically 0.2 to 2.0 m^3/d/m within the Mona Array Area. Net sediment transport occurs in an easterly direction with bed load in the order of 20,000 m^3 per day through the Mona Array Area which is *circa* 20 km in width perpendicular to the net migration direction.

1.5.1.29 Modelling undertaken for the Mona Seabed Mobility Study (ABPmer, 2023) examined sediment transport patterns over the course of a spring-neap tidal period and confirmed the findings of the shorter period refined modelling undertaken and presented in Volume 6, Annex 1.1: Physical processes technical report of the Environmental Statement. Typically, net sediment transport occurs in an easterly direction with bed load in the order of 1 m^3/d/m. The Mona Seabed Mobility Study examines the variation of sediment transport patterns over a longer spring-neap tidal period however with a model resolution of 200 to 500 m it would not encompass the variations across individual barchan dunes and megaripples features. The detailed model indicated that localised net transport across these features may be two or three times the magnitude of the surrounding environment.

1.5.1.30 There are strong circulatory currents where tidal flows interact with headlands and embayments. With the greatest sediment transport rates in estuaries and at headlands where finer sand fractions are present and where tidal currents are strongest. The littoral currents and dominant flood tide significantly increase easterly residual currents particularly along the Welsh coastline. Figure 1.11 shows the shallow water bathymetric features and sediment transport pattern during a spring tide, with bolder vectors indicating increased magnitude. This indicates how the nearshore sandwaves and associated sandbanks (such as Constable Bank discussed previously) are supplied with sediment.

1.5.1.31 For example, during a 1 in 1 year storm from south west, currents on the flood tide will be increased with the contribution of wave driven currents and therefore the residual currents (which determine resulting sediment transport) will be increased. The residual currents arising from a 1 in 1 year storm from the south west are shown in Figure 1.12 and indicate increased transport to the east. Similarly, sediment transport would occur in a westerly direction during storms from easterly sectors; however these events are both less frequent and of smaller magnitude, as indicated by the wind and wave rises in Figure 1.8. This provides further evidence that the area is a sediment sink. This sediment transport may give rise to changes in bed levels if sediment supply is not maintained and also the potential migration of seabed features. Studies undertaken of both bathymetric data collected for this project and historic data indicated migration rates for barchan dunes in the study area are generally found to be in the range 1 to 4 m per year (ABPmer, 2023).

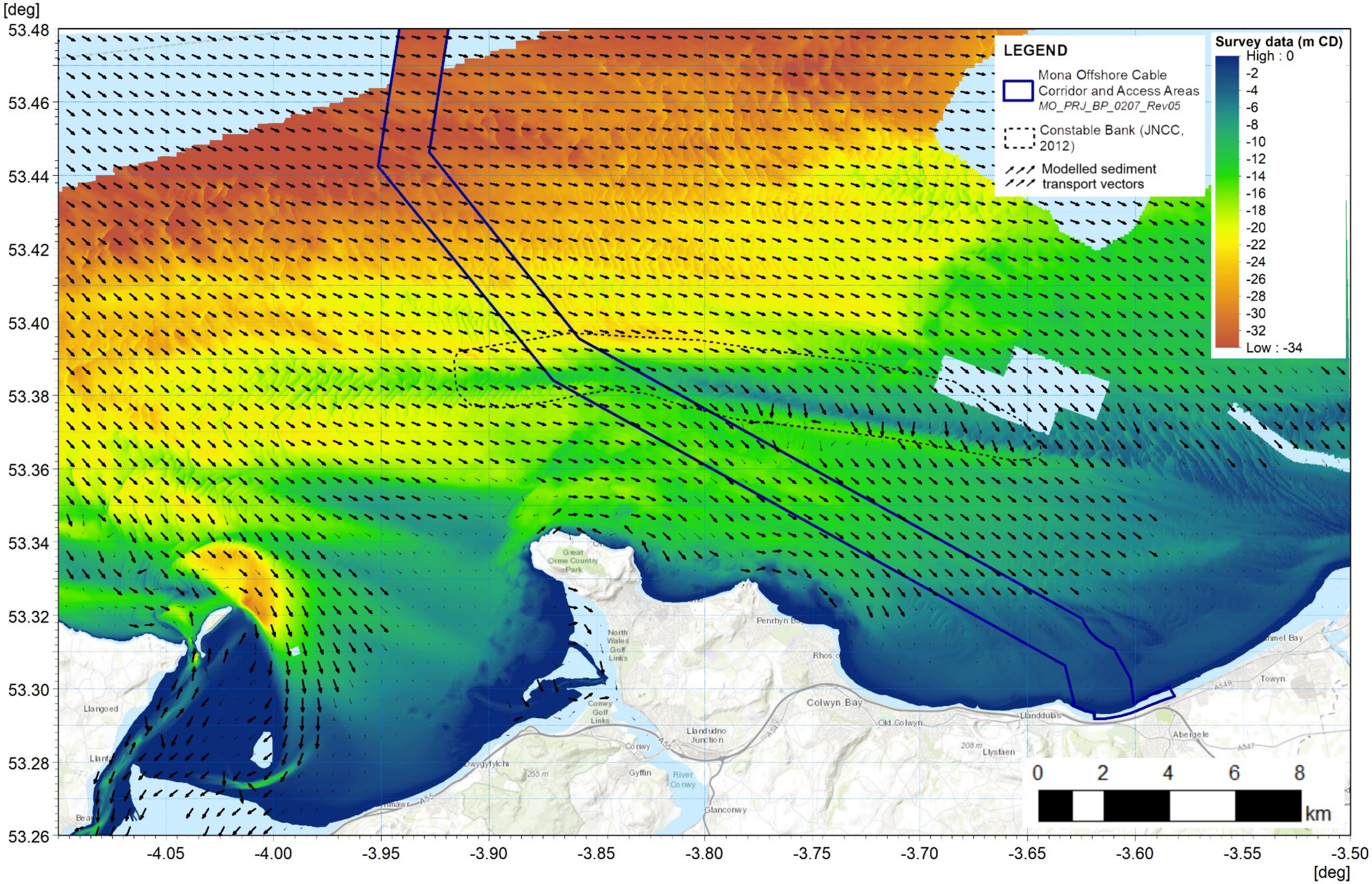


Figure 1.11: Shallow water bathymetric features and sediment transport vectors over one day spring tide.

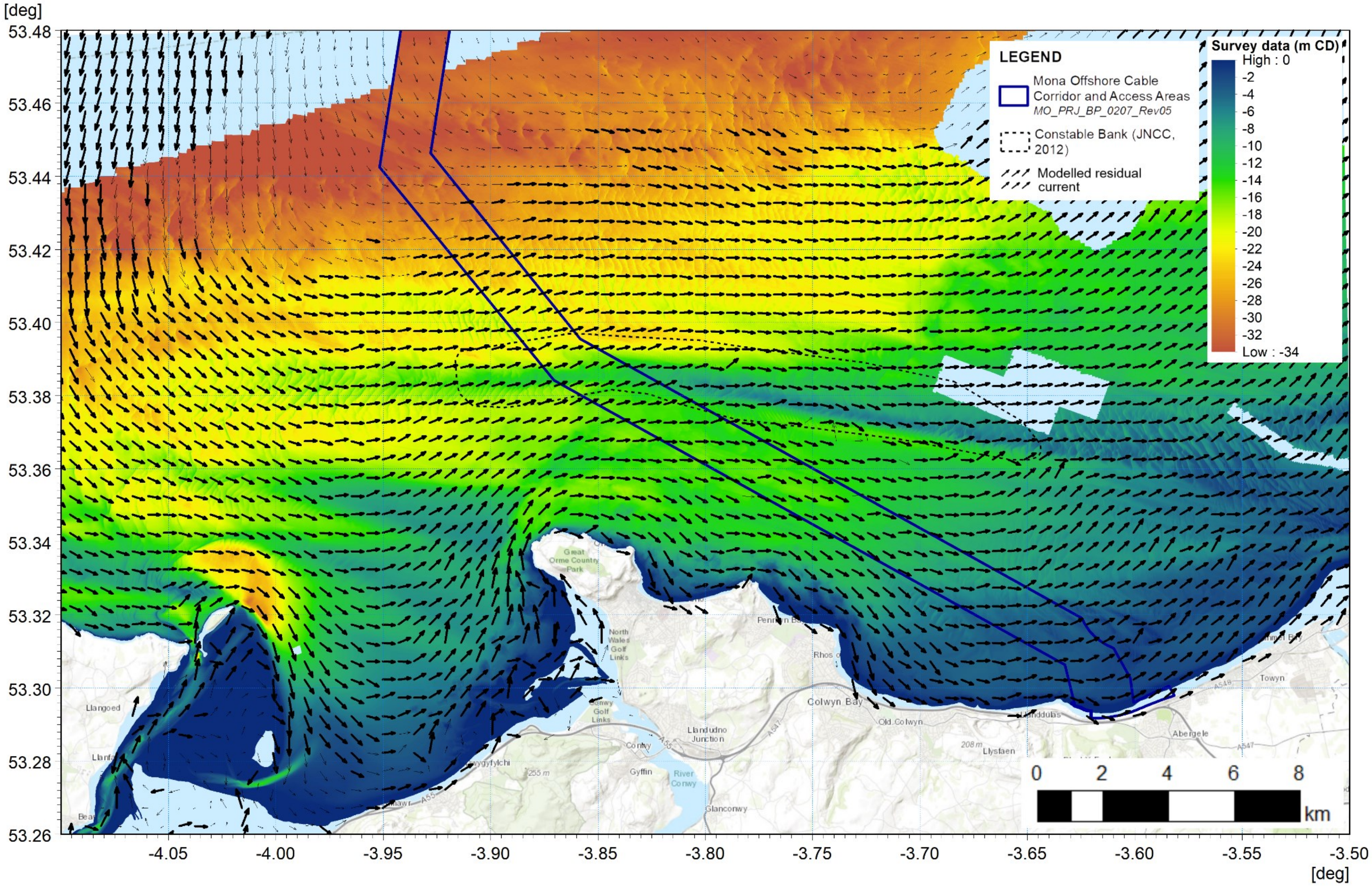


Figure 1.12: Shallow water bathymetric features and residual current pattern 1 in 1 year return period storm from 270°, highlighting Constable Bank.

Suspended sediments

1.5.1.32 Suspended SSC are regulated by tidal currents and intensify during wind-driven storm events throughout the water column. SSC levels have a seasonal pattern due to the seasonality of storm events. Offshore monitoring to the north of Mona Array Area within the proposed Morgan Offshore Wind Project: Generation Assets (hereafter referred to as the Morgan Generation Assets) recorded typical SSC levels of <5 mg/l, however as expected during storm events this increased to circa 20 mg/l corresponding with increased wave heights (Fugro (2022)).

1.5.1.33 Within the Mona Array Area, the non-algal SPM was estimated to be on average 0.9 – 3 mg/l between 1998 and 2015 (Cefas, 2016). As for the SSC, the SPM levels display a seasonal pattern with heightened levels during winter months and are regulated by tidal currents.

1.5.2 Designated sites

1.5.2.1 Using the JNCC database (https://jncc.gov.uk/mpa-mapper/), Ramsar and Defra databases, designated sites identified for the physical processes chapter are described in Table 1.11 and illustrated in Figure 1.13.

Table 1.11: Designated sites, sites of importance and bathing water locations.

Designated site and relevant sites of interest	Closest distance to the Mona Array Area (km)	Closest distance to the Mona Offshore Cable Corridor and Access Areas (km)	Relevant qualifying interest
Designated Sites			
Menai Strait and Conwy Bay SAC (UK0030202)	29.82	0	Protected Features: • Large shallow inlets and bays • Mudflats and sandflats not covered by seawater at low tide • Reefs • Sandbanks which are slightly covered by sea water all the time • Submerged or partially submerged sea caves.
Great Ormes Head SSSI	30.35	3.26	Habitats: • Reefs • European Dry Heath • Semi-Natural Dry Grassland • Vegetated Sea Cliff. Species: • Wild cotoneaster • Spiked speedwell • Goldilocks aster • Hairy-fruited cornsalad • Welsh hawkweed • Spotted cat's-ear

Designated site and relevant sites of interest	Closest distance to the Mona Array Area (km)	Closest distance to the Mona Offshore Cable Corridor and Access Areas (km)	Relevant qualifying interest
			• Lichens (*Collema fragile* and *Synalissa symphorea*) • Grayling • Silver-studded blue • Silky wave moth • Horehound plume moth • Weevil *Helianthemapion aciculare* • Pollen beetle *Meligethes brevis*.
Little Ormes Head SSSI	31.48	2.35	Habitats: • Reefs • Maritime cliff & slope • Lowland calcareous grassland • Calcareous grassland • Improved grassland • Broadleaved, mixed and yew woodland • Bracken • Inland rock • Species: – Lesser horseshoe bat – Lichens (*Leptogium diffractum* and *Catapyyrenium pilosellum*) – *Veronica spicata* ssp. Hybrida.
Traeth Pensarn SSSI	37.58	0	Habitat: • Coastal vegetated shingle beach
Site of Importance			
Constable Bank	23.9	0	Habitat: • Sandbank.
Bathing Water Locations			
Llandudno North Shore	31.74	4.37	Bathing water Current status: Sufficient.
Colwyn Bay	34.19	3.20	Bathing water Current status: Excellent.
Colwyn Bay Porth Eirias	35.15	3.47	Bathing water

Designated site and relevant sites of interest	Closest distance to the Mona Array Area (km)	Closest distance to the Mona Offshore Cable Corridor and Access Areas (km)	Relevant qualifying interest
			Current status: Excellent.
Kinmel Bay (Sandy Cove)	37.53	3.50	Bathing water Current status: Good.
Abergele (Pensarn)	37.63	0	Bathing water Current status: Sufficient.

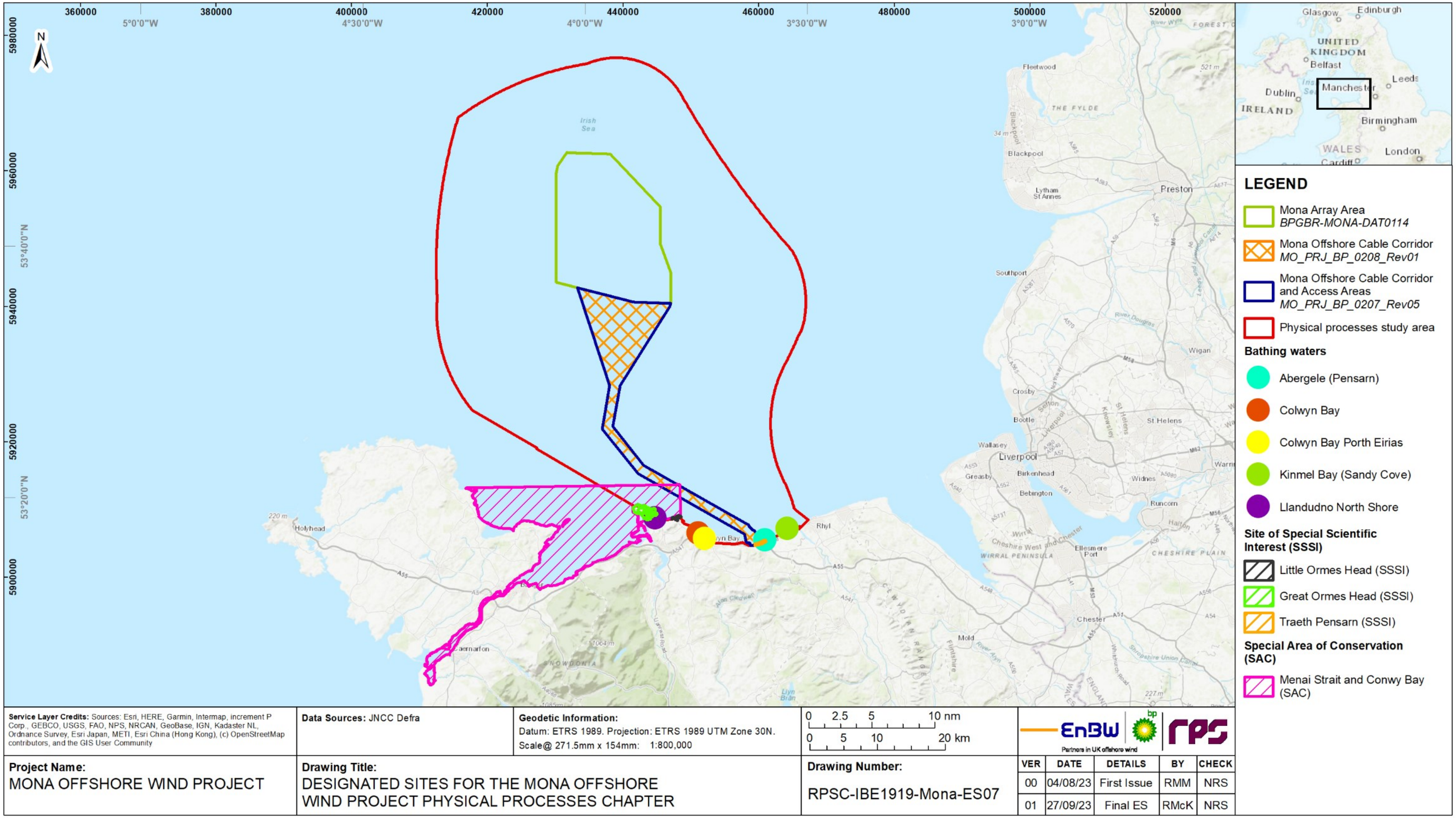


Figure 1.13: Designated sites and relevant sites of interest for the Mona Offshore Wind Project physical processes chapter.

1.5.3 Future baseline scenario

1.5.3.1 The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 requires that "an outline of the likely evolution thereof without implementation of the development as far as natural changes from the baseline scenario can be assessed with reasonable effort on the basis of the availability of environmental information and scientific knowledge" is included within the Environmental Statement. In the event that Mona Offshore Wind Project does not come forward, an assessment of the future baseline conditions has been carried out and is described within this section.

1.5.3.2 The baseline environment for physical processes is not static and will exhibit a degree of natural change over time. Such changes will occur with or without the Mona Offshore Wind Project in place due to natural variability. Future baseline conditions would be altered by climate change resulting in sea level rise and increased storminess. This is unlikely to have the effect of significantly altering tidal patterns and sediment transport regimes offshore at the Mona Array Area. The return period of the wave climates would be altered (e.g. what is currently defined as a 1 in 50 year event may become a 1 in 20 year event) as deeper water would allow larger waves to develop. Although increased water depth would potentially increase the wave climate, sandbank development is driven by tides and sediment source rather than waves (Kenyon and Cooper, 2005). Therefore features, such as Constable Bank would continue to develop regardless of wave climate. There is, however, a notable degree of uncertainty regarding how future climate change will impact prevailing wave climates within the Irish Sea and beyond.

1.5.3.3 In the intertidal area increased frequency of storm events may have the potential to alter existing sediment transport regimes however the installation of Mona export cables will be undertaken via trenchless techniques under the intertidal area from below MLWS, where the exit pits will be located, to onshore. There will therefore be no open-cut trenching or placement of cable protection within the intertidal area and sediment transport regimes will be unaffected. In nearshore areas, the cable protection will cause no more than a 5% reduction in water depth (referenced Chart Datum) at any point along the export cables without prior written approval from the Licensing Authority in consultation with the MCA, as per the standard navigation requirements. This will ensure any cable protection is sufficiently low profile to cause minimal changes to wave, tide and sediment transport, meaning that sediment transport pathways are retained and will not be impacted. Routine inspection of cables and geophysical surveys in line with the cable maintenance plan would also have the benefit of identifying any changes in baseline conditions.

1.5.4 Data limitations

1.5.4.1 The physical processes study area has been the focus of study for both academic and government institutions. Additionally, significant data collection campaigns have been undertaken by the Applicant and other offshore wind farm developers in the locality. Although some physical processes are complex and inter-related, there is a significant amount of data available. It is therefore considered that the data sources used in this assessment are robust and sufficient for the purposes of the impact assessment presented.

1.5.4.2 The geophysical survey for the Mona Offshore Cable Corridor and Access Areas was undertaken in summer 2022 and preliminary data was utilised in the physical processes modelling study presented in Volume 6, Annex 1.1: Physical processes technical report of the Environmental Statement. A review of the finalised datasets determined that the use of the preliminary data was legitimate. Similarly, the open source datasets used for sediment grading in the modelling study (British Geological Survey, 2022) were found to be consistent with PSA undertaken on the site specific sample data (Ocean Ecology, 2023).

1.6 Impact assessment methodology

1.6.1 Overview

1.6.1.1 The physical processes impact assessment has followed the methodology set out in Volume 1, Chapter 5: Environmental Impact Assessment methodology of the Environmental Statement. Specific to the physical processes impact assessment, the following guidance documents have also been considered.

- Physical processes guidance to inform EIA baseline survey, monitoring and numerical modelling requirements for major development projects with respect to marine, coastal and estuarine environments, GN041, Natural Resources Wales, Marine Programming Planning and Delivery Group (NRW, 2020)
- Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards, Natural England, (Natural England, 2022)
- Nature considerations and environmental best practice for subsea cables in English inshore and UK offshore waters, Natural England and JNCC, (2022)
- Guidance on EIS and Natura Impact Statement (NIS) Preparation for Offshore Renewable Energy Projects, Department of Communications, Climate Action and Environment, (Barnes, 2017)
- Guidance on Marine Baseline Ecological Assessments and Monitoring Activities for Offshore Renewable Energy Projects Parts 1 and 2, Department of the Environment, Climate and Communications, (DECC, 2018)
- COWRIE – Coastal Process Modelling for Offshore Wind Farm EIA (Lambkin *et al.,* 2009)
- Advice to Inform Development of Guidance on Marine, Coastal and Estuarine Physical Processes Numerical Modelling Assessments. NRW Report No 208, 139pp, Natural Resources Wales. (Pye *et al.,* 2017)
- Guidance on Best Practice for Marine and Coastal Physical Processes Baseline Survey and Monitoring Requirements to inform EIA of Major Development Projects, NRW Report No: 243, 119 pp, Natural Resources Wales, Cardiff. (Brooks *et al*., 2018).

1.6.1.2 In addition, the physical processes impact assessment has considered the legislative framework as defined by:

- Overarching NPS for Energy (EN-1) (DESNZ, 2024a)
- NPS for Renewable Energy Infrastructure (EN-3) (DESNZ, 2024b)
- Welsh National Marine Plan (Welsh Government, 2019)
- North West Inshore and North West Offshore Coast Marine Plans (MMO, 2021).

1.6.2 Impact assessment criteria

1.6.2.1 Physical processes are not generally receptors in themselves; they may be a pathway by which coastal features may be impacted or form a pathway for indirect impacts on other receptors. For example, increases in suspended sediments during the construction phase may lead to the deposit of these sediments and smothering of benthic habitats. For this impact, the magnitude of the potential changes has been assessed, with the sensitivity of the receptors to these changes and the significance of effects assessed within Volume 2, Chapter 2: Benthic subtidal and intertidal ecology of the Environmental Statement.

1.6.2.2 A full impact assessment has however been provided within this chapter, section 1.9, for the hydrodynamic regime and the sediment transport regime, which have been identified as potentially sensitive physical processes receptors.

1.6.2.3 The criteria for determining the significance of effects is a two-stage process that involves defining the magnitude of the impacts and the sensitivity of the receptors. This section describes the criteria applied in this chapter to assign values to the magnitude of potential impacts and the sensitivity of the receptors. The terms used to define magnitude and sensitivity are based on those which are described in further detail in Volume 1, Chapter 5: Environmental Impact Assessment methodology of the Environmental Statement.

1.6.2.4 The criteria for defining magnitude in this chapter are outlined in Table 1.12 below.

Table 1.12: Definition of terms relating to the magnitude of an impact.

Magnitude of impact	Definition
High	Change in physical processes which results in the loss of a coastal feature (e.g. blockage of sediment pathway resulting in loss of spit (Adverse)).
	Change in physical processes which results in the creation of a coastal feature (e.g. reduction in wave climate giving rise to dune formation (Beneficial)).
Medium	Alteration of physical processes which effects the rate at which a coastal feature is maintained (e.g. reduction in accretion rate (Adverse)).
	Alteration of physical processes which effects the rate at which a coastal feature is developing (e.g. reduction in erosion rate (Beneficial)).
Low	Variation in physical processes which maintains the coastal feature (e.g. localised change in sediment pathway which does not destabilise bank).
Negligible	Imperceptible variation in physical process (e.g. in the order of natural variability). No observable impact either adverse or beneficial.

1.6.2.5 The criteria for defining sensitivity in this chapter are outlined in Table 1.13 below.

Table 1.13: Definition of terms relating to the sensitivity of the receptor.

Sensitivity	Definition
Very High	Coastal feature forms vital part of a wider scale system which is scarce and non-recoverable.
High	Coastal feature forms part of a wider scale system and is non-recoverable.
Medium	Coastal feature has limited potential for re-creation.
Low	Coastal features of local scale and recoverable.
Negligible	Coastal feature adaptable to changes in physical processes.

1.6.2.6 The significance of the effect upon physical processes is determined by correlating the magnitude of the impact and the sensitivity of the receptor. The particular method employed for this assessment is presented in Table 1.14. Where a range of significance of effect is presented in Table 1.14, the final assessment for each effect is based upon expert judgement.

1.6.2.7 For the purposes of the assessment, any effects with a significance level of minor or less have been concluded to be not significant in terms of The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017.

Table 1.14: Matrix used for the assessment of the significance of the effect.

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

1.7 Key parameters for assessment

1.7.1 Maximum design scenario

1.7.1.1 The maximum design scenarios (MDS) identified in Table 1.15 have been selected as those having the potential to result in the greatest effect on an identified receptor or receptor group. These scenarios have been selected from the project description provided in Volume 1, Chapter 3: Project description of the Environmental Statement. Effects of greater adverse significance are not predicted to arise should any other development scenario, based on details within the project description (e.g. different infrastructure layout), to that assessed here be taken forward in the final design scheme.

1.7.1.2 The results of the physical processes study, particularly the numerical modelling output detailed in Volume 6, Annex 1.1: Physical processes technical report of the Environmental Statement, will be used to support and inform the following chapters:

- Volume 2, Chapter 2: Benthic subtidal and intertidal ecology of the Environmental Statement
- Volume 2, Chapter 3: Fish and shellfish ecology of the Environmental Statement
- Volume 2, Chapter 4: Marine mammals of the Environmental Statement
- Volume 2, Chapter 9: Marine archaeology of the Environmental Statement
- Volume 2, Chapter 10: Other sea users of the Environmental Statement.

Table 1.15: Maximum design scenario considered for the assessment of potential impacts on physical processes.

[a] C=construction, O=operations and maintenance, D=decommissioning

Potential impact	Phase[a] C	O	D	Maximum Design Scenario	Justification
Increase in suspended sediments due to construction, operations and maintenance and/or decommissioning related activities, and the potential impact to physical features.	✓	✓	✓	**Construction phase** Site preparation: Sandwave clearance: • Sandwave clearance activities undertaken over an approximate 12 month duration within the wider four year construction programme • Wind turbines and OSP foundations: sandwave clearance has been calculated on the basis of wind turbine generator foundations and site investigations indicating clearance may be required at up to 50% of locations. Spoil volume per location has been calculated on the basis of 34 locations supporting the largest suction bucket four legged jacket foundation with an associated base diameter of 205 m to an average depth of 7.5 m. This equates to a total spoil volume of 8,416,621 m^3 and a volume of 247,548 m^3 per location • Inter-array cables: sandwave clearance along 163 km of cable length, with a width of 80 m, to an average depth of 3.0 m. Total spoil volume of 4,188,876 m^3 • Interconnector cables: sandwave clearance along 30 km of cable length, with a width of 80 m, to an average depth of 5.1 m. Total spoil volume of 432,000 m^3 • Offshore export cables: sandwave clearance along 72 km of export cable, with a width of 40 m, to an average depth of 5.1 m. Total spoil volume of 1,504,000 m^3 • Removal of up to 46 km of disused cables. Foundation installation: • Undertaken over an approximate 12 month duration • Wind turbines: – installation of 45 three legged jacket piles of 5.5 m diameter, drilled to a depth of 75 m at a rate of up to	**Construction phase** Site preparation: • The volume of material to be cleared from individual sandwaves will vary according to the local dimensions of the sandwave (height, length, and shape) and the level to which the sandwave must be reduced. These details are not fully known at this stage, however based on the available data, it is anticipated that the sandwaves requiring clearance in the array area are likely to be in the range up to 15 m in height. This will be confirmed pre-construction. In all cases the material cleared from the sandwave will be sidecast (i.e. placed in close proximity to the breach) in order that the sediment is readily available for supply for sandwave recovery. The exception to this will be if the material is used for ballast within the foundation structure (see foundation installation below) • Site clearance activities may be undertaken using a range of techniques, the suction hopper dredger will result in the greatest increase in suspended sediment and largest plume extent as material is released near the water surface during the relocation of material. In reality plough dredging may be implemented however the volume of material brought into suspension would be reduced as material is ploughed along the bed • Boulder clearance activities will result in minimal increases in SSCs and have therefore not been considered in the assessment. Foundation installation: • The dredging and site preparation associated with conical gravity base foundations may involve the use of

Potential impact	Phase[a] C	O	D	Maximum Design Scenario	Justification
				1.78 m/h, with maximum spoil volume of 2,107 m^3 per pile – installation of 23 conical gravity base foundations with a caisson diameter of 37 m and a sea surface diameter 15 m. Installation requires dredging of a maximum area of 32,761 m^2 to a maximum depth of 10 m • OSPs: installation of one OSP with six legs with three piles per leg, each 5.5 m drilled to a depth of 75 m at a rate of up to 1.78 m/h, with maximum spoil volume of 2,107 m^3 per pile • Two drilled piles installed concurrently at adjacent sites. Cable installation: • Inter-array cables: Installation via trenching of up to 325 km of cable, with a trench width of up to 3 m and a depth of up to 6 m. Total maximum spoil volume of 2,925,000 m^3. Installed over a period of approximately 12 months • Interconnector cables: installation via trenching of up to 50 km of cable, with a trench width of up to 3 m and a depth of up to 3 m. Total spoil volume of 225,000 m^3. Installed over a period of approximately four months • Offshore export cables: installation via trenching of up to 360 km of cable, with a trench width of up to 3 m and a depth of up to 3 m. Total spoil volume of 1,620,000 m^3. Installed over a period of 15 months • Intertidal export cable: installation via trenchless techniques with breakout location offshore of MLWS. Bentonite release for the trenchless techniques limited to punch out on four occasions, one per drill shot, and over a short duration with an indicative period of up to 12 hours per location. **Operational and maintenance phase** Project lifetime of 35 years • Inter-array cables: repair of up 10 km of cable in one event every three years. Reburial of up to 20 km of cable in one event every five years	up to 7,000 m^3 of this material as ballast within the structure. The remaining material will be sidecast in close proximity to be available within the sediment cell for transport and sandwave regeneration • Installation of foundations via augured (drilled) operations results in the release of the largest volume of sediment unrestrained through the water column. The greatest volume of sediment disturbance by drilling at individual locations is associated with the largest diameter pile for wind turbines. It is noted that it is unlikely that drilling would be required to the full depth and the most likely scenario is that piles would be driven, with no drilling required. This would give rise to minimal increases in SSC, however the most arduous scenario has been assessed as the MDS • The maximum number of three legged jacket pile foundations to be installed for the largest wind turbine generators is 45 out of an array of 68 wind turbine generators. Therefore, for the holistic approach of SSC assessment the remaining 23 foundations are conical gravity based foundations with associated dredging activities. • The selected OSP scenario represents the greatest volume of sediment to be released for a drilling event • The greatest drilling rate associated with the largest pile diameter represents the maximum level of increase in SSC • The volume of bentonite release for the cable installation using trenchless techniques punch out will be controlled and will be limited depending on the method adopted for conduit insertion. On the basis of previous experience, these quantities will be limited. This controlled bentonite release will occur during the punch out for each drill shot, so this is limited to four occasions, one per drill shot, and over a short duration with an indicative period of up to 12 hours per location. Discharge quantities will, however,

Potential impact	Phase[a] C	O	D	Maximum Design Scenario	Justification
				• Interconnector cables: repair of up to 16 km of cable in each of three events every 10 years. Reburial of up to 2 km of cable in one event every five years • Offshore export cables: repair of up to 32 km of cable in eight events every five years. Reburial of up to 15 km of cable in one event every five years. **Decommissioning phase** • Scour and cable protection will remain *in situ*. If suction caissons are removed using the overpressure to release them then SSC will be temporarily increased • Inter-array and interconnector cables will be removed and disposed of onshore • Offshore export cables will be removed up to the cable installation exit pits and disposed of onshore.	vary through the period, with the bulk of the material lost on the initial punch out. Cable installation: • Cable routes inevitably include a variety of seabed material and in some areas 3 m depth may not be achieved or may be of a coarser nature which settles in the vicinity of the cable route. The maximum burial depth of 6 m for inter-array cables would only be required at locations where significant seabed/sandwave mobility is identified. The assessment therefore considers the upper bound in terms of suspended sediment and dispersion potential • Cables may be buried by ploughing, trenching or jetting with trenching or jetting mobilising the greatest volume of material to increase SSCs • The volume of bentonite release for the duct punch out will be controlled and will be limited depending on the method adopted for conduit insertion. This controlled Bentonite release will only occur during the punch out for each drill shot, so this is limited to four occasions, one per drill shot, and the duration for each discharge will be of short duration with an indicative period of up to 12 hours per location. **Operation and maintenance phase** • The greatest foreseeable number of cable reburial and repair events is considered to the MDS for sediment dispersion. **Decommissioning phase** • The removal of cables may be undertaken using similar techniques to those employed during installation, therefore the potential increases in SSC and deposition would be in-line with the construction phase.

Potential impact	Phase[a]			Maximum Design Scenario	Justification
	C	O	D		
					• The MDS assumes the complete removal of all wind turbine and OSP foundations and cables; piles will be cut below the seabed.
Impacts to the tidal regime due to presence of infrastructure and the associated potential impacts along adjacent shorelines. Impacts to the wave regime due to presence of infrastructure and the associated potential impacts along adjacent shorelines. Impacts to sediment transport and sediment transport pathways due to presence of infrastructure and associated potential impacts to physical features and bathymetry. Impacts to temperature and salinity stratification due to the presence of infrastructure.	✓	✓	✓	**Construction phase** • During the construction phase the potential changes to receptor pathways will be gradually introduced as the presence of infrastructure increases; reaching the MDS outlined below in the operations and maintenance phase. The MDS in terms of the presence of infrastructure would be on the completion of construction, during the operations and maintenance phase. **Operation and maintenance phase** Holistic MDS for tides, waves and sediment transport • Wind turbines: 68 installations with four-legged suction bucket foundations, each jacket leg with a diameter of 5 m, spaced 48 m apart, and each bucket with a diameter of 16 m. Scour protection to a height of 2.5 m and extending 20 m from the bucket. Total footprint of 10,816 m^2 per wind turbine • OSPs: one installation with a rectangular gravity base foundation, with an 80 m by 60 m dimension at the surface, a slab base dimension of 100 m by 80 m and with scour protection to a height of 2.6 m extending 25 m from the base. Total footprint of 19,500 m^2 • Inter-array cables: cable protection along 32.5 km of the cable. Up to 67 cable crossings, each crossing has a height of up to 4 m, a width of up to 36 m and a length of up to 80 m • Interconnector cables: cable protection along 10 km of the cable, with a height of up to 3 m and up to 10 m width. Up to ten cable crossings, each crossing has a height of up to 3 m, a width of up to 20 m and a length of up to 50 m • Export cables: cable protection along 72 km of the cable, with a height of up to 3 m and up to 10 m width. Up to 14	Physical processes are comprised of tides, waves and sediment transport and these aspects are integrated (i.e. without the influence of tides and waves there would be no sediment transport) as outlined below: • The tidal regime is influenced by changes in bathymetry due to the placement of scour protection and the obstruction of tidal flow due to foundation structures within the water column • The wave climate is influenced by obstruction within the water column however changes in bathymetry would only cause effects in shallow water • The sediment transport regime is affected by obstructions in the sediment transport pathways and also potential changes to the littoral currents which drive this process (i.e. those factors which also affect tide and wave climate) • Stratification is governed by the factors controlling mixing therefore the effects on tide and wave climate are common to stratification. As no single parameter occurs in isolation a holistic approach has therefore been applied to compile the MDS. The greatest surface blockage to influence wave climate is from the wind turbines with the largest four-legged suction bucket foundations. The four legs provide a slightly smaller obstruction to tidal flows at each wind turbine site than gravity base foundations however the gravity base obstruction is concentrated towards to the lower section of the water column where tidal currents are weaker and influence of conveyance is therefore reduced. Additionally, placement of gravel to accommodate pad foundations for gravity base structures would occur within a dredged area and not impact on tidal flow. Suction bucket foundations

<table>
<tr><th>Potential impact</th><th colspan="3">Phase[a]</th><th>Maximum Design Scenario</th><th>Justification</th></tr>
<tr><th></th><th>C</th><th>O</th><th>D</th><th></th><th></th></tr>
<tr><td></td><td></td><td></td><td></td><td>cable crossings, each crossing has a height of up to 3 m, a width of up to 30 m and a length of up to 50 m. Cable protection height will cause no more than a 5% reduction in water depth (referenced Chart Datum) at any point along the Mona offshore cable corridor without prior written approval from the Licensing Authority in consultation with the MCA.

Sediment budget

• The dredging and site preparation associated with conical gravity base foundations may involve the use of up to a total of 490,000 m³ of this material as ballast in structures at up to 96 locations. Up to 7,000 m³ of material may be harvested from site preparation activities at any given site.

Decommissioning phase

• During the decommissioning phase the potential changes to the receptor pathway would gradually decrease from the operational MDS as structures are removed and cut below the seabed

• Scour and cable protection will remain in situ and continue to influence tidal regime.</td><td>have the largest footprint at each wind turbine in terms of scour protection and provide the greatest influence on bathymetry. The devices also have a greater footprint over the site as a whole rather than the more numerous smaller design options. Sensitivity testing was undertaken on a single unit of each of these foundation types, as presented in Volume 6, Annex 1.1: Physical processes technical report of the Environmental Statement. It was seen that although there were differences in influences in the immediate vicinity of each unit, they would not give rise to a different magnitude of impact.

The greatest overall in-water column blockage to influence tidal flow and wave climate from the OSPs is the maximum number of OSPs (four) with gravity base foundations. These parameters also present the largest overall footprints to affect changes in bathymetry and sediment transport pathways. However, the greatest single site influence in terms of OSP structures is the rectangular gravity base structure, which is larger than other foundation options. This was demonstrated in modelling of this single foundation under sensitivity testing presented in Volume 6, Annex 1.1: Physical processes technical report of the Environmental Statement.

The volume of material which may be harvested from site preparation activities for ballast in gravity based foundations is up to 7,000 m³ for each location, up to a total of 490,000 m³. Therefore the MDS differs from the holistic assessment applied to tides, waves and sediment transport when sediment budget and the potential impact on sediment transport is considered.</td></tr>
</table>

1.8 Measures adopted as part of the Mona Offshore Wind Project

1.8.1.1 For the purposes of the EIA process, the term 'measures adopted as part of the project' is used to include the following proposed measures (adapted from IEMA, 2016):

- Measures included as part of the project design. These include modifications to the location or design of the Mona Offshore Wind Project which are integrated into the application for consent. These proposed measures are secured through the consent itself through the description of the development and the parameters secured in the DCO and/or marine licences (referred to as primary mitigation in IEMA, 2016)
- Measures required to meet legislative requirements, or actions that are generally standard practice used to manage commonly occurring environmental effects and are secured through the DCO requirements and/or the conditions of the marine licences (referred to as tertiary mitigation in IEMA, 2016).

1.8.1.2 A number of primary measures have been proposed to be adopted as part of the Mona Offshore Wind Project to reduce the potential for impacts on physical processes. These are outlined in Table 1.16 below. As there is a commitment to implementing these measures, they are considered inherently part of the design of the Mona Offshore Wind Project and have therefore been considered in the assessment presented in section 1.9 below (i.e. the determination of magnitude and therefore significance assumes implementation of these measures).

Table 1.16: Measures adopted as part of the Mona Offshore Wind Project.

Measures adopted as part of the Mona Offshore Wind Project	Justification	How the measure will be secured
Primary measures: Measures included as part of the project design		
Development and adherence to an Offshore CMS, which will include details of scour protection management, to be used around offshore structures and foundations to reduce scour as much as is practical.	There is the potential for scouring of seabed sediments to occur due to interactions between the metocean regime (waves and currents) and foundations or other seabed structures. This scouring can develop into depressions around the structure. The use of scour protection around offshore structures and foundations will be employed, as described in detail in Volume 1, Chapter 3: Project description of the Environmental Statement. The scour protection has been included in the modelled scenarios used within the impact assessment.	The Offshore CMS is secured within the deemed marine licence (DML) in Schedule 14 of the draft DCO and expected to be secured within the standalone NRW marine licence.
Development and adherence to an Offshore CMS including a cable specification and installation plan (CSIP) which will include cable burial where possible and cable protection.	To minimise potential impact from the cables and removal of cables a commitment to bury cables where possible has been made in accordance with the specific policies set out in the Welsh Marine Plan (Welsh Government, 2019) and additionally the North West Inshore and North West Offshore Coast Marine Plans (MMO, 2021). The Applicant recognises that the best form of cable protection is achieved through cable burial to the required depths, according to the results of a Cable Burial	The Offshore CMS is secured within the DML in Schedule 14 of the draft DCO and expected to be secured within the standalone NRW marine licence.

Measures adopted as part of the Mona Offshore Wind Project	Justification	How the measure will be secured
	Risk Assessment and Burial Assessment Study, which will be included within the CSIP. The burial methodology should select the appropriate tools to endeavour to achieve burial to the required depth of lowering in a single pass, seeking to avoid burial methods that require multiple passes with a burial tool in order to achieve lowering of the cable.	
Development and adherence to an Offshore CMS which includes a CSIP that will only permit sandwave clearance on the Constable Bank within the swept path width (20m) of the cable burial tool.	To minimise potential impacts to Constable Bank (an Annex 1 habitat outside of an SAC).	The Offshore CMS is secured within the DML in Schedule 14 of the draft DCO and expected to be secured within the standalone NRW marine licence.
Development and adherence to an Offshore CMS which includes a CSIP that does not permit sandwave clearance within the Menai Strait and Conwy Bay SAC.	To minimise potential impacts to habitats and species within the Menai Strait and Conwy Bay SAC.	The Offshore CMS is secured within the DML in Schedule 14 of the draft DCO and expected to be secured within the standalone NRW marine licence.
Development and adherence to an Offshore CMS which includes a CSIP that does not permit the installation of cable protection within Constable Bank.	To minimise potential impacts of cable protection to Constable Bank morphology.	The Offshore CMS is secured within the DML in Schedule 14 of the draft DCO and expected to be secured within the standalone NRW marine licence.
Development and adherence to an Offshore CMS which includes a CSIP that does not permit cable protection higher than 70 cm to be installed within in the Menai Strait and Conwy Bay SAC.	To minimise impacts on physical processes, particularly sediment transport regimes in the Menai Strait and Conwy Bay SAC. If and where cable protection is required within the SAC the cable protection measure used will be with sufficiently low profile to cause minimal changes to wave, tide and sediment transport.	The Offshore CMS is secured within the DML in Schedule 14 of the draft DCO and expected to be secured within the standalone NRW marine licence.
No more than 5% reduction in water depth (referenced to Chart Datum) will occur at any point along the Mona offshore cable corridor without prior written approval from the Licensing Authority in consultation with the MCA.	As per the standard navigation requirements, the cable protection will cause no more than a 5% reduction in water depth (referenced Chart Datum) at any point along the Mona offshore cable corridor without prior written approval from the Licensing Authority in consultation with the MCA. This will ensure any cable protection is sufficiently low profile to cause minimal changes to wave, tide and sediment transport.	Secured within the DML in Schedule 14 of the draft DCO and expected to be secured within the standalone NRW marine licence.
Development and adherence to a Landfall CMS (in accordance with the Outline landfall CMS, Document	To prevent impacts to intertidal and surrounding habitats.	Included in the Landfall CMS which is expected to be secured within the standalone NRW marine licence.

Measures adopted as part of the Mona Offshore Wind Project	Justification	How the measure will be secured
Reference J26.14) which commits to the installation of Mona export cables via trenchless techniques under the intertidal area from below MLWS, where the exit pits will be located, to onshore.		
Development and adherence to an Offshore CMS which includes a CSIP which requires material arising from drilling and/or sandwave clearance to be deposited in close proximity to the works.	To retain material within the sediment cell and maintain sediment transport regimes.	The Offshore CMS is secured within the DML in Schedule 14 of the draft DCO and expected to be secured within the standalone NRW marine licence.

1.9 Assessment of significant effects

1.9.1 Overview

1.9.1.1 The impacts of the construction, operations and maintenance, and decommissioning phases of the Mona Offshore Wind Project have been assessed on physical processes. The potential impacts arising from the construction, operations and maintenance and decommissioning phases of the Mona Offshore Wind Project are listed in Table 1.15, along with the MDS against which each impact has been assessed.

1.9.1.2 A description of the potential effect on physical processes receptors caused by each identified impact is given below.

1.9.2 Increase in suspended sediments due to construction, operations and maintenance and/or decommissioning related activities, and the potential impact to physical features.

1.9.2.1 Increased SSCs may arise due to seabed preparation involving sandwave clearance, the installation of the wind turbines and OSP foundations, the installation and/or maintenance of cables and associated decommissioning activities. This impact is relevant to the construction, operations and maintenance, and decommissioning phases of the Mona Offshore Wind Project and may cause indirect impacts to receptors.

1.9.2.2 The following scenarios were investigated:

- Site preparation activities – sand wave clearance and dredging to facilitate wind turbine, OSP and cable installation
- Drilled pile installation – across the range of hydrodynamic conditions
- Inter-array cable installation – for a zone of sandy seabed sediment
- Offshore export cable installation – through sandy seabed sediment
- Cable installation (using trenchless techniques) breakout and the release of bentonite.

1.9.2.3 Modelling was undertaken related to the MDS as outlined in Table 1.15 with the detail of the assessment provided in Volume 6, Annex 1.1: Physical processes technical report of the Environmental Statement.

Construction phase

Magnitude of impact

1.9.2.4 The preparation of the seabed involves sandwave clearance activities within the Mona Array Area and Mona Offshore Cable Corridor which may lead to SSCs and associated deposition. The MDS for sandwave clearance was along 163 km length of the inter array cable and width of 80 m, to an average depth of 3.0 m. Similarly, sandwave clearance at the same depth and width was determined along the interconnector cable (30 km). For the export cable the clearance length was 72 km with a 40 m width of clearance. Sandwave clearance on Constable Bank will be minimised by restricting any sandwave clearance to within the swept path width (20 m) of the cable burial tool, and there will be no sandwave clearance in the Menai Strait and Conwy Bay SAC.

1.9.2.5 Sandwave clearance may be required at up to 50% of the potential locations for suction bucket foundations and both sandwave clearance and dredging may be required for the installation of gravity base foundations. For the largest conical gravity bases the maximum dredging area per foundation may be 32,761 m^2 whilst the average area is 14,641 m^2, similarly the maximum dredging depth may be 10 m with an average depth of 3 m.

1.9.2.6 It is proposed that a small proportion of the dredged material from site preparation, 7,000 m^3 per foundation, is to be sequestered as ballast within the gravity base foundation with a maximum total volume of 490,000m^3. Within the Mona Array Area the seabed sediment is comprised largely of medium to coarse sand, as illustrated in Figure 1.10, and is therefore suited to augment with rock infill to provide ballast. This material typically represents a depth of *circa* 95cm below the slab foundation and scour protection extent and <8% of the seabed preparation volume. At the site of each of the largest wind turbine gravity base foundation an average of 41,337 m^3 of gravel may be placed to underlie the installation. Therefore, although the sequestered material will be removed from the sediment budget, the sediment in question represents a smaller volume than that occupied by the gravity base foundation within the seabed and the installation processes will not result in a void which could potentially interrupt transport processes by intercepting sediment. This is discussed further and assessed in section 1.9.5.

1.9.2.7 The installation of infrastructure within the Mona Array Area and Mona Offshore Cable Corridor may lead to increased SSCs and associated deposition. The MDS is for the drilled installation of 45 wind turbine foundations each with three-legged piles of 5.5 m diameter and the remaining 23 foundations being conical gravity base foundation with a caisson diameter of 37 m. Included is the installation of one OSP with foundations consisting of six legs with three 5.5 m piles per leg, drilled to a depth of 75m. Up to two piles may be installed concurrently. For the installation of inter-array cables (325 km), interconnector cables (50 km) and export cables (360 km) a trench of up to 3 m in width and typical maximum depth 3 m in depth with a triangular cross section may be excavated. It may be necessary in selected locations to increase the burial depth to 6 m. Trenchless techniques will be used for export cable landfall from shoreward of MLWS.

1.9.2.8 The modelled scenarios examined a range of locations within and in close proximity to the Mona Array Area, with two concurrent drilling operations at adjacent locations. The modelled scenarios examined drilling of larger 16 m diameter piles at a similar drilling rate. These are anticipated to generate plumes with a suspended sediment level of <50 mg/l therefore the smaller diameter piles would result in lower SSC. These levels would be localised and only persist for a short period. Concentrations within the plume envelope are much lower, typically <1 mg/l a short distance from the discharge locations. Following the cessation of drilling the turbidity levels reduce within a few hours as tidal currents reduce. Some of the finer material associated with the drilling process is re-suspended during successive tides as it is redistributed, but turbidity levels remain low. The sedimentation beyond the immediate drilling location is indiscernible (less than 1 mm). This is due to the relatively slow drilling rate, allowing the fine sediment to be widely dispersed while the larger material settles at the release point due to the limited current speed.

1.9.2.9 For the inter-array cable installation, the sediment plumes are much larger than those for the pile installation. The reason for this is twofold, firstly there is a large amount of sediment mobilised (220,500 m^3 of material was mobilised during the 4 day simulation along the 49 km modelled route), and secondly there was elevated tidal currents on successive tides which remobilised material over the extended period of installation. Peak plume concentrations are highest at around 500 mg/l (at the release site), with the sediment settling during slack water becoming resuspended in the form of an amalgamated plume. Sedimentation of 30 mm occurs at the trench site, with sediment thickness reducing moving away from the trench but remaining in the sediment cell and retained in the sediment transport system.

1.9.2.10 Following the completion of the works the turbidity levels return to baseline within a couple of tidal cycles. It would however be anticipated that spring tides following the works may mobilise and redistribute unconsolidated seabed material deposited at the end of the construction phase; this material will therefore be incorporated into the existing transport regime. Following installation, the native seabed material settles close to where it is mobilised and remains in situ. This would be expected as the baseline modelling indicated that sediment transport potential is limited across the offshore wind farm area. The sedimentation is concentrated along the installation route as material effectively returns to the site from where it was disturbed. Sedimentation thicknesses of <30 mm arise beyond the immediate vicinity of the trench the day after drilling cessation, and therefore, would be indiscernible from the existing seabed sediment.

1.9.2.11 Export cable installation shows a higher variability in SSC due to the change in hydrography along the export cable corridor and, as anticipated, SSC increased in limited water depth. Average levels of SSCs of <300 mg/l are noted along the cable path, with the level dropping to background levels on the slack tide.

1.9.2.12 The modelling of offshore cable installation from the Mona Array Area to the nearshore region was undertaken with tidal forcing. The orientation of tidal currents changes from an east to west alignment offshore to a southeast to northwest alignment as flows are influenced by the presence of Great Ormes Head. The tidal ellipse then becomes aligned with the cable trenching route approaching nearshore areas, (illustrated in Figure 1.7). In nearshore regions the tidal flows are oriented parallel to the coastline and the sediment plume did not encroach on the shoreline and Menai Strait & Conwy Bay SAC features. This would therefore also be the case for any seabed preparation activities. Under the additional influence of wind and wave driven currents the plume may be driven towards the shoreline when installation is taking place both inshore of the Constable Bank and during ebb tides. However, it is noted that in the case of the Menai Strait & Conwy Bay SAC features the principal wind direction would be from the northeast. Winds from this sector typically have a 6% occurrence and waves are fetch limited. Additionally, the influence of wind and wave action perpendicular to tidal flow will also increase dispersion and reduce SSC and any related deposition to levels indiscernible from background levels.

1.9.2.13 The project design includes the provision of site preparation, (i.e. sandwave clearance and dredging activities) which have the potential to increase SSCs in the construction phase with associated sedimentation. Sandwave clearance was calculated for 50% of the wind turbine and OSP foundations at a width of 205 m and a depth of 7.5 m and similar dredging parameters for gravity base foundations. For cable installation, sandwaves will be reduced in height in order to allow passage of the burial tool to enable cable burial to a sufficient target depth. Modelling was undertaken for representative areas of sandwave clearance, with clearance of a 104 m wide corridor to facilitate cable installation with an average depth of 5.1 m, with modelling assuming a clearance dredging rate of 10,000 m^3/h and a 3% spill of material during the dredging phase. The sample stretches modelled were 5 km in length and therefore represent much greater volumes than those at individual wind turbine or OSP locations.

1.9.2.14 In practice, plough dredging which mobilises a much smaller amount of sediment into suspension at the seabed and has reduced sediment plume concentrations and extents compared to other types of dredging activities may be undertaken. However, the modelling simulated the use of a suction hopper dredger with a phasing representative of the scale of the sandwaves; dredging, and then depositing material within the cable corridor as it progressed along the route, resulting in higher quantification of sedimentation compared to the plough dredging. It should be noted that when undertaking sandwave clearance the material will be sidecast to a location adjacent to the sandwave clearance to allow this material to be available for migration and sandwave recovery. At the site of gravity base foundations a proportion of the dredged volume removed to place the foundation will be used as ballast. This volume is less than the volume of the bed occupied by the installed foundation.

1.9.2.15 Refinement of the project description has subsequently reduced the length of cable route requiring sandwave clearance, the height of sandwave clearance to 3.0 m and also minimised the corridor width to 80 m for inter-array and interconnector cables and 40 m for export cables. Therefore, the magnitude of impacts would be reduced from those presented in Volume 6, Annex 1.1: Physical processes technical report of the Environmental Statement and also reducing the sandwave recovery period. It is also noted that the refinement of the array area for the Environmental Statement means that some of the modelled clearance and cable routes lie beyond the revised array area. However, these locations are comparable with those within the array area in terms of sediment grading and hydrodynamic conditions, and therefore, it can be assumed that the modelled data is applicable to the revised scheme.

1.9.2.16 The application of trenchless techniques for the landfall installation of export cables under the intertidal area from below MLWS, where the exit pits will be located, to onshore means that open-cut trenching activities will not take place within the intertidal region. Bentonite is an inert water-based drilling mud which will only be released if a long drill is used and the volume of bentonite release from trenchless techniques punch out will be controlled and will be limited depending on the method adopted for conduit insertion. On the basis of previous experience, these quantities will be limited. This controlled bentonite release will occur during the punch out for each drill shot, so this is limited to four occasions, one per drill shot, and over a short duration with an indicative period of up to 12 hours per location. Discharge quantities will, however, vary through the period, with the bulk of the material lost on the initial punch out. Uncontrolled release may occur in the form of a frac out, where bentonite may blead through fissures within the bedrock/overburden during the installation of cables via trenchless techniques. The risk of this happening is managed and controlled and is considered as part of the trenchless techniques design. The Landfall Construction Method Statement will define the details and appropriate remedial measures as per the selected methodology in line with the Outline Landfall Construction Method Statement (Document Reference J26.14). As such, control measures will be in place to limit the risk and volume of bentonite released via frac outs.

1.9.2.17 The sediment plume and subsequent deposition arising from duct breakout is strongly dependant on the prevailing tidal and meteorological conditions at the time of sediment release. Onshore winds may increase shoreline deposition although the plume would undergo greater dispersion and conversely offshore winds, such as those from the south west which are much more common, would reduce any potential shoreline deposition. Modelling of open cut trenching in the intertidal region undertaken for PEIR and presented in Volume 6, Annex 1.1: Physical processes technical report of the Environmental Statement included release of sediment with very fine silt fractions, akin to bentonite. So, although the intertidal trenching no longer forms part of the project design the plume extents can be used to inform the assessment of duct breakout. Initially deposition along the coastline is seen to extend around 100 m to 200 m and over successive tides this extends to *circa* 2 km. It should be noted that the volumes released would be much smaller than those modelled and the release location would be further offshore providing greater dispersion prior to deposition on the shoreline.

1.9.2.18 It is predicted that the impact will affect the Menai Strait & Conwy Bay SAC, Traeth Pensarn SSSI and Constable Bank features directly whilst affecting the remainder receptors indirectly. The magnitude is therefore, considered to be low for the receptors within the SAC and Constable Bank with a negligible magnitude for other receptor groups.

1.9.2.19 Overall, the impact is predicted to be of local spatial extent, short term duration, intermittent and of high reversibility. It is predicted that the impact will affect the receptors directly. The magnitude is therefore, considered to be **low**.

Sensitivity of the receptor

1.9.2.20 The Mona Offshore Wind Project partially overlaps with the Menai Strait & Conwy Bay SAC, Figure 1.13. The Menai Strait & Conwy Bay SAC is designated for multiple qualifying features under Annex 1 of the EC Habitats Directive; sandbanks which are slightly covered by sea water all the time, mudflats and sandflats not covered by seawater at low tide and reefs. The Menai Strait & Conwy Bay includes the Four Fathom Banks complex which is a rare subtidal sandbank. The sandbanks support relatively species-rich sandy communities of polychaetes such as *Spio filicornis* and internationally important flocks of common scoter *Melanitta nigra* feed on them when bivalve numbers are high. The mudflats and sandflats of the SAC are fully marine with a broad range of animal species and support the nationally scarce and important biotope, dwarf eelgrass *Zostera noltei*. Rocky reefs are situated in the strait and during spring tides the tidal current can reach 4 m/s these turbid waters contain high levels of suspended material supporting many species of filter feeders. Other Annex 1 habitats such as large shallow inlets and bays and submerged or partially submerged sea caves found in the Menai Strait & Conwy Bay SAC are qualifying features but not the primary purpose for designation. The sedimentation identified is localised and composed of native material therefore the structure and function of the designated features is of low vulnerability and recoverable. The sensitivity of the receptor to changes as a result of seabed preparation, foundation installation and cable installation is therefore considered to be **low.**

1.9.2.21 The Menai Strait & Conwy Bay SAC is deemed to be of low vulnerability, high recoverability and high value. The sensitivity of the receptor is therefore, considered to be **low**.

1.9.2.22 Constable Bank is not a designated site but supports sandbanks which are an Annex 1 habitat of the EC Habitats Directive. Constable Bank is an area of shallow water creating rougher areas of wave stress, shifting sand creating sandbanks. The sedimentation identified is localised and composed of native material therefore the structure and function of sandbanks is of low vulnerability and recoverable. The sensitivity of the receptor to changes as a result of seabed preparation, foundation installation and cable installation is therefore considered to be **low**.

1.9.2.23 The Constable Bank is deemed to be of low vulnerability, high recoverability and high value. The sensitivity of the receptor is therefore, considered to be **low**.

1.9.2.24 Traeth Pensarn SSSI is designated for its vegetated shingle beach and associated plant communities. Shingle ridges are primarily derived of local Carboniferous Limestone together with calcareous sands, shingle and non-limestone material from the Irish Sea glacial till. Shingle ridges would recover from sedimentation as the sedimentation identified is localised and composed of native material therefore the structure and function of the designated features is of low vulnerability and recoverable. The sensitivity of the receptor to changes as a result of seabed preparation, foundation installation and cable installation is therefore considered to be **low**.

1.9.2.25 The Traeth Pensarn SSSI is deemed to be of low vulnerability, high recoverability and high value. The sensitivity of the receptor is therefore, considered to be **low**.

1.9.2.26 The Great Ormes Head SSSI is comprised of features such as reefs (intertidal) and terrestrial habitats, vegetated sea cliffs, European dry heath, and semi-natural dry grassland. These rocky reefs would recover from sedimentation as typically no material reaches the intertidal zone from nearshore cabling. The sensitivity of the receptor to changes as a result of seabed preparation, foundation installation and cable installation is therefore considered to be **low**.

1.9.2.27 The Great Ormes Head SSSI is deemed to be of low vulnerability, high recoverability and high value. The sensitivity of the receptor is therefore, considered to be **low**.

1.9.2.28 Similarly, Little Ormes Head SSSI is primarily designated for terrestrial habitats such as lowland calcareous grassland, calcareous grassland and improved grassland (see Table 1.11). However, the reef at Little Ormes Head is described as geologically important for its Carboniferous stratigraphy. Special interest is given to the intertidal area due to scarce and specialised biotopes of hard vertical limestone rock off the headland and sand-scoured caves. Associated reefs and intertidal area would recover from sedimentation as no material reaches the intertidal zone from nearshore cabling. The sensitivity of the receptor to changes as a result of seabed preparation, foundation installation and cable installation is therefore considered to be **low**.

1.9.2.29 The Little Ormes Head SSSI is deemed to be of low vulnerability, high recoverability and high value. The sensitivity of the receptor is therefore, considered to be **low**.

1.9.2.30 Bathing water quality is measured in terms of biological levels and due to the low potential influx of native sediment into the bathing waters of the intertidal zone the level of vulnerability would be low and recoverable. It is expected that the sensitivity of the receptor to changes because of seabed preparation, foundation installation and cable installation is therefore considered to be **low**.

Significance of the effect

1.9.2.31 During the installation of the wind turbines in the Mona Array Area, the peak sediment plumes are <50 mg/l and do not persist or result in discernible sedimentation. However, these sediment concentrations do not extend as far south as Menai Strait & Conwy Bay SAC, Constable Bank, Great Ormes Head SSSI, Little Ormes Head SSSI and Traeth Pensarn SSSI.

1.9.2.32 Sediment plumes associated with the inter-array cable and inter-connector cable installation create plumes on average <100-300 mg/l, highest during the release (of material) phase however these plume concentrations do not persist in the designated sites. Sedimentation is typically <0.5 mm beyond the immediate vicinity of the installation and less than one tenth of this value in the wider domain, and would therefore, not affect features beyond the development area (i.e. limited to the Mona Array Area). These plumes do not extend to any of the other designated sites with sediment concentrations settling to background levels within the Mona Offshore Wind Project.

1.9.2.33 In terms of the Constable Bank, the structure of the offshore subtidal sandbanks would remain unchanged as the deposition is of native material and the supporting hydrodynamic processes are not altered by the minimal level of bathymetric change as a result of the construction phase sediment releases. Similarly, reefs, mudflats and sandflats would remain stable and supporting hydrodynamics processes for communities of polychaetes such as *Spio filicornis*, bivalves and dwarf eelgrass *Zostera noltei* would remain unaffected.

1.9.2.34 Export cable trenching routes do not pass through either of the designated sites Great Ormes Head SSSI and Little Ormes Head SSSI therefore will have no impact on the geodiversity of these sites. Although the offshore cable trenching passes through the outer extent of the Menai Strait & Conwy Bay SAC it does not intersect with any designated features. This increase in sediment entering the sediment cell causes sediment thickness of <0.5 mm at the coast off Bodelwyddan adjacent to the export cable trenching operations, however this material is native to the sediment cell and will therefore not affect geodiversity.

1.9.2.35 The Mona Offshore Cable Corridor and Access Areas landfall site at the coast off Bodelwyddan intersects the Traeth Pensarn SSSI. However cable installation under the intertidal area from below MLWS, where the exit pits will be located, to onshore will be undertaken using trenchless techniques which means that any impacts to the Traeth Pensarn SSSI will be indirect. Therefore, similar to the other designated sites, the increased sedimentation from the export cable installation could cause a temporary increase in sedimentation in the intertidal zone, however it would be insufficient to affect beach morphology.

1.9.2.36 Overall, the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **low**. The effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.

1.9.2.37 A significance of **minor** or **negligible** can be established from a **low** magnitude and **low** receptor, in this case a **negligible adverse** significance is concluded due to the limited scale of the **low** magnitude which does not affect all receptors.

Further mitigation and residual effect

1.9.2.38 No effects which are significant in EIA terms have been identified therefore further mitigation is not required.

Operations and maintenance phase

Magnitude of impact

1.9.2.39 Operations and maintenance activities within the Mona Array Area and Mona Offshore Cable Corridor may lead to increases in SSCs and associated sediment deposition.

1.9.2.40 The MDS is for up to 10 km inter-array cable repair (one event every three years) and reburial event of up to 20 km (once every five years). Including 16 km export cable repair (three events every 10 years) and reburial events of up to 2 km of cable every one event in every five years. The repair of 32 km of offshore export cables (eight events in every five years) and reburial of up to 15 km once every five years will be undertaken over the 35-year lifetime of the project (Table 1.15). Using similar methods as those for cable installation activities (i.e. trenching/jetting, with trench width up to 3 m and trench depth up to 3 m).

1.9.2.41 In each case the length of the repair or reburial activity may be up to 20 km; therefore, the magnitude of the impacts would be a fraction of those for the construction phase. In the case of the export cable the total length of works would be approximately 60% of the length of the construction phase with events being undertaken over the duration of the 35 year project lifetime. The sediment plumes and sedimentation footprints would be dependent on which section of the cable is being repaired however the entire length has been quantified under the construction phase scenario discussed above.

1.9.2.42 It is predicted that the impact will affect the Constable Bank directly whilst affecting other receptors, including Menai Strait & Conwy Bay SAC features, Traeth Pensarn SSSI, indirectly to a much lesser degree than the construction phase.

1.9.2.43 Overall, the impact is predicted to be of local spatial extent, short term duration, intermittent and of high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

Sensitivity of receptor

1.9.2.44 The sensitivity of receptors to changes in suspended sediments concentration and sedimentation remains the same as for all project phases. The significance of the effects will however be reduced as the works are limited to intermittent, discrete repair activities.

1.9.2.45 The Menai Strait & Conwy Bay SAC, Traeth Pensarn SSSI and Constable Bank would recover from sedimentation as the material released is localised and native. The sensitivity of the receptor to changes as a result of seabed preparation, foundation installation and cable installation is therefore considered to be **low**. Other receptors that are indirectly impacted to a much lesser degree than the construction phase are therefore considered **low**.

1.9.2.46 The Menai Strait & Conwy Bay SAC, Traeth Pensarn SSSI and Constable Bank are deemed to be of low vulnerability, high recoverability and high value. The sensitivity of the receptor is therefore, considered to be **low**.

Significance of effect

1.9.2.47 Overall, the magnitude of the impact is deemed to be **negligible** and the sensitivity of the receptor is considered to be **low**. The effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.

1.9.2.48 A significance of **minor** or **negligible** can be established from a **negligible** magnitude and **low** receptor, in this case a **negligible adverse** significance is concluded due to the limited scale of the **negligible** magnitude which does not affect all receptors.

Further mitigation and residual effects

1.9.2.49 No effects which are significant in EIA terms have been identified therefore further mitigation is not required.

Decommissioning phase

1.9.2.50 During decommissioning, increases in suspended sediments and potential impact on the physical features would be of lesser magnitude than both the construction phase and the operations and maintenance phase with scour and cable protection remaining *in situ*. In the case of piled foundations, there is no significant disturbance of the seabed during decommissioning as piles are cut off. SSC would increase temporarily if suction caissons were removed using overpressure to release. Decommissioning of gravity bases would involve the removal of ballast, including sand sequestered during construction. This material, which may also include rock will be disposed off-site, however a small proportion of sediment may be released during the removal process noting the ballast material derived from offsite sources would be tested for contamination prior to use. As per the MDS (Table 1.15), increases in SSC due to the removal of inter-array, interconnector and offshore export cables would be similar to those experienced during the construction phase, as retrieval would be undertaken using similar techniques to installation. The increase in suspended sediments and the potential impacts on physical features may persist during decommissioning, however they are temporary and localised in nature.

1.9.3 Impacts to the tidal regime due to presence of infrastructure and the associated potential impacts along adjacent shorelines.

1.9.3.1 The presence of infrastructure may lead to changes to the tidal regime and associated potential impacts along adjacent shorelines principally during the operations and maintenance phase of the Mona Offshore Wind Project. This impact is also relevant to the construction phase and following decommissioning associated with residual infrastructure. Modelling was undertaken using the MDS as outlined in Table 1.15 including the presence of scour protection as outlined in the project description (Volume 1, Chapter 3: Project description of the Environmental Statement). The detail of the numerical modelling underpinning the assessment is provided in Volume 6, Annex 1.1: Physical processes technical report of the Environmental Statement. The magnitude of the impact is detailed in this section along with the assessment of the effect of changes to physical processes on relevant receptors.

Construction phase

1.9.3.2 As the assessment was carried out with and without the presence of infrastructure, it can be inferred that during the construction phase there will be gradual changes to tidal regime as infrastructure is introduced into the environment. This would result in changes and therefore potential impacts, ranging from the baseline environment (no presence of infrastructure) to the operation phase (MDS), which are assessed in the following section.

Operations and maintenance phase

Magnitude of impact

1.9.3.3 The presence of infrastructure within the offshore wind farm area may lead to changes in tidal regime and the associated potential impacts along adjacent shorelines during the operations and maintenance phase of the Mona Offshore Wind Project. The MDS in terms of hydrographic impacts is for up to 68 wind turbines with 4-legged suction bucket foundations for each jacket leg at 5 m diameter spaced 48 m apart, and each bucket with a diameter of 16 m. Scour protection at each bucket foundation of 2.5 m in height and extending 20 m covering a total footprint of 10,816 m^2.

1.9.3.4 Additionally, the MDS includes one OSP, with a rectangular gravity base foundation each with an 80 m by 60 m dimension at the surface and a slab base dimension of 100 m by 80 m. Associated scour protection extends from the slab base by 25 m at a height of 2.6 m giving rise to 19,500 m^2 footprint per unit. The modelled scenario presented in Volume 6, Annex 1.1: Physical processes technical report of the Environmental Statement used an alternate arrangement array layout and also for the inclusion of the OSPs within the modelled scenario.

1.9.3.5 The modelled array comprised of the same number of units and dimensions as those described by the MDS, however, following the modelling study the Mona Array Area has been reduced in size to accommodate navigation issues. The influence of each unit quantified by the modelling study remains applicable for the assessment. This is outlined in section 1.1 and agreed with stakeholders as detailed in Table 1.6. The influence of the rectangular gravity base unit was quantified in supplemental modelling detailed in Volume 6, Annex 1.1: Physical processes technical report of the Environmental Statement.

1.9.3.6 The results of the modelling indicated that peak tidal flows are redirected in the immediate proximity of structures by a maximum variation of 5 cm/s which constitutes as less than 5% of the peak flow and reduces significantly with distance from the structures. These changes are also limited to the immediate Mona Array Area which may have a direct impact on the hydrodynamic regime and persist for the entire lifecycle of the Mona Offshore Wind Project. However, they would be imperceptible beyond the immediate vicinity of the Mona Array Area and would be reversible on decommissioning. The limited nature of these changes would not influence the tidal regime which underpins sediment transport.

1.9.3.7 The use of a single rectangular gravity base OSP forms a greater obstruction to tidal flow. Currents accelerate at the exposed face of the structure and along the sides, whilst decreasing on the sheltered lee side. The variation is a maximum of circa 20% of the tidal current within 50 m of the structure and decreases rapidly with distance. Variations may extend to the proximity of the smaller wind turbine structures but typically less than 1 cm/s. This is a much larger unit than the previous suction bucket foundation types considered with respect to wind turbine structures, however, it would be implemented as a single OSP structure to serve the entire wind project, with other adjacent wind turbines comprised of the smaller foundation types.

1.9.3.8 Cable protection will only be used where sufficient trenching depths cannot be achieved. Project commitments, presented in Table 1.16, outline that no cable protection will be installed within Constable Bank whilst no cable protection higher than 70 cm will be installed within in the Menai Strait and Conwy Bay SAC. If and where cable protection is required within the Menai Strait and Conwy Bay SAC, the cable protection measure used will be with sufficiently low profile to cause minimal changes to tidal flow. Additionally, the percentage of export cable requiring cable protection will not exceed 10% of the total length of the export cable within the Conwy Bay and Menai Straits SAC which does not intersect with any designated features. No more than 5% reduction in water depth (referenced to Chart Datum) will occur at any point along the Mona offshore cable corridor without prior written approval from the Licensing Authority in consultation with the MCA. The installation of Mona export cables will be undertaken via trenchless techniques under the intertidal area from below MLWS, where the exit pits will be located, to onshore. Therefore there will be no placement of cable protection within the intertidal area.

1.9.3.9 From the modelling outcomes presented and the application of project commitments, it is predicted that the impact on tidal regime will affect the Menai Strait & Conwy Bay SAC features and Constable Bank indirectly. The magnitude is therefore, considered to be low within the Menai Strait & Conwy Bay SAC and Constable Bank and negligible at coastal and intertidal receptors.

1.9.3.10 Overall, the impact is predicted to be of local spatial extent, long term duration, continuous and of high reversibility in the event of infrastructure being removed. It is predicted that the impact will affect the receptor indirectly. The magnitude is therefore, considered to be **low**.

Sensitivity of the receptor

1.9.3.11 Overlapping with the Mona Offshore Cable Corridor, the Menai Strait & Conwy Bay SAC is designated for multiple qualifying features under Annex 1 of the EC Habitats Directive; sandbanks which are slightly covered by sea water all the time, mudflats and sandflats not covered by seawater at low tide and reefs. Due to the localised and limited changes in tidal regime the Menai Strait & Conwy Bay SAC features are adaptable. Changes of the magnitude predicted for the Mona Offshore Wind Project however are highly unlikely to lead to a major shift in conditions due to the indirect nature of the changes and distance from the Mona Offshore Wind Project to designated features.

1.9.3.12 The Menai Strait & Conwy Bay SAC is deemed to be of low vulnerability, high recoverability and high value. The sensitivity of the receptor is therefore, considered to be **low**.

1.9.3.13 Also overlapping with the Mona Cable Corridor and Access Areas is the Constable Bank which is not a designated site but supports sandbanks which are an Annex 1 habitat of the EC Habitats Directive. The changes to tidal regime due to the presence of infrastructure identified is localised therefore the sandbank is of low vulnerability and recoverable.

1.9.3.14 The Constable Bank is deemed to be of low vulnerability, high recoverability and high value. The sensitivity of the receptor is therefore, considered to be **low**.

1.9.3.15 Traeth Pensarn SSSI is designated for its vegetated shingle beach and associated plant communities. Shingle ridges would recover from the changes in tidal regime due to the presence of infrastructure identified as localised therefore the shingle beach is adaptable.

1.9.3.16 The Traeth Pensarn SSSI is deemed to be of low vulnerability, high recoverability and high value. The sensitivity of the receptor is therefore, considered to be **low**.

1.9.3.17 Within the physical processes study area, Great Ormes Head SSSI is comprised of features such as reefs (intertidal) and terrestrial habitats, vegetated sea cliffs, European dry heath, and semi-natural dry grassland. These rocky intertidal reefs would recover from changes in tidal regime from infrastructure as no changes extend to Great Ormes Head.

1.9.3.18 The Great Ormes Head SSSI is deemed to be of low vulnerability, high recoverability and high value. The sensitivity of the receptor is therefore, considered to be **negligible** in line with the site being largely onshore.

1.9.3.19 Similarly, Little Ormes Head SSSI is primarily designated on terrestrial habitats but the reef at Little Ormes Head is described as geologically important for its Carboniferous stratigraphy. Reefs and the intertidal area would recover from changes in tidal regime from infrastructure as no changes reach Little Ormes Head.

1.9.3.20 The Little Ormes Head SSSI is deemed to be of low vulnerability, high recoverability and high value. The sensitivity of the receptor is therefore, considered to be **negligible** in line with the site being largely onshore.

1.9.3.21 Bathing water quality is measured in terms of biological levels and due to the distance from the Mona Offshore Wind Project, it is expected that the sensitivity of the receptor to changes in tidal regime is therefore considered to be **negligible.**

Significance of the effect

1.9.3.22 Overall, the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **low**. The effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.

1.9.3.23 A significance of **minor** or **negligible** can be established from a **low** magnitude and **low** receptor, in this case a **negligible adverse** significance is concluded due to the limited scale of the **low** magnitude which does not affect all receptors.

Further mitigation and residual effect

1.9.3.24 No effects which are significant in EIA terms have been identified therefore further mitigation is not required.

Decommissioning phase

Magnitude of impact

1.9.3.25 Following decommissioning, changes to tidal regime would be of lesser magnitude than the operations and maintenance phase, as no structures would remain in the water column to influence tidal currents, with only the colonised scour and cable protection retained within the context of the MDS.

1.9.3.26 No cable protection will be placed within the intertidal region, (i.e. within Traeth Pensarn SSSI) or on Constable Bank. However, cable protection may be retained within the Menai Strait & Conwy Bay SAC, albeit limited, and noting that the export cable route does not intersect with SAC designated features.

1.9.3.27 Overall, the impact is predicted to be of local spatial extent, long term duration, continuous and of high reversibility in the event of infrastructure being removed. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**.

Sensitivity of receptor

1.9.3.28 The sensitivity of receptors to changes in tidal regime remains the same as for all project phases, as detailed in the previous section.

1.9.3.29 Overall, the receptor is deemed to be of low vulnerability, high recoverability and high value. The sensitivity of the receptor is therefore, considered to be **low**.

Significance of effect

1.9.3.30 Overall, the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **low**. The effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.

1.9.3.31 A significance of **minor** or **negligible** can be established from a **low** magnitude and **low** receptor, in this case a **negligible adverse** significance is concluded due to the limited scale of the **low** magnitude which does not affect all receptors.

Further mitigation and residual effects

1.9.3.32 No effects which are significant in EIA terms have been identified therefore further mitigation is not required.

1.9.4 Impacts to the wave regime due to presence of infrastructure and the associated potential impacts along adjacent shorelines.

1.9.4.1 Introducing infrastructure may lead to changes to the wave regime and the associated potential impacts along adjacent shorelines principally during the operations and maintenance phase of the Mona Offshore Wind Project. Also, relevant to a lesser degree is the construction phase and following decommissioning associated with residual infrastructure. Modelling was undertaken using the MDS as outlined in Table 1.15 including the presence of scour protection as outlined in the project description (Volume 1, Chapter 3: Project description of the Environmental Statement). The detail of the numerical modelling underpinning the assessment is provided in Volume 6, Annex 1.1: Physical processes technical report of the Environmental Statement. The magnitude of the impact is detailed in this section along with the assessment of the effect of changes to physical processes on relevant receptors.

Construction phase

1.9.4.2 Similar to the above assessment of tidal regime, modelling was carried out with and without the presence of infrastructure. During the construction phase there will be gradual changes to wave regime as infrastructure is introduced into the environment. This would result in changes and therefore potential impacts ranging from the baseline environment (no presence of infrastructure) to the operational phase MDS), which are assessed in the following section below.

Operations and maintenance phase

Magnitude of impact

1.9.4.3 Changes may occur in the wave regime due to the introduction of infrastructure with the Mona Offshore Wind Project and potential impacts along adjacent shorelines during the operations and maintenance phase. The MDS in terms of hydrographic impacts is for up to 68 wind turbines with 4-legged suction bucket foundations for each jacket leg at 5 m diameter spaced 48 m apart, and each bucket with a diameter of 16 m. Scour protection at each bucket foundation of 2.5 m in height and extending 20 m covering a total footprint of 10,816 m^2.

1.9.4.4 Additionally, the MDS includes one OSP with a rectangular gravity base foundation, with an 80 m by 60 m dimension at the surface and a slab base dimension of 100 m by 80 m at the bed. Associated scour protection extends from the slab base by 25 m at a height of 2.6 m giving rise to 19,500 m^2 footprint per unit. The modelled scenario presented in Volume 6, Annex 1.1: Physical processes technical report of the Environmental Statement used an alternate array arrangement and OSPs within the modelled scenario.

1.9.4.5 The modelled array comprised of the same number of units and dimensions as those described by the MDS however following the modelling study the array area has been reduced in size to accommodate navigation issues. As agreed with stakeholders, (Table 1.6), the influence of each unit quantified by the modelling study remains applicable for the assessment. The influence of the rectangular gravity base unit was quantified in supplemental modelling detailed in Volume 6, Annex 1.1: Physical processes technical report of the Environmental Statement

1.9.4.6 Examination of a 1 in 1 year storm from the west (of greatest influence of approaching storms) shows the deflection of waves by the structures result in a reduction in the lee and increases where the waves had been deflected either side of each structure. Changes in the wave height at the larger wind turbine structures were in the order of 3 cm equating to <1% of the baseline significant wave height. For a 1 in 20 year storm event, the pattern is similar, however, the change in wave height at the structures is 3 cm to 4.5 cm and due to the larger baseline associated with the return period the overall impact on the wave climate is less obvious.

1.9.4.7 In the case of the single rectangular gravity base OSP during a 1 in 20 year storm post construction waves may experience a change up to a maximum of 25 cm or *c.* 4% in the immediate vicinity. These changes reduce in magnitude with distance from the structure, *c.* 2.5% at 200 m. This is a much larger unit than the previous foundation types considered, however, it would be implemented as a single OSP structure to serve the entire wind project, with other adjacent wind turbines comprised of the smaller foundation types.

1.9.4.8 Cable protection will only be used where sufficient trenching depths cannot be achieved. Project commitments, presented in Table 1.16, outline that no cable protection will be installed within Constable Bank whilst no cable protection higher than 70 cm will be installed within in the Menai Strait and Conwy Bay SAC. If and where cable protection is required within the Menai Strait and Conwy Bay SAC, the cable protection measure used will be with sufficiently low profile to cause minimal changes to wave climate. Additionally, the percentage of export cable requiring cable protection will not exceed 10% of the total length of the export cable within the Conwy Bay and Menai Straits SAC which does not intersect with any designated features. No more than 5% reduction in water depth (referenced to Chart Datum) will occur at any point along the Mona offshore cable corridor without prior written approval from the Licensing Authority in consultation with the MCA. The installation of Mona export cables will be undertaken via trenchless techniques under the intertidal area from below MLWS, where the exit pits will be located, to onshore. Therefore there will be no placement of cable protection within the intertidal area..

1.9.4.9 From the modelling outcomes presented and the application of project commitments, it is predicted that the impact on wave climate will affect the Menai Strait & Conwy Bay SAC features and Constable Bank indirectly. The magnitude is therefore considered to be low within the Menai Strait & Conwy Bay SAC and Constable Bank and negligible at coastal and intertidal receptors.

1.9.4.10 Overall, the impact is predicted to be of local spatial extent, long term duration, continuous and of high reversibility in the event of infrastructure being removed. It is predicted that the impact will affect the receptor indirectly. The magnitude is therefore, considered to be **low**.

Sensitivity of receptor

1.9.4.11 Overlapping with the Mona Offshore Cable Corridor, the Menai Strait & Conwy Bay SAC is designated for multiple qualifying features under Annex 1 of the EC Habitats Directive; sandbanks which are slightly covered by sea water all the time, mudflats and sandflats not covered by seawater at low tide and reefs. Menai Strait & Conwy Bay SAC features are adaptable to limited changes in wave regime. Changes of the magnitude predicted for the Mona Offshore Wind Project however are highly unlikely to lead to a major shift in conditions due to the indirect nature of the changes and distance from the Mona Offshore Wind Project to designated features.

1.9.4.12 The Menai Strait & Conwy Bay SAC is deemed to be of low vulnerability, high recoverability and high value. The sensitivity of the receptor is therefore, considered to be **low**.

1.9.4.13 Also overlapping with the Mona Cable Corridor and Access Areas is the Constable Bank which is not a designated site but supports sandbanks which are an Annex 1 habitat of the EC Habitats Directive. The changes to wave climate due to the presence of infrastructure identified is localised therefore the sandbank is of low vulnerability and recoverable.

1.9.4.14 The Constable Bank is deemed to be of low vulnerability, high recoverability and high value. The sensitivity of the receptor is therefore, considered to be **low**.

1.9.4.15 Traeth Pensarn SSSI is designated for its vegetated shingle beach and associated plant communities. Shingle ridges would recover from the changes in tidal regime due to the presence of infrastructure identified as localised.

1.9.4.16 The Traeth Pensarn SSSI is deemed to be of low vulnerability, high recoverability and high value. The sensitivity of the receptor is therefore, considered to be **low**.

1.9.4.17 Within the physical processes study area, Great Ormes Head SSSI is comprised of features such as reefs (intertidal) and terrestrial habitats, vegetated sea cliffs, European dry heath, and semi-natural dry grassland. These rocky intertidal reefs would recover from changes in wave climate from infrastructure as no changes extend to Great Ormes Head.

1.9.4.18 The Great Ormes Head SSSI is deemed to be of low vulnerability, high recoverability and high value. The sensitivity of the receptor is therefore, considered to be **negligible** in line with the site being largely onshore.

1.9.4.19 Similarly, Little Ormes Head SSSI is primarily designated for terrestrial habitats but the reef at Little Ormes Head is described as geologically important for its Carboniferous stratigraphy. Reefs and the intertidal area would recover from changes in wave climate from infrastructure as no changes reach Little Ormes Head.

1.9.4.20 The Little Ormes Head SSSI is deemed to be of low vulnerability, high recoverability and high value. The sensitivity of the receptor is therefore, considered to be **negligible** in line with the site being largely onshore.

1.9.4.21 Bathing water quality is measured in terms of biological levels and due to the distance from the Mona Offshore Wind Project, it is expected that the sensitivity of the receptor to changes in wave climate is therefore considered to be **negligible.**

Significance of effect

1.9.4.22 Overall, the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **low**. The effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.

1.9.4.23 A significance of **minor** or **negligible** can be established from a **low** magnitude and **low** receptor, in this case a **negligible adverse** significance is concluded due to the limited scale of the **low** magnitude which does not affect all receptors.

Further mitigation and residual effects

1.9.4.24 No effects which are significant in EIA terms have been identified therefore further mitigation is not required.

Decommissioning phase

Magnitude of impact

1.9.4.25 Following decommissioning, changes to the wave regime would be of lesser magnitude than the operations and maintenance phase, as no structures would remain in the water column to influence the waves, with only the colonised scour and cable protection retained.

1.9.4.26 No cable protection will be placed within the intertidal region (i.e. within Traeth Pensarn SSSI) or on Constable Bank. However, cable protection may be retained within the Menai Strait & Conwy Bay SAC but this does not intersect with designated features.

1.9.4.27 Overall, the impact is predicted to be of local spatial extent, long term duration, continuous and of high reversibility in the event of infrastructure being removed. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**.

Sensitivity of receptor

1.9.4.28 The sensitivity of receptors to changes in tidal regime remains the same as for all project phases, as detailed in the previous section.

1.9.4.29 Overall, the receptor is deemed to be of low vulnerability, high recoverability and high value. The sensitivity of the receptor is therefore, considered to be **low**.

Significance of effect

1.9.4.30 Overall, the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **low**. The effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.

1.9.4.31 A significance of **minor** or **negligible** can be established from a **low** magnitude and **low** receptor, in this case a **negligible adverse** significance is concluded due to the limited scale of the **low** magnitude which does not affect all receptors.

Further mitigation and residual effects

1.9.4.32 No effects which are significant in EIA terms have been identified therefore further mitigation is not required.

1.9.5 Impacts to sediment transport and sediment transport pathways due to presence of infrastructure and associated potential impacts to physical features and bathymetry.

1.9.5.1 During the operations and maintenance phase the presence of infrastructure may alter the sediment transport and sediment transport pathways leading to changes in the Mona Offshore Wind Project area and the associated potential impacts along adjacent shorelines. The construction phase and following decommissioning associated with residual infrastructure is relevant but changes are gradual and to a lesser extent in these phases. Modelling was undertaken using the MDS as outlined in Table 1.15 including the presence of scour protection as outlined in the project description (Volume 1, Chapter 3: Project description of the Environmental Statement). The detail of the numerical modelling underpinning the assessment is provided in Volume 6, Annex 1.1: Physical processes technical report of the Environmental Statement. The magnitude of the impact is detailed in this section along with the assessment of the effect of changes to physical processes on relevant receptors.

Construction phase

1.9.5.2 During the construction phase there will be gradual changes to sediment transport and sediment transport pathways as infrastructure is introduced into the environment. With changes and therefore potential impacts ranging from the baseline environment (no presence of infrastructure) to the operations and maintenance phase (MDS) assessed in the following section below.

Operations and maintenance phase

Magnitude of impact

1.9.5.3 With the introduction of infrastructure during the operations and maintenance phase changes may occur in the sediment transport and sediment transport pathways in the Mona Offshore Wind Project area and potential impacts along adjacent shorelines. The MDS in terms of hydrographic impacts is for up to 68 wind turbines with 4-legged suction bucket foundations for each jacket leg at 5 m diameter spaced 48 m apart, and each bucket with a diameter of 16 m. Scour protection at each bucket foundation of 2.5 m in height and extending 20 m covering a total footprint of 10,816 m^2.

1.9.5.4 Additionally, the MDS includes one OSP with a rectangular gravity base foundation with an 80 m by 60 m dimension at the surface and a slab base of 100 m by 80 m at the bed. Associated scour protection extends from the slab base by 25 m at a height of 2.6 m giving rise to 19,500 m^2 footprint per unit. The modelled scenario presented in Volume 6, Annex 1.1: Physical processes technical report of the Environmental Statement used an alternate array arrangement and OSPs within the modelled scenario.

1.9.5.5 The modelled array comprised of the same number of units and dimensions as those described by the MDS however following the modelling study the array area has been reduced in size. The influence of each unit quantified by the modelling study remains applicable for the assessment. One of the measures to be adopted as part of the project design, detailed in Table 1.16, is the provision of scour protection. A CMS will be developed and include details of scour protection management to be used around offshore structures and foundations to reduce scour. The scour protection measures will be subject to engineering design to ensure they minimise as much as practical the occurrence of scour. Therefore any impacts would relate only to residual/secondary scour which would be very localised and of negligible magnitude; typically confined to within a few meters of the direct footprint of that scour protection material.

1.9.5.6 To minimise the potential impact from the cables and removal of cables there is a commitment to bury cables where possible. Where burial cannot be achieved to the required depth cable protection may be required. A Cable Burial Risk Assessment and Burial Assessment Study, which will be included within the CSIP, will establish these parameters. The detail of design and construction will be outlined within the CSIP and would also determine the likely extent of any potential scour and would aim to mitigate this through site specific detailed design of scour protection measures. It is therefore likely that any secondary scour effects associated with cable protection and would be confined to within a few meters of the direct footprint of that scour protection material.

1.9.5.7 During the operations and maintenance phase of the project routine inspections will be made of cable and scour protection in line with the Offshore Monitoring Plan. If secondary scour is identified remedial works may be undertaken to both mitigate environmental impacts and also provide asset security.

1.9.5.8 Sediment transport is driven by a combination of tidal currents and wave conditions, the magnitude of these has been individually quantified as described above. For a 1 in 1 year storm from the north, during the flood tide the wave climate is in concert with tidal flow reducing the tidal flow on the lee side of the structure further. However, during the ebb flow, the wave climate and tidal flow are in opposition reducing the magnitude of the littoral current. With the presence of infrastructure, wave climate causes a small reduction in the magnitude of flow whilst there is little difference between the magnitude of littoral current flow and the tidal flows. Changes in magnitude compared to baseline current flow are ±5% which would not be sufficient to disrupt beach and offshore bank morphological processes or destabilise coastal features.

1.9.5.9 Residual currents are effectively the driver of sediment transport and therefore any changes to residual currents would have a direct impact on sediment transport which would persist for the lifecycle of the Mona Offshore Wind Project. However, if the presence of the foundation structures does not have a significant influence on either tide or wave conditions (see impact assessments presented above for changes in tidal and wave regime) they cannot therefore have a significant effect on the sediment transport regime. For completeness, the residual current and sediment transport was simulated with the foundations in place. The maximum change in residual current and sediment transport is circa ±10% which is largely sited within close proximity to the wind turbine foundation structures (i.e. as a result of the scour protection). Changes in the residual current and sediment transport reduce with increasing distance from the wind turbines towards baseline levels.

1.9.5.10 The use of a single rectangular gravity base OSP forms a greater obstruction to sediment transport than the suction bucket foundations considered for the wind turbine structures. The footprint of the foundation is 19,500 m^2, therefore, the orientation of the unit and the detail of the scour protection design will determine the impact of sediment transport pathways. The influence of wave and tides and therefore the driving force of sediment transport, diminished rapidly from the unit, therefore, the OSP being sited within the Mona Array Area would not induce changes to sediment transport beyond the immediate vicinity or extent to adjacent shorelines.

1.9.5.11 Cable protection will only be used where sufficient trenching depths cannot be achieved. Project commitments, presented in Table 1.16, outline that no cable protection will be installed within Constable Bank whilst no cable protection higher than 70 cm will be installed within in the Menai Strait and Conwy Bay SAC. Additionally, the percentage of export cable requiring cable protection will not exceed 10% of the total length of the export cable within the Conwy Bay and Menai Straits SAC which does not intersect with any designated features. No more than 5% reduction in water depth (referenced to Chart Datum) will occur at any point along the Mona offshore cable corridor without prior written approval from the Licensing Authority in consultation with the MCA. The installation of Mona export cables will be undertaken via trenchless techniques under the intertidal area from below MLWS, where the exit pits will be located, to onshore. Therefore there will be no placement of cable protection within the intertidal area.

1.9.5.12 It is anticipated that trenching to the required depth in areas of sandwaves and in the vicinity of sandbanks should be achievable due to the nature of the sediment, with the reduced need for placement of material on the bed in these areas which may potentially reduce transport until pathways are re-established. It is recognised that the best form of cable protection is achieved through cable burial to the required depths, according to the results of a Cable Burial Risk Assessment and Burial Assessment Study, which will be included within the CSIP. Geophysical surveys have been carried out within the Mona Offshore Cable Corridor and Access Areas, and this additional data will be used to determine cable protection requirements and inform detailed design parameters. Noting that as previously outlined, no cable protection will be installed within Constable Bank and no cable protection higher than 70 cm will be installed within in the Menai Strait and Conwy Bay SAC. Where cable protection is required within the Menai Strait and Conwy Bay SAC the cable protection measure used will be with sufficiently low profile to cause minimal changes to sediment transport.

1.9.5.13 Sandwave clearance may be required at the site of turbine locations, particularly in the case of gravity base structures to accommodate a slab base. For the largest gravity base foundation proposed, the slab base has a diameter of 43 m with scour protection extending 22 m from the slab base. Dredging and sandwave clearance may be required up to a diameter of 173 m to accommodate seabed profiling; therefore, there may be localised disruption to sandwave features. As described in section 1.5.1, net sediment transport within Mona Array Area ranges from 0.2 m^3/d/m to 2.0 m^3/d/m with migration of larger sandwave features of *circa* 1 to 4 m per year. This occurs in an easterly direction which indicates that placement of dredged material to the west of clearance operations would aid in sandwave recovery.

1.9.5.14 Within the Mona Array Area, particularly to the north and east, there are areas with sandwave features including megaripples and barchan dunes. These sandwaves will be reduced in height in order to allow passage of the burial tool to enable cable burial to a sufficient target depth. Significant reductions in sandwave clearance volumes have been identified, from those identified within the PEIR, by detailed analysis of survey data and refining the clearance parameters. Sandwave features are predominately aligned perpendicular to the net sediment transport which is to the east. These features are generally circa 1 km in length, however some barchan dunes are greater than 2 km in length (ABPmer, 2023).

1.9.5.15 The detailed requirements for sandwave clearance, particularly for inter-array cabling, will be dependent on the layout of the array and cable routing. The mean height of sandwaves in the Mona Array Area is 8 m, with an average width of 400 m and spaced 750 m apart. To accommodate the passage of the trenching tool (30 m), incorporating side slopes (25 m either side) and passage through the sandwave an average trenching depth of 3 m is required. For context, the clearance of material for a crossing through a typical sandwave therefore represents less than 5% of the volume of the sandwave as a whole.

1.9.5.16 Up to 50% of the Mona Array Area and thus inter-array cable routes may be affected by areas of sandwave features, with fewer and smaller sandwave features within the Mona Offshore Cable Corridor. Considering the average parameters presented for the Mona Array Area, this corresponds to circa 50 sandwave crossings across an area of 150 km^2, representing circa 1% of this region (or 0.5% on the Mona Array Area as a whole). The material which is cleared from the sandwaves to allow passage of the burial tool will not be removed from the site, it will be relocated in close proximity to the sandwave such that it is readily available for sandwave recharge. The magnitude, extent and proposed methodology is therefore unlikely to affect the sandwave system as a whole.

1.9.5.17 The rate of reformation of sandwaves is dependent on a range of factors including the size, location and alignment of any breach with respect to the sediment transport pathways and available recharge material. It has been shown that the region has active sediment transport systems with net sediment transport rates of circa 1 m^3/d/m within Mona Array Area and rates more than double this at sandwave crests. Indeed the use of prelay trenches is not recommended due to rapid infilling. Increases in littoral currents during storm events would also significantly increase transport rates. The sandwave features themselves are also mobile, typically moving 1 to 4 m in an easterly direction each year (ABPmer, 2023). Therefore, although it is not possible to quantify the reformation rate of sandwave breaches with certainty, given the number of variables and dependencies, in an active sediment transport with rechange material available it is anticipated that in the months following installation infilling would become evident. Post installation surveys, that will be undertaken for engineering purposes during the operations and maintenance phase may be utilised to monitor these processes.

1.9.5.18 It is proposed to sequester 7,000 m^3 of the dredged material to provide ballast, however the majority (92.8%) of the dredged material will be placed in the immediate vicinity of the seabed preparation activities. This material will be available for sediment transport under the revised transport pathways, which are altered by typically 10% in the immediate vicinity of the structures as flow and transport are redirected around the infrastructure. Within the Mona Array Area the seabed sediment is comprised largely of coarse gravelly sand, as illustrated in Figure 1.10, and is therefore suited to provide ballast. This, coupled with the diminutive volume, means the removal of coarser fractions would not alter either the local or regional sediment characteristics.

1.9.5.19 The coarse sand which is proposed for use as ballast in gravity base foundations would be drawn from site preparation at each foundation location. Depending on each location, the area affected may vary given the requirement for sandwave clearance or dredging to prepare for the slab base. Typically the area affected corresponds with dredging an area 120 m by 120 m with the material harvested equivalent to 0.5 m in depth. Each of these discrete 120 by 120 m areas are located a minimum of 1.4 km from each other and in total typically represent 0.33% of the Mona Array area. In terms of sediment budget, 490,000 m^3 of the maximum 6,746,105 m^3 seabed preparation volume (which equates to 7.2%) may be removed across the Mona Array Area during the 12 month installation period. This will also equate to an average sediment ballast requirement of 5,104 m^3 per foundation location when 96 gravity base foundations are considered.

1.9.5.20 Typical net sediment transport, under tides alone, though the array area is circa 20,000 m^3 per day; the harvested material therefore represents a one-off 6.7% reduction in sediment budget during the construction phase and would therefore not significantly influence sediment transport across the Mona Array Area.

1.9.5.21 As discussed in section 1.9.2, dredging undertaken at the site of the gravity base foundations will be infilled with gravel, with the sequestered material representing a small proportion of this volume and will not result in a void which could potentially interrupt transport processes by intercepting sediment.

1.9.5.22 The hydrodynamic regime is highly variable through tidal cycles and due to meteorological conditions, with the scale of the impact being well within the natural variation. The changes to tidal currents, wave climate, littoral currents, and sediment transport are insignificant in terms of the hydrodynamic regime and would not alter beach, sandbanks or reefs. Effects on tidal current and wave climate would be reversible on decommissioning (i.e. following removal of the wind turbine structures).

1.9.5.23 It is predicted that the impact on sediment transport regimes will affect the Menai Strait & Conwy Bay SAC features and Constable Bank indirectly. The magnitude is therefore considered to be low within the Menai Strait & Conwy Bay SAC and Constable Bank and negligible at coastal and intertidal receptors.

1.9.5.24 Overall, the impact is predicted to be of local spatial extent, long term duration, continuous and of high reversibility in the event of infrastructure being removed. It is predicted that the impact will affect the receptor indirectly. The magnitude is therefore, considered to be **low**.

Sensitivity of receptor

1.9.5.25 Overlapping with the Mona Offshore Cable Corridor, the Menai Strait & Conwy Bay SAC is designated for multiple qualifying features under Annex 1 of the EC Habitats Directive; sandbanks which are slightly covered by sea water all the time, mudflats and sandflats not covered by seawater at low tide and reefs. Menai Strait & Conwy Bay SAC features are adaptable to limited changes in sediment transport. Changes of the magnitude predicted for the Mona Offshore Wind Project however are highly unlikely to lead to a major shift in conditions due to the indirect nature of the changes and distance from the Mona Offshore Wind Project to designated features.

1.9.5.26 The Menai Strait & Conwy Bay SAC is deemed to be of low vulnerability, high recoverability and high value. The sensitivity of the receptor is therefore, considered to be **low**.

1.9.5.27 Also overlapping with the Mona Offshore Cable Corridor and Access Areas is the Constable Bank which is not a designated site but supports sandbanks which are an Annex 1 habitat of the EC Habitats Directive. The changes to sediment transport patterns due to the presence of infrastructure identified is localised therefore the as an active sandbank is adaptable.

1.9.5.28 The Constable Bank is deemed to be of low vulnerability, high recoverability and high value. The sensitivity of the receptor is therefore, considered to be **low**.

1.9.5.29 Traeth Pensarn SSSI is designated for its vegetated shingle beach and associated plant communities. Shingle ridges would recover from the very limited changes in sediment transport due to the presence of infrastructure.

1.9.5.30 The Traeth Pensarn SSSI is deemed to be of low vulnerability, high recoverability and high value. The sensitivity of the receptor is therefore, considered to be **low**.

1.9.5.31 Within the physical processes study area, Great Ormes Head SSSI is comprised of features such as reefs (intertidal) and terrestrial habitats, vegetated sea cliffs, European dry heath, and semi-natural dry grassland. These rocky intertidal reefs would recover from changes in sediment transport from infrastructure as no changes extend to Great Ormes Head.

1.9.5.32 The Great Ormes Head SSSI is deemed to be of low vulnerability, high recoverability and high value. The sensitivity of the receptor is therefore, considered to be **negligible** in line with the site being largely onshore.

1.9.5.33 Similarly, Little Ormes Head SSSI is primarily designated for terrestrial habitats but the reef at Little Ormes Head is described as geologically important for its Carboniferous stratigraphy. Reefs and the intertidal area would recover from changes in sediment transport from infrastructure as no changes reach Little Ormes Head.

1.9.5.34 The Little Ormes Head SSSI is deemed to be of low vulnerability, high recoverability and high value. The sensitivity of the receptor is therefore, considered to be **negligible** in line with the site being largely onshore.

1.9.5.35 Bathing water quality is measured in terms of biological levels and due to the distance from the Mona Offshore Wind Project, it is expected that the sensitivity of the receptor to changes in sediment transport is therefore considered to be **negligible.**

Significance of effect

1.9.5.36 Overall, the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **low**. The effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.

1.9.5.37 A significance of **minor** or **negligible** can be established from a **low** magnitude and **low** receptor, in this case a **negligible adverse** significance is concluded due to the limited scale of the **low** magnitude which does not affect all receptors.

Further mitigation and residual effects

1.9.5.38 No effects which are significant in EIA terms have been identified therefore further mitigation is not required.

Decommissioning phase

Magnitude of impact

1.9.5.39 Following decommissioning, changes to the sediment transport and sediment pathways would be of lesser magnitude than the operations and maintenance phase, as no structures would remain in the water column to influence the littoral currents above bed level, with only the colonised scour and cable protection remaining *in situ*.

1.9.5.40 No cable protection will be placed within the intertidal region, (i.e. within Traeth Pensarn SSSI) or on Constable Bank. However, cable protection may be retained within the Menai Strait & Conwy Bay SAC but this does not intersect with any SAC designated features.

1.9.5.41 Overall, the impact is predicted to be of local spatial extent, long term duration, continuous and of high reversibility in the event of infrastructure being removed. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**.

Sensitivity of receptor

1.9.5.42 The sensitivity of receptors to changes in tidal regime remains the same as for all project phases, as detailed in the previous section.

1.9.5.43 Overall, the receptor is deemed to be of low vulnerability, high recoverability and high value. The sensitivity of the receptor is therefore, considered to be **low**.

Significance of effect

1.9.5.44 Overall, the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **low**. The effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.

1.9.5.45 A significance of **minor** or **negligible** can be established from a **low** magnitude and **low** receptor, in this case a **negligible adverse** significance is concluded due to the limited scale of the **low** magnitude which does not affect all receptors.

Further mitigation and residual effects

1.9.5.46 No effects which are significant in EIA terms have been identified therefore further mitigation is not required.

1.9.6 Impacts to temperature and salinity stratification due to the presence of infrastructure.

1.9.6.1 Within the physical processes study area most of the water column remains thoroughly mixed due to the occurrence of sufficiently intense tidal mixing throughout the year. There are short periods when marginal stratification occurs for example during hot, calm conditions however these are easily disrupted by storms or spring tides. Localised changes in tidal flow around infrastructure would be beneficial in providing additional mixing in the immediate vicinity.

1.9.6.2 It has been noted that more significant stratification of the water column can occur in estuaries and specifically in the Dee Estuary, as fresh water associated with river discharge is less dense than the saline offshore environment. In order to disrupt temperature and salinity stratification in the Dee Estuary a change in hydrography would be required in this region, an example being increased tidal currents or wave climate resulting in additional mixing.

1.9.6.3 The modelling studies undertaken for the Mona Offshore Wind Project detailed in Volume 6, Annex 1.1: Physical processes technical report of the Environmental Statement demonstrated that potential changes in tidal currents and wave climate do not extend into these areas located beyond the physical processes study area therefore there will be no impact density and thermal stratification in the Dee estuary.

1.9.7 Future monitoring

1.9.7.1 No physical processes monitoring to test the predictions made within the impact assessment is considered necessary.

1.9.7.2 Overall, no effects which are significant in EIA terms have been identified therefore, in terms of physical processes, no specific monitoring is recommended beyond those related to undertaking maintenance activities outlined in the project description, Volume 1, Chapter 3: Project description of the Environmental Statement. These include routine inspections of inter-array, interconnector and offshore export cables to ensure the cables are buried to an adequate depth and not exposed. We anticipate that geophysical surveys will be required as a condition of the marine licence(s).

1.10 Cumulative effect assessment methodology

1.10.1 Methodology

1.10.1.1 The CEA takes into account the impact associated with the Mona Offshore Wind Project together with other projects and plans. The projects and plans selected as relevant to the CEA presented within this chapter are based upon the results of a screening exercise (see Volume 5, Annex 5.1: Cumulative effects screening matrix of the Environmental Statement). Each project has been considered on a case by case basis for screening in or out of the chapter's assessment based upon data confidence, effect-receptor pathways and the spatial/temporal scales involved.

1.10.1.2 The physical processes CEA methodology has followed the methodology set out in Volume 1, Chapter 5: EIA methodology of the Environmental Statement. As part of the assessment, all projects and plans considered alongside the Mona Offshore Wind Project have been allocated into ‘tiers’ reflecting their current stage within the planning and development process, these are listed below.

1.10.1.3 A tiered approach to the assessment has been adopted, as follows:

- Tier 1
  - Under construction
  - Permitted application
  - Submitted application
  - Those currently operational that were not operational when baseline data were collected, and/or those that are operational but have an ongoing impact
- Tier 2
  - Scoping report has been submitted and is in the public domain
- Tier 3
  - Scoping report has not been submitted and is not in the public domain
  - Identified in the relevant Development Plan
  - Identified in other plans and programmes.

1.10.1.4 This tiered approach is adopted to provide a clear assessment of the Mona Offshore Wind Project alongside other projects, plans and activities.

1.10.1.5 The specific projects, plans and activities scoped into the CEA, are outline in Table 1.17 and illustrated in Figure 1.14. In accordance with The Planning Inspectorate advice, where other projects are expected to be completed before construction of the proposed NSIP and the effects of those projects are fully determined, effects arising from them are considered as part of the baseline and are considered as part of both the construction and operational assessment.

Table 1.17: List of other projects, plans and activities considered within the CEA.

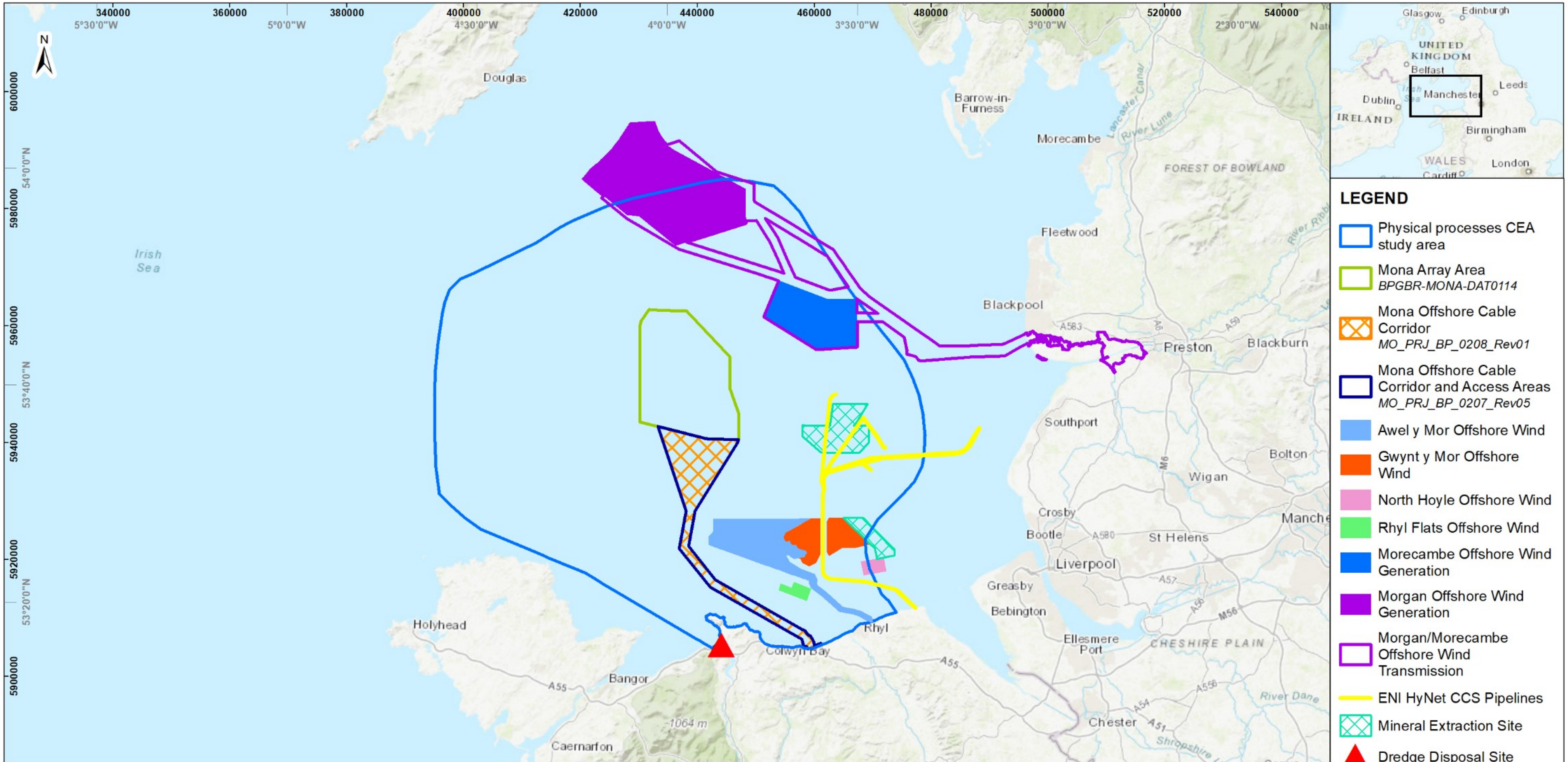
Project/Plan	Status	Distance from the Mona Array Area (km)	Distance from the Mona Offshore Cable Corridor and Access Areas (km)	Description of project/plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Mona Offshore Wind Project
Tier 1- Offshore Wind Projects and Associated Cables							
Awel y Môr Offshore Wind Farm	Consented	13.5	3.6	Awel y Môr Offshore Wind Farm	2026-2029	01/01/2030-01/01/2055	Project Construction Phase overlaps with Mona Offshore Wind Project Construction Phase. Project Operation and Maintenance Phase overlaps with Mona Offshore Wind Project Operations and Maintenance Phase. Project Decommissioning Phase overlaps with Mona Offshore Wind Project Operations and Maintenance Phase.
Rhyl Flats Offshore Wind Farm	Operational	24.8	3.8	Maintenance activities at Rhyl Flats Wind Farm Limited	N/A	04/06/2015-03/06/2034	Project Maintenance Phase overlaps with Mona Offshore Wind Project Construction and Operations and Maintenance Phases. Project Decommissioning Phase overlaps with Mona Offshore Wind Project Operations and Maintenance Phase.

Project/Plan	Status	Distance from the Mona Array Area (km)	Distance from the Mona Offshore Cable Corridor and Access Areas (km)	Description of project/plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Mona Offshore Wind Project
Gwynt y Môr Offshore Wind Farm	Operational	17.8	9.9	Maintenance activities at Gwynt y Môr Offshore Wind Farm Limited	N/A	03/12/2008-03/12/2033	Project Maintenance Phase overlaps with Mona Offshore Wind Project Construction and Operations and Maintenance Phases. Project Decommissioning Phase overlaps with Mona Offshore Wind Project Operations and Maintenance Phase.
North Hoyle Offshore Wind Farm	Operational	29.6	13.6	Maintenance activities at North Hoyle Wind Farm Limited	N/A	19/06/2015-31/12/2029	Project Maintenance Phase overlaps with Mona Offshore Wind Project Construction Phase. Project Decommissioning Phase overlaps with Mona Offshore Wind Project Operations and Maintenance Phase.
Disposal Sites							
Conwy River	Operational	35.2	7.7	Dredging Activities and Dredge Disposal Sites. Extracted amount: 2,813 tonnes.	N/A	10/08/2022-10/08/2037	Project Operational Phase overlaps with Mona Offshore Wind Project Construction and Operations and Maintenance Phases.

Project/Plan	Status	Distance from the Mona Array Area (km)	Distance from the Mona Offshore Cable Corridor and Access Areas (km)	Description of project/plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Mona Offshore Wind Project
Aggregate Extraction							
Hilbre Swash	Operational	22.4	17.2	Deposit and Removals Marine Aggregate Extraction	N/A	01/01/2015-31/12/2029	Project Operational Phase overlaps with Mona Offshore Wind Project Construction Phase.
Tier 2-Offshore Wind Projects and Associated Cables							
Morgan Generation Assets	Pre-application PEIR submitted	5.5	33.0	Morgan Generation Assets	2026-2029	01/01/2030-01/01/2065	Project Construction Phase overlaps with Mona Offshore Wind Project Construction Phase. Project Operation and Maintenance Phase overlaps with Mona Offshore Wind Project Operations and Maintenance Phase. Project Decommissioning Phase overlaps with Mona Offshore Wind Project Decommissioning Phase.

Project/Plan	Status	Distance from the Mona Array Area (km)	Distance from the Mona Offshore Cable Corridor and Access Areas (km)	Description of project/plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Mona Offshore Wind Project
Morecambe Offshore Windfarm: Generation Assets (hereafter referred to as the Morecambe Generation Assets)	Pre-application PEIR submitted	8.9	21.5	Morecambe Generation Assets	2026-2029	01/01/2030-01/01/2065	Project Construction Phase overlaps with Mona Offshore Wind Project Construction Phase. Project Operation and Maintenance Phase overlaps with Mona Offshore Wind Project Operations and Maintenance Phase. Project Decommissioning Phase overlaps with Mona Offshore Wind Project Decommissioning Phase.
Morgan and Morecambe Offshore Windfarms: Transmission Assets	Pre-application PEIR submitted	8.9	21.5	Morgan Offshore Wind Project and Morecambe Offshore Windfarm Transmission Assets	2026-2029	01/01/2030-01/01/2065	Project Construction Phase overlaps with Mona Offshore Wind Project Construction Phase. Project Operation and Maintenance Phase overlaps with Mona Offshore Wind Project Operations and Maintenance Phase. Project Decommissioning Phase overlaps with Mona Offshore Wind Project Decommissioning Phase.

Project/Plan	Status	Distance from the Mona Array Area (km)	Distance from the Mona Offshore Cable Corridor and Access Areas (km)	Description of project/plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Mona Offshore Wind Project
Carbon Capture and Storage (CCS)							
Eni Hynet CCS Offshore development area	Pre-application	12.1	9.5	Re-development of depleted hydrocarbon wells and infrastructure for carbon capture and storage	unknown	unknown	Project Construction Phase overlaps with Mona Offshore Wind Project Construction Phase.
Aggregate Extraction							
Liverpool Bay Area 457	Pre-application	11.0	11.0	Deposit and Removals Marine Aggregate Extraction	unknown	unknown	Project Operational Phase overlaps with Mona Offshore Wind Project Construction Phase.
Tier 3- Subsea Cables (Telecommunications and Interlinks)							
MaresConnect	Pre-application	16.4	0.0	MaresConnect is a proposed 750 MW subsea and underground electricity interconnector system linking the electricity grids in Ireland and Great Britain.	2025-2027	2027 onwards	Project Construction Phase overlaps with Mona Offshore Wind Project Construction Phase. Project Operation and Maintenance Phase overlaps with Mona Offshore Wind Project Operations and Maintenance Phase.



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community	**Data Sources:** **References for all data shown in the map to be added here**	**Geodetic Information:** Datum: ETRS 1989. Projection: ETRS 1989 UTM Zone 30N. Scale@ 271.5mm x 154mm: 1:1,000,000	0 2.5 5 10 nm; 0 5 10 20 km	
Project Name: MONA OFFSHORE WIND PROJECT	**Drawing Title:** Physical processes CEA study area		**Drawing Number:** RPSC-IBE1919-Mona-ES08	

VER	DATE	DETAILS	BY	CHECK
01	27/09/23	Draft ES	RMcK	NRS
02	09/11/23	Final ES	RMcK	NRS

Figure 1.14: Other projects, plans and activities screened into the Mona Offshore Wind Project CEA for physical processes.

1.10.2 Maximum design scenario

1.10.2.1 The MDS identified in Table 1.18 have been selected as those having the potential to result in the greatest effect on an identified receptor or receptor group. The cumulative effects presented and assessed in this section have been selected from the Project Design Envelope provided in Volume 1, Chapter 3: Project description of the Environmental Statement as well as the information available on other projects and plans, in order to inform an MDS. Effects of greater adverse significance are not predicted to arise should any other development scenario, based on details within the Project Design Envelope (e.g. different wind turbine layout), to that assessed here, be taken forward in the final design scheme.

Table 1.18: Maximum design scenario considered for the assessment of potential cumulative effects on physical processes.

[a] C=construction, O=operations and maintenance, D=decommissioning

Potential cumulative effect	Phase[a] C	O	D	Maximum Design Scenario	Justification
Increase in suspended sediments due to construction, operations and maintenance and/or decommissioning related activities, and the potential impact to physical features.	✓	✓	✓	MDS as described for the Mona Offshore Wind Project Table 1.15 assessed cumulatively with the following other projects/plans: **Tier 1** **Construction Phase** • Proposed development of Awel y Môr Offshore Wind Farm • Maintenance of Rhyl Flats Wind Farm • Maintenance of Gwynt y Môr Offshore Wind Farm • Maintenance and decommissioning of North Hoyle Wind Farm • Use of Conwy River disposal site • Operation of Hilbre Swash extraction. **Operations and Maintenance Phase** • Maintenance and decommissioning of Awel y Môr Offshore Wind Farm • Maintenance and decommissioning of Rhyl Flats Wind Farm • Maintenance and decommissioning of Gwynt y Môr Offshore Wind Farm • Use of Conwy River disposal site. **Tier 2** **Construction Phase** • Tier 1 Projects • Construction of Morgan Generation Assets • Construction of Morgan and Morecambe Offshore Wind Farms: Transmission Assets • Construction of Morecambe Generation Assets • Construction of Eni Hynet CCS	Outcome of the CEA will be greatest when the greatest number of other schemes are considered in combination. Including schemes and developments within the CEA study area to capture the potential overlap of impacts during the construction, operations and maintenance and decommissioning phases. Activities from schemes that potentially increase SSCs during the temporal overlap with the Mona Offshore Wind Project phases have been included as these may create a cumulative impact on physical features/receptors.

Potential cumulative effect	Phase[a] C	O	D	Maximum Design Scenario	Justification
				• Operation of Liverpool Bay aggregate extraction area 457. **Operations and Maintenance Phase** • Tier 1 Projects • Operational and maintenance of Morgan Generation Assets • Operational and maintenance of Morgan and Morecambe Offshore Wind Farms: Transmission Assets • Operational and maintenance of Morecambe Generation Assets • Operation of Liverpool Bay aggregate extraction area 457. **Decommissioning Phase** • Decommissioning of Morgan Generation Assets • Decommissioning of Morgan and Morecambe Offshore Wind Farms: Transmission Assets • Decommissioning of Morecambe Generation Assets. **Tier 3** **Construction Phase** • Construction of MaresConnect interconnector.	
Impacts to the tidal regime due to presence of infrastructure and the associated potential impacts along adjacent shorelines.	✓	✓	✓	**Tier 1** **Construction Phase** • Proposed development of Awel y Môr Offshore Wind Farm. **Operations and Maintenance Phase** • Operations and maintenance of Awel y Môr Offshore Wind Farm.	Outcome of the CEA will be greatest when the greatest number of other schemes are considered in combination. Including schemes and developments within the CEA study area to capture the potential overlap of impacts during the construction, operations and maintenance and decommissioning phases. Activities from schemes that potentially

Potential cumulative effect	Phase[a] C	O	D	Maximum Design Scenario	Justification
Impacts to the wave regime due to presence of infrastructure and the associated potential impacts along adjacent shorelines. Impacts to sediment transport and sediment transport pathways due to presence of infrastructure and associated potential impacts to physical features and bathymetry.				**Decommissioning Phase** • Awel y Môr Offshore Wind Farm residual structures. **Tier 2** **Construction Phase** • Tier 1 Projects • Construction of Morgan Generation Assets • Construction of Morgan and Morecambe Offshore Wind Farms: Transmission Assets • Construction of Morecambe Generation Assets. **Operations and Maintenance Phase** • Tier 1 Projects • Operation and maintenance of Morgan Generation Assets • Operation and maintenance of Morgan and Morecambe Offshore Wind Farms: Transmission Assets • Operation and maintenance of Morecambe Generation Assets. **Decommissioning Phase** • Tier 1 Projects • Residual structures of Morgan Generation Assets • Residual structures of Morgan and Morecambe Offshore Wind Farms: Transmission Assets • Residual structures of Morecambe Generation Assets.	impact the tidal/wave regime and sediment transport during the temporal overlap with the Mona Offshore Wind Project phases have been included as these may create a cumulative impact on physical features/receptors.

1.11 Cumulative effects assessment

1.11.1 Overview

1.11.1.1 A description of the significance of cumulative effects upon physical processes receptors arising from each identified impact is given below.

1.11.2 Increase in suspended sediments due to construction, operations and maintenance and/or decommissioning related activities, and the potential impact to physical features.

1.11.2.1 Increased SSCs may arise due to seabed preparation involving sandwave clearance, the installation of the wind turbines and OSP foundations, the installation and/or maintenance of cables and associated decommissioning activities. Should the other projects cited take place concurrently with the Mona Offshore Wind Project (construction or operations and maintenance), there is potential for cumulative increased turbidity levels.

Tier 1

Construction phase

Magnitude of impact

1.11.2.2 The magnitude of the increase in SSCs arising from seabed preparation involving sandwave clearance, the installation of the wind turbines, OSP foundations and cables, has been assessed as low for the Mona Offshore Wind Project alone, as described in section 1.9.2. The greatest impacts are due to installation of the export cabling through the Constable Bank.

1.11.2.3 The construction phase of the Mona Offshore Wind Project may coincide with the maintenance activities associated with the Rhyl Flats Wind Farm, Gwynt y Môr Offshore Wind Farm and North Hoyle Wind Farm. Maintenance activities may result in increased SSC however, these activities would be of limited spatial extent and frequency and unlikely to interact with sediment plumes from the Mona Offshore Wind Project.

1.11.2.4 Also coinciding with the construction phase of the Mona Offshore Wind Project is the proposed development of Awel y Môr Offshore Wind Farm. Construction activities may result in increased SSC; however, these activities would be of limited spatial extent and frequency and unlikely to interact with sediment plumes from the Mona Array Area. However, the Mona Offshore Cable Corridor runs adjacent to the Awel y Môr array area and the cable corridors are parallel. Therefore, interaction of SSC plumes on spring tide events may occur should trenching activities be undertaken simultaneously however this is unlikely. SSC plumes would most likely reach background levels before overlapping with the Awel y Môr development area, when travelling on the flood tide as they would run in parallel. Resultant overlapping plumes may have increased SSCs between 2 mg/l on the outer extent of the plume.

1.11.2.5 The cumulative impact assessment encompasses aggregate extraction at both Hilbre Swash licensed areas located within 22.4 km of the Mona Array Area and 17.2 km of the Mona Offshore Cable Corridor. Resultant plumes from the disposal of dredged material and extraction of aggregate would be advected on the tidal current running in parallel and not coincide.

1.11.2.6 Similarly, the cumulative impact assessment considers sea disposal of dredged material at the Conwy River disposal site, located 35.2 km and 7.7 km from the Mona Array Area and Mona Offshore Cable Corridor respectively. If the offshore cable installation and dredge material dumping coincided both resultant plumes would be advected on the tidal currents, they would travel in parallel, and not towards one another, and are unlikely to interact if offshore cable installation coincides with the use of the licensed sea disposal site.

1.11.2.7 The cumulative effect is predicted to be of local spatial extent, short term duration, intermittent and of high reversibility. It is predicted that the impact will affect the Constable Bank directly and will affect the Menai Strait and Conwy Bay SAC features and Traeth Pensarn SSSI indirectly. The magnitude is therefore, considered to be **low**.

Sensitivity of the receptor

1.11.2.8 The sensitivity of physical processes receptors to increases in SSC and subsequent deposition is discussed in section 1.9.2.

1.11.2.9 The Menai Strait and Conwy Bay SAC features, Traeth Pensarn SSSI and Constable Bank is deemed to be of low vulnerability and high recoverability and of high value. The sensitivity of the receptor is therefore, considered to be **low**.

Significance of effect

1.11.2.10 Overall, the magnitude of the cumulative impact is deemed to be **low**, and the sensitivity of the receptor is considered to be **low**. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.

1.11.2.11 A significance of **minor** or **negligible** can be established from a **low** magnitude and **low** receptor, in this case a **negligible adverse** significance is concluded due to the limited scale of the **low** cumulative effect, which does not affect all receptors.

Further mitigation and residual effect

1.11.2.12 No effects which are significant in EIA terms have been identified therefore further mitigation is not required.

Operations and maintenance phase

Magnitude of impact

1.11.2.13 The magnitude of the increase in SSCs arising from maintenance activities during operations and maintenance phase, has been assessed as negligible for the Mona Offshore Wind Project alone, as described in section 1.9.2.

1.11.2.14 The operations and maintenance phase of the Mona Offshore Wind Project may coincide with the maintenance and decommissioning activities associated with the Awel y Môr Offshore Wind Farm, Rhyl Flats Wind Farm and Gwynt y Môr Offshore Wind Farm. Maintenance activities may result in increased SSC however, these activities would be of limited spatial extent and frequency and unlikely to interact with sediment plumes from the Mona Offshore Wind Project maintenance activities. With resultant plumes from the Mona Offshore Wind Project being smaller in scale than during the construction phase potential cumulative impacts are less likely to occur during this operations and maintenance phase.

1.11.2.15 Awel y Môr, Rhyl Flats and Gwynt y Môr Offshore Wind Farms may be decommissioned on a similar time frame as the Mona Offshore Wind Project. As highlighted previously, any potential increase in SSC associated with sediment plumes as a result of decommissioning activities would be advected on tidal currents. These plumes would run in parallel and are not advected towards each other and therefore do not overlap. Residual structures remaining from the decommissioning of these wind farms would not have a cumulative impact on SSCs.

1.11.2.16 Potential cumulative impacts may relate to maintenance of offshore cables coinciding with the use of the Conwy River disposal site. Maintenance activities are both intermittent and a smaller scale than that of the construction phase and therefore any potential cumulative impacts are less likely to occur and be on a smaller scale.

1.11.2.17 The operation and maintenance phase of the Mona Offshore Wind Project may coincide with the decommissioning activities associated with the North Hoyle Offshore Wind Farm. Decommissioning activities would result in increased suspended sediment concentration however, these activities would be of limited spatial extent and frequency and unlikely to interact with sediment plumes from the Mona Offshore Wind Project given the significant distance separating the sites (13.6 km).

1.11.2.18 The cumulative effect is predicted to be of local spatial extent, short term duration, intermittent and of high reversibility. It is predicted that the impact will affect the Constable Bank directly and will affect the Menai Strait and Conwy Bay SAC features and Traeth Pensarn SSSI indirectly. The magnitude is therefore, considered to be **negligible.**

Sensitivity of the receptor

1.11.2.19 The sensitivity of physical processes receptors to increases in SSC and subsequent deposition is discussed in section 1.9.2.

1.11.2.20 The Menai Strait and Conwy Bay SAC features, Traeth Pensarn SSSI and Constable Bank is deemed to be of low vulnerability and high recoverability and of high value. The sensitivity of the receptor is therefore, considered to be **low**.

Significance of effect

1.11.2.21 Overall, the magnitude of the cumulative impact is deemed to be **negligible**, and the sensitivity of the receptor is considered to be **low**. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.

1.11.2.22 A significance of **minor** or **negligible** can be established from a **negligible** magnitude and **low** sensitivity of the receptor, in this case a **negligible adverse** significance is concluded due to the limited scale of the **negligible** cumulative effect, which does not affect all receptors.

Further mitigation and residual effect

1.11.2.23 No effects which are significant in EIA terms have been identified therefore further mitigation is not required.

Tier 2

Construction phase

Magnitude of impact

1.11.2.24 The magnitude of the increase in suspended sediment concentrations arising from seabed preparation involving sandwave clearance, the installation of the wind turbines, OSP foundations and cables, has been assessed as low for the Mona Offshore Wind Project alone, as described in section 1.9.2. The greatest impacts are due to installation of the export cabling through the Constable Bank.

1.11.2.25 During the construction phase of the Mona Offshore Wind Project there is the potential for cumulative impacts with two proposed offshore wind farm installations (the Morgan Generation Assets and the Morecambe Generation Assets), and the Morgan and Morecambe Offshore Wind Farms: Transmission Assets. Construction activities may result in increased suspended sediment concentrations; however, these activities would be of limited spatial extent and frequency and unlikely to interact with sediment plumes from the Mona Offshore Wind Project. As described in section 1.9.2, SSC plumes are localised to within the immediate vicinity of the construction activity and returning to background levels, therefore, travelling on the tide in parallel will most likely avoid interception of the most concentrated suspended sediment part of each plume.

1.11.2.26 Scoping reports have been submitted to the Offshore Petroleum Regulator for Environment and Decommissioning (OPRED) in relation to the Eni Hynet CCS storage project. Although limited information is available on the project it is likely that it may involve the installation of cables via trenching to accommodate the redevelopment of existing pipelines for CCS. The construction phase Mona Offshore Wind Project coincides with that of the Eni Hynet project located 12.1 km east of the Mona Array Area. As such, interaction between suspended sediment plumes may occur should trenching activities be undertaken simultaneously, however, this is unlikely given the length of construction phase and range of activities. SSC plumes are expected to reach background levels before overlapping and additionally plumes would not directly interact as they would run in parallel.

1.11.2.27 The MMO have been made aware of a proposal by Westminster Gravels Ltd. to undertake aggregate extraction from the Liverpool Bay aggregate extraction area 457. The existing site is the northern of the two mineral extraction sites in Figure 1.14, located 11 km to the east of Mona Array Area. Aggregate extraction activities are typically intermittent and given their nature, to remove rather than deposit material, spilled material will be kept to a minimum. Due to the distance from the Mona Array Area sediment plumes will be greatly dispersed and SSC low when the extraction site is reached meaning that cumulative impacts are unlikely.

1.11.2.28 The cumulative effect is predicted to be of local spatial extent, short term duration, intermittent and of high reversibility. It is predicted that the impact will affect the Constable Bank directly and will affect the Menai Strait and Conwy Bay SAC features and Traeth Pensarn SSSI indirectly. The magnitude is therefore, considered to be **low**.

Sensitivity of the receptor

1.11.2.29 The sensitivity of physical processes receptors to increases in SSC and subsequent deposition is discussed in section 1.9.2.

1.11.2.30 The Menai Strait and Conwy Bay SAC features, Traeth Pensarn SSSI and Constable Bank is deemed to be of low vulnerability and high recoverability and of high value. The sensitivity of the receptor is therefore, considered to be **low**.

Significance of effect

1.11.2.31 Overall, the magnitude of the cumulative impact is deemed to be **low**, and the sensitivity of the receptor is considered to be **low**. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.

1.11.2.32 A significance of **minor** or **negligible** can be established from a **low** magnitude and **low** sensitivity of the receptor, in this case a **negligible adverse** significance is concluded due to the limited scale of the **low** cumulative effect, which does not affect all receptors.

Further mitigation and residual effect

1.11.2.33 No effects which are significant in EIA terms have been identified therefore further mitigation is not required.

Operations and maintenance phase

Magnitude of impact

1.11.2.34 The magnitude of the increase in SSCs arising from maintenance activities during the operations and maintenance phase has been assessed as negligible for the Mona Offshore Wind Project alone, as described in section 1.9.2.

1.11.2.35 The Morgan Generation Assets and the Morecambe Generation Assets, along with the Morgan and Morecambe Offshore Wind Farms: Transmission Assets as cited within the construction phase cumulative assessment will all be within the operational and maintenance phases therefore, as previously, maintenance activities may result in increased SSCs, however these activities would be of limited spatial extent and frequency. The cumulative impacts would therefore be of a lesser magnitude, (i.e. also negligible).

1.11.2.36 During the operations and maintenance phase it is likely that the Liverpool Bay aggregate extraction area 457 will be operational. Given the intermittent nature of both activities and the 11 km separation of the sites, cumulative impacts are very unlikely.

1.11.2.37 The cumulative effect is predicted to be of local spatial extent, short term duration, intermittent and of high reversibility. It is predicted that the impact will affect the Constable Bank directly and will affect the Menai Strait and Conwy Bay SAC features and Traeth Pensarn SSSI indirectly. The magnitude is therefore, considered to be **negligible.**

Sensitivity of the receptor

1.11.2.38 The sensitivity of physical processes receptors to increases in SSC and subsequent deposition is discussed in section 1.9.2.

1.11.2.39 The Menai Strait and Conwy Bay SAC features, Traeth Pensarn SSSI and Constable Bank is deemed to be of low vulnerability and high recoverability and of high value. The sensitivity of the receptor is therefore, considered to be **low**.

Significance of effect

1.11.2.40 Overall, the magnitude of the cumulative impact is deemed to be negligible, and the sensitivity of the receptor is considered to be low. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.

1.11.2.41 A significance of **minor** or **negligible** can be established from a **negligible** magnitude and **low** sensitivity of the receptor, in this case a **negligible adverse** significance is concluded due to the limited scale of the **negligible** cumulative effect, which does not affect all receptors.

Further mitigation and residual effect

1.11.2.42 No effects which are significant in EIA terms have been identified therefore further mitigation is not required.

Decommissioning phase

Magnitude of impact

1.11.2.43 Decommissioning of the Morecambe Generation Assets, the Morgan Generation Assets, and the Morgan and Morecambe Offshore Wind Farms: Transmission Assets, will most likely occur on the same projected timeline as the Mona Offshore Wind Project. Decommissioning activity may result in increased SSCs, however, this would be localised and of a lesser magnitude than the construction phase. If decommissioned prior to the Mona Offshore Wind Project, the residual infrastructure on the seabed would not cause a cumulative increase in SSC.

1.11.2.44 The cumulative effect is predicted to be of local spatial extent, short term duration, intermittent and of high reversibility. It is predicted that the impact will affect the Constable Bank directly and will affect the Menai Strait and Conwy Bay SAC features and Traeth Pensarn SSSI indirectly. The magnitude is therefore, considered to be **low.**

Sensitivity of the receptor

1.11.2.45 The sensitivity of physical processes receptors to increases in SSC and subsequent deposition is discussed in section 1.9.2.

1.11.2.46 The Menai Strait and Conwy Bay SAC features, Traeth Pensarn SSSI and Constable Bank is deemed to be of low vulnerability and high recoverability and of high value. The sensitivity of the receptor is therefore, considered to be **low**.

Significance of effect

1.11.2.47 Overall, the magnitude of the cumulative impact is deemed to be **low**, and the sensitivity of the receptor is considered to be **low**. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.

1.11.2.48 A significance of **minor** or **negligible** can be established from a **low** magnitude and **low** sensitivity of the receptor, in this case a **negligible adverse** significance is concluded due to the limited scale of the **low** cumulative effect, which does not affect all receptors.

Further mitigation and residual effect

1.11.2.49 No effects which are significant in EIA terms have been identified therefore further mitigation is not required.

Tier 3

Construction phase

Magnitude of impact

1.11.2.50 The magnitude of the increase in SSCs arising from seabed preparation involving sandwave clearance, the installation of the wind turbines, OSP foundations and cables, has been assessed as low for the Mona Offshore Wind Project alone, as described in section 1.9.2.

1.11.2.51 During the construction phase the MaresConnect cable will be in construction which may result in increased SSCs, the cable is located 16.4 km from the Mona Array Area and crosses the Mona Offshore Cable Corridor. As expected, the trenching activities for both projects will run concurrently and interaction of SSC plumes on spring tide events may occur. However, the concentration of suspended sediment reduces significantly moving further from the activity with levels of less than 10 mg/l around 8 km away therefore the potential overlap of resultant plumes would be low.

1.11.2.52 The cumulative effect is predicted to be of local spatial extent, short term duration, intermittent and of high reversibility. It is predicted that the impact will affect the Constable Bank directly and will affect the Menai Strait and Conwy Bay SAC features and Traeth Pensarn SSSI indirectly. The magnitude is therefore, considered to be **low**.

Sensitivity of the receptor

1.11.2.53 The sensitivity of physical processes receptors to increases in SSC and subsequent deposition is discussed in section 1.9.2.

1.11.2.54 The Menai Strait and Conwy Bay SAC features, Traeth Pensarn SSSI and Constable Bank is deemed to be of low vulnerability and high recoverability and of high value. The sensitivity of the receptor is therefore, considered to be **low**.

Significance of effect

1.11.2.55 Overall, the magnitude of the cumulative impact is deemed to be **low**, and the sensitivity of the receptor is considered to be **low**. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.

1.11.2.56 A significance of **minor** or **negligible** can be established from a **low** magnitude and **low** sensitivity of the receptor, in this case a **negligible adverse** significance is achieved due to the limited scale of the **low** cumulative effect, which does not affect all receptors.

Further mitigation and residual effect

1.11.2.57 No effects which are significant in EIA terms have been identified therefore further mitigation is not required.

1.11.3 Impacts to the tidal regime due to presence of infrastructure and the associated potential impacts along adjacent shorelines.

1.11.3.1 The presence of infrastructure may lead to changes to the tidal regime and associated potential impacts along adjacent shorelines principally during the operations and maintenance phase of the Mona Offshore Wind Project. This impact is also relevant to the construction phase and following decommissioning associated with residual infrastructure.

Tier 1

Construction phase

1.11.3.2 An assessment of the Mona Offshore Wind Project was carried out with and without the presence of infrastructure. Through this comparative study we can infer that during the construction phase there will be gradual changes to tidal regime, with changes occurring as infrastructure is introduced to the environment. The greatest magnitude of effect and significance will therefore be equal to that of the operations and maintenance phase when all structures are installed.

1.11.3.3 The proposed developments of the Awel y Môr Offshore Wind Farm, Gwynt y Môr Offshore Wind Farm, and the Rhyl Flats Offshore Wind Farm are programmed for construction on the same schedule as the Mona Offshore Wind Project, therefore, cumulative impacts would also range from baseline environment (no presence of infrastructure) to the operations and maintenance phase. The greatest magnitude of cumulative effects and significance will therefore be equal to that of the operations and maintenance phase which is presented in the following section.

Operations and maintenance phase

Magnitude of impact

1.11.3.4 The presence of infrastructure within the offshore wind farm area may lead to changes in tidal regime and the associated potential impacts along adjacent shorelines during the operations and maintenance phase of the Mona Offshore Wind Project. The magnitude of increased infrastructure leading to changes in the tidal regime during the operations and maintenance phase, has been assessed as low for the Mona Offshore Wind Project alone as described in section 1.9.3.

1.11.3.5 The proposed development of the Awel y Môr Offshore Wind Farm comprising of 50 wind turbines may be in operation during the operations and maintenance phase of the Mona Offshore Wind Project. The Awel y Môr Offshore Wind Farm array is 13.5 km from the Mona Array Area and within the Mona Offshore Cable Corridor (due to licensing permits). The modelling carried out for Mona Offshore Wind Project concluded that the impact on tidal regime was low when considering the development alone. Changes are observed in close proximity to the wind turbine structures with tides returning to baseline levels within the Mona Array Area. Therefore, no overlap is expected to create cumulative changes in the tidal regime between the two wind farm developments.

1.11.3.6 The Gwynt y Môr Offshore Wind Farm operations and maintenance phase also overlaps with that of the Mona offshore Wind Project. Despite an increased number of wind turbine structures (160) compared to the Awel y Môr Offshore Wind Farm, the site is located further from the Mona Array Area (17.8 km). As stated above for the Awel y Môr Offshore Wind Farm changes in tidal regime are observed in close proximity to the wind turbine structures, returning to baseline levels within the Mona Array Area. Therefore, no overlap is expected to create cumulative changes in the tidal regime between the two wind farm developments.

1.11.3.7 The Rhyl Flats Offshore Wind Farm operations and maintenance phase also overlaps with that of the Mona offshore Wind Project. However given both reduced turbine numbers (25) and a greater distance of separation (24.8 km) from the Mona Array Area, than the Awel y Môr Offshore Wind Farm no overlap is expected to create cumulative changes in the tidal regime between the two wind farm developments.

1.11.3.8 The cumulative effect is predicted to be of local spatial extent, long term duration, continuous and of high reversibility in the event of infrastructure being removed. It is predicted that the impact will affect the Menai Strait and Conwy Bay SAC features, Traeth Pensarn SSSI and Constable Bank indirectly. The magnitude is therefore, considered to be **low**.

Sensitivity of the receptor

1.11.3.9 The sensitivity of physical processes receptors to changes in tidal regime is discussed in section 1.9.3.

1.11.3.10 The Menai Strait and Conwy Bay SAC features, Traeth Pensarn SSSI and Constable Bank is deemed to be of low vulnerability, recoverable and of high value. The sensitivity of the receptor is therefore, considered to be **low**.

Significance of effect

1.11.3.11 Overall, the magnitude of the cumulative impact is deemed to be **low**, and the sensitivity of the receptor is considered to be **low**. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.

1.11.3.12 A significance of **minor** or **negligible** can be established from a **low** magnitude and **low** sensitivity of receptor, in this case a **negligible adverse** significance is achieved due to the limited scale of the **low** cumulative effect, which does not affect all receptors.

Further mitigation and residual effect

1.11.3.13 No effects which are significant in EIA terms have been identified therefore further mitigation is not required.

Decommissioning phase

Magnitude of impact

1.11.3.14 The presence of residual infrastructure within the Mona Array Area may lead to changes in tidal regime the magnitude of which has been assessed as low for the Mona Offshore Wind Project alone as described in section 1.9.3.

1.11.3.15 With a similar lifespan to the Mona Offshore Wind Project, Awel y Môr Offshore Wind Farm may be or have been decommissioned during the decommissioning phase of the Mona Offshore Wind Project. Residual structures left on the seabed from decommissioning will not cause a cumulative impact on changes to the tidal regime and will result in a lesser magnitude of impact than that described in the operations and maintenance phase.

1.11.3.16 The cumulative effect is predicted to be of local spatial extent, long term duration, continuous and of high reversibility in the event of infrastructure being removed. It is predicted that the impact will affect the Menai Strait and Conwy Bay SAC features indirectly. The magnitude is therefore, considered to be **low**.

Sensitivity of the receptor

1.11.3.17 The sensitivity of physical processes receptors to changes in tidal regime is discussed in section 1.9.3.

1.11.3.18 The Menai Strait and Conwy Bay SAC features, Traeth Pensarn SSSI and Constable Bank is deemed to be of low vulnerability, recoverable and of high value. The sensitivity of the receptor is therefore, considered to be **low**.

Significance of effect

1.11.3.19 Overall, the magnitude of the cumulative impact is deemed to be **low**, and the sensitivity of the receptor is considered to be **low**. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.

1.11.3.20 A significance of **minor** or **negligible** can be established from a **low** magnitude and **low** sensitivity of receptor, in this case a **negligible adverse** significance is concluded due to the limited scale of the **low** cumulative effect, which does not affect all receptors.

Further mitigation and residual effect

1.11.3.21 No effects which are significant in EIA terms have been identified therefore further mitigation is not required.

Tier 2

Construction phase

1.11.3.22 An assessment of the Mona Offshore Wind Project was carried out with and without the presence of infrastructure. Through this comparative study we can infer that during the construction phase there will be gradual changes to tidal regime, with changes occurring as infrastructure is introduced to the environment. The greatest magnitude of effect and significance will therefore be equal to that of the operations and maintenance phase when all structures are installed.

1.11.3.23 The proposed development of Morgan Generation Assets, Morecambe Generation Assets and the Morgan and Morecambe Offshore Wind Farms: Transmission Assets are programmed for construction on the same schedule as the Mona Offshore Wind Project therefore cumulative impacts would also range from baseline environment (no presence of infrastructure) to the operations and maintenance phase. The greatest magnitude of cumulative effects and significance will therefore be equal to that of the operations and maintenance phase which is presented in the following section.

Operations and maintenance phase

Magnitude of impact

1.11.3.24 The magnitude of increased infrastructure leading to changes in the tidal regime during the operations and maintenance phase, has been assessed as low for the Mona Offshore Wind Project alone as described in section 1.9.3.

1.11.3.25 On similar project timelines, the construction and operation of both the Morecambe Generation Assets and Morgan Generation Assets alongside the Morgan and Morecambe Offshore Wind Farms: Transmission Assets are expected to coincide with the operations and maintenance phase of the Mona Offshore Wind Project. The increase in infrastructure will not cause a cumulative change on the tidal regime as the impacts caused by the wind turbines are localised and return to baseline levels just beyond the infrastructure. An overlap of these changes in the tidal flow is not expected as they are limited to the Mona Array Area.

1.11.3.26 The cumulative effect is predicted to be of local spatial extent, long term duration, continuous and of high reversibility in the event of infrastructure being removed. It is predicted that the impact will affect the Menai Strait and Conwy Bay SAC features, Traeth Pensarn SSSI and Constable Bank indirectly. The magnitude is therefore, considered to be **low**.

Sensitivity of the receptor

1.11.3.27 The sensitivity of physical processes receptors to changes in tidal regime is discussed in section 1.9.3.

1.11.3.28 The Menai Strait and Conwy Bay SAC features, Traeth Pensarn SSSI and Constable Bank is deemed to be of low vulnerability, recoverable and of high value. The sensitivity of the receptor is therefore, considered to be **low**.

Significance of effect

1.11.3.29 Overall, the magnitude of the cumulative impact is deemed to be **low**, and the sensitivity of the receptor is considered to be **low**. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.

1.11.3.30 A significance of **minor** or **negligible** can be established from a **low** magnitude and **low** sensitivity of receptor, in this case a **negligible adverse** significance is concluded due to the limited scale of the **low** cumulative effect, which does not affect all receptors.

Further mitigation and residual effect

1.11.3.31 No effects which are significant in EIA terms have been identified therefore further mitigation is not required.

Decommissioning phase

Magnitude of impact

1.11.3.32 The presence of residual infrastructure within the Mona Array Area may lead to changes in tidal regime the magnitude of which has been assessed as low for the Mona Offshore Wind Project alone as described in section 1.9.3.

1.11.3.33 Morecambe Generation Assets and Morgan Generation Assets, along with the Morgan and Morecambe Offshore Wind Farms: Transmission Assets, have a similar lifespan to that of the Mona Offshore Wind Project therefore decommissioning activities could coincide. However, residual structures left on the seabed from decommissioning will not cause a cumulative impact on changes to the tidal regime and will result in a lesser magnitude of impact than that described in the operations and maintenance phase.

1.11.3.34 The cumulative effect is predicted to be of local spatial extent, long term duration, continuous and of high reversibility in the event of infrastructure being removed. It is predicted that the impact will affect the Menai Strait and Conwy Bay SAC features indirectly. The magnitude is therefore, considered to be **low**.

Sensitivity of the receptor

1.11.3.35 The sensitivity of physical processes receptors to changes in tidal regime is discussed in section 1.9.3.

1.11.3.36 The Menai Strait and Conwy Bay SAC features, Traeth Pensarn SSSI and Constable Bank is deemed to be of low vulnerability, recoverable and of high value. The sensitivity of the receptor is therefore, considered to be **low**.

Significance of effect

1.11.3.37 Overall, the magnitude of the cumulative impact is deemed to be **low**, and the sensitivity of the receptor is considered to be **low**. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.

1.11.3.38 A significance of **minor** or **negligible** can be established from a **low** magnitude and **low** sensitivity of receptor, in this case a **negligible adverse** significance is concluded due to the limited scale of the **low** cumulative effect, which does not affect all receptors.

Further mitigation and residual effect

1.11.3.39 No effects which are significant in EIA terms have been identified therefore further mitigation is not required.

1.11.4 Impacts to the wave climate due to presence of infrastructure and the associated potential impacts along adjacent shorelines.

1.11.4.1 Introducing infrastructure may lead to changes to the wave regime and the associated potential impacts along adjacent shorelines principally during the operations and maintenance phase of the Mona Offshore Wind Project. Also, relevant to a lesser degree is the construction phase and following decommissioning associated with residual infrastructure.

Tier 1

Construction phase

1.11.4.2 An assessment of the Mona Offshore Wind Project was carried out with and without the presence of infrastructure. Through this comparative study we can infer that during the construction phase there will be gradual changes to tidal regime, with changes occurring as infrastructure is introduced to the environment. The greatest magnitude of effect and significance will therefore be equal to that of the operations and maintenance phase when all structures are installed.

1.11.4.3 The proposed developments of the Awel y Môr Offshore Wind Farm, Gwynt y Môr Offshore Wind Farm, and the Rhyl Flats Offshore Wind Farm are programmed for construction on the same schedule as the Mona Offshore Wind Project therefore cumulative impacts would also range from baseline environment (no presence of infrastructure) to the operations and maintenance phase. The greatest magnitude of cumulative effects and significance will therefore be equal to that of the operations and maintenance phase which is presented in the following section.

Operations and maintenance phase

Magnitude of impact

1.11.4.4 The magnitude of changes in the wave regime has been assessed as low for the Mona Offshore Wind Project alone as described in section 1.9.4, with no influence on shoreline wave climate.

1.11.4.5 The proposed development of the Awel y Môr Offshore Wind Farm comprising of 50 wind turbines may be in operation during the operations and maintenance phase of the Mona Offshore Wind Project. The Awel y Môr Offshore Wind Farm array is 13.5 km from the Mona Array Area. The modelling carried out for Mona Offshore Wind Project concluded that the impact on the wave regime was low when considering the development alone. Changes are observed in close proximity to the wind turbine structures with changes to wave climate decreasing rapidly with distance from the infrastructure. Under storm conditions from the north the change in wave climate due to the Mona Offshore Wind Project may extend to the limit of the Awel y Môr Offshore Wind Farm however at this distance the change is diminutive (i.e. circa 0.2% reduction in significant wave height during a 1 in 20 storm from the north).

1.11.4.6 The Gwynt y Môr Offshore Wind Farm operations and maintenance phase also overlaps with that of the Mona offshore Wind Project. Despite an increased number of wind turbine structures (160), the site is located further from the Mona Array Area (17.8 km) compared to the Awel y Môr Offshore Wind Farm. Given this further degree of separation it is not expected that an overlap in impacts would occur between the two sites, with changes to wave climate being observed in close proximity to the structures and decreasing rapidly with distance from the infrastructure.

1.11.4.7 The Rhyl Flats Offshore Wind Farm operations and maintenance phase also overlaps with that of the Mona offshore Wind Project. However given both reduced turbine numbers (25) and a greater distance of separation (24.8 km) from the Mona Array Area, than the Awel y Môr Offshore Wind Farm, no overlap is expected to create cumulative changes in the wave climate between the two wind farm developments.

1.11.4.8 The cumulative effect is predicted to be of local spatial extent, long term duration, continuous and of high reversibility in the event of infrastructure being removed. It is predicted that the impact will affect the Menai Strait and Conwy Bay SAC features, Traeth Pensarn SSSI and Constable Bank indirectly. The magnitude is therefore, considered to be **low**.

Sensitivity of the receptor

1.11.4.9 The sensitivity of physical processes receptors to changes in wave climate is discussed in section 1.9.4.

1.11.4.10 The Menai Strait and Conwy Bay SAC features, Traeth Pensarn SSSI and Constable Bank is deemed to be of low vulnerability, recoverable and of high value. The sensitivity of the receptor is therefore, considered to be **low**.

Significance of effect

1.11.4.11 Overall, the magnitude of the cumulative impact is deemed to be **low**, and the sensitivity of the receptor is considered to be **low**. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.

1.11.4.12 A significance of **minor** or **negligible** can be established from a **low** magnitude and **low** sensitivity of receptor, in this case a **negligible adverse** significance is concluded due to the limited scale of the **low** cumulative effect, which does not affect all receptors.

Further mitigation and residual effect

1.11.4.13 No effects which are significant in EIA terms have been identified therefore further mitigation is not required.

Decommissioning phase

Magnitude of impact

1.11.4.14 The magnitude of changes in the wave regime has been assessed as low for the Mona Offshore Wind Project alone as described in section 1.9.4, with no influence on shoreline wave climate.

1.11.4.15 With a similar lifespan to the Mona Offshore Wind Project, Awel y Môr Offshore Wind Farm may be or have been decommissioned during the decommissioning phase of the Mona Offshore Wind Project. Residual structures left on the seabed from decommissioning will not cause a cumulative impact on changes to the wave regime and will result in a lesser magnitude of impact than that described in the operations and maintenance phase.

1.11.4.16 The cumulative effect is predicted to be of local spatial extent, long term duration, continuous and of high reversibility in the event of infrastructure being removed. It is predicted that the impact will affect the Menai Strait and Conwy Bay SAC features, Traeth Pensarn SSSI and Constable Bank indirectly. The magnitude is therefore, considered to be **low**.

Sensitivity of the receptor

1.11.4.17 The sensitivity of physical processes receptors to changes in wave climate is discussed in section 1.9.4.

1.11.4.18 The Menai Strait and Conwy Bay SAC features, Traeth Pensarn SSSI and Constable Bank is deemed to be of low vulnerability, recoverable and of high value. The sensitivity of the receptor is therefore, considered to be **low**.

Significance of effect

1.11.4.19 Overall, the magnitude of the cumulative impact is deemed to be **low**, and the sensitivity of the receptor is considered to be **low**. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.

1.11.4.20 A significance of **minor** or **negligible** can be established from a **low** magnitude and **low** sensitivity of receptor, in this case a **negligible adverse** significance is concluded due to the limited scale of the **low** cumulative effect, which does not affect all receptors.

Further mitigation and residual effect

1.11.4.21 No effects which are significant in EIA terms have been identified therefore further mitigation is not required.

Tier 2

Construction phase

1.11.4.22 An assessment of the Mona Offshore Wind Project was carried out with and without the presence of infrastructure. Through this comparative study we can infer that during the construction phase there will be gradual changes to tidal regime, with changes occurring as infrastructure is introduced to the environment. The greatest magnitude of effect and significance will therefore be equal to that of the operations and maintenance phase when all structures are installed.

1.11.4.23 The proposed development of Morgan Generation Assets, Morecambe Generation Assets and Morgan and Morecambe Offshore Wind Farms: Transmission Assets are programmed for construction on the same schedule as the Mona Offshore Wind Project therefore cumulative impacts would also range from baseline environment (no presence of infrastructure) to the operations and maintenance phase. The greatest magnitude of cumulative effects and significance will therefore be equal to that of the operations and maintenance phase which is presented in the following section.

Operations and maintenance phase

Magnitude of impact

1.11.4.24 The magnitude of changes in the wave regime has been assessed as low for the Mona Offshore Wind Project alone as described in section 1.9.4, with no influence on shoreline wave climate.

1.11.4.25 On similar project timelines, the construction and operation of both the Morecambe Generation Assets and Morgan Generation Assets alongside the Morgan and Morecambe Offshore Wind Farms: Transmission Assets are expected to coincide with the operations and maintenance phase of the Mona Offshore Wind Project. The impact of the Mona Offshore Wind Project on the wave regime has been modelled on its own, with a low magnitude of impact discussed in section 1.9.4. The Morgan Generation Assets are located to the north of the Mona Array Area, whilst the Morecambe Generation Assets are located to the east.

1.11.4.26 Storms approaching from the south are limited in magnitude due to restricted fetch length therefore the changes in wave field do not extend to the Morgan Generation Assets. However, with storms approaching from the north, the Morgan Generation Assets may influence the wave climate in the Mona Array Area to a small degree. The changes in wave climate due to storms from the southwest and west interacting with Mona Array infrastructure do not extend to the Morecambe Generation Assets due to the influence of Anglesey and the reduced number of wind turbine structures in the north of the Mona Array Area. The limited frequency and fetch length would reduce the likelihood of storms from the east giving rise to a change in wave climate in the Mona Array Area due to the presence of the Morecambe Generation Assets.

1.11.4.27 Given storms approaching from the south are limited in magnitude due to restricted fetch lengths, and storms from the southwest/ west mitigated by the influence of Anglesey, changes in the wave regime would not extend as far as the Morgan and Morecambe Offshore Wind Farms: Transmission Assets. Likewise storms from the north and the east are unlikely to create a cumulative change in wave field as the infrastructure associated with the Morgan and Morecambe Offshore Wind Farm: Transmission Assets is much reduced compared to the Morgan Generation Assets and the Morecambe Generation Assets.

1.11.4.28 The cumulative effect is predicted to be of local spatial extent, long term duration, continuous and of high reversibility in the event of infrastructure being removed. It is predicted that the impact will affect the Menai Strait and Conwy Bay SAC features, Traeth Pensarn SSSI and Constable Bank indirectly. The magnitude is therefore, considered to be **low**.

Sensitivity of the receptor

1.11.4.29 The sensitivity of physical processes receptors to changes in wave climate is discussed in section 1.9.4.

1.11.4.30 The Menai Strait and Conwy Bay SAC features, Traeth Pensarn SSSI and Constable Bank is deemed to be of low vulnerability, recoverable and of high value. The sensitivity of the receptor is therefore, considered to be **low**.

Significance of effect

1.11.4.31 Overall, the magnitude of the cumulative impact is deemed to be **low**, and the sensitivity of the receptor is considered to be low. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.

1.11.4.32 A significance of **minor** or **negligible** can be established from a **low** magnitude and **low** sensitivity of receptor, in this case a **negligible adverse** significance is concluded due to the limited scale of the **low** cumulative effect, which does not affect all receptors.

Further mitigation and residual effect

1.11.4.33 No effects which are significant in EIA terms have been identified therefore further mitigation is not required.

Decommissioning phase

Magnitude of impact

1.11.4.34 The magnitude of changes in the wave regime has been assessed as low for the Mona Offshore Wind Project alone as described in section 1.9.4, with no influence on shoreline wave climate.

1.11.4.35 The Morecambe Generation Assets and the Morgan Generation Assets, along with the Morgan and Morecambe Offshore Wind Farms: Generation Assets, have a similar lifespan to that of the Mona Offshore Wind Project and therefore decommissioning activities could coincide. However, residual structures left on the seabed from decommissioning will not cause a cumulative impact on changes to the wave regime and will result in a lesser magnitude of impact than that described in the operations and maintenance phase.

1.11.4.36 The cumulative effect is predicted to be of local spatial extent, long term duration, continuous and of high reversibility in the event of infrastructure being removed. It is predicted that the impact will affect the Menai Strait and Conwy Bay SAC features, Traeth Pensarn SSSI and Constable Bank indirectly. The magnitude is therefore, considered to be **low**.

Sensitivity of the receptor

1.11.4.37 The sensitivity of physical processes receptors to changes in wave climate is discussed in section 1.9.4.

1.11.4.38 The Menai Strait and Conwy Bay SAC features, Traeth Pensarn SSSI and Constable Bank is deemed to be of low vulnerability, recoverable and of high value. The sensitivity of the receptor is therefore, considered to be **low**.

Significance of effect

1.11.4.39 Overall, the magnitude of the cumulative impact is deemed to be **low**, and the sensitivity of the receptor is considered to be **low**. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.

1.11.4.40 A significance of **minor** or **negligible** can be established from a **low** magnitude and **low** sensitivity of receptor, in this case a **negligible adverse** significance is concluded due to the limited scale of the **low** cumulative effect, which does not affect all receptors.

Further mitigation and residual effect

1.11.4.41 No effects which are significant in EIA terms have been identified therefore further mitigation is not required.

1.11.5 Impacts to sediment transport and sediment transport pathways due to presence of infrastructure and associated potential impacts to physical features and bathymetry.

1.11.5.1 During the operations and maintenance phase the presence of infrastructure may alter the sediment transport and sediment transport pathways leading to changes in the Mona Offshore Wind Project area. The construction phase and following decommissioning associated with residual infrastructure is relevant but changes are gradual and to a lesser extent in these phases.

Tier 1

Construction phase

1.11.5.2 An assessment of the Mona Offshore Wind Project was carried out with and without the presence of infrastructure. Through this comparative study we can infer that during the construction phase there will be gradual changes to sediment transport regimes, with changes occurring as infrastructure is introduced to the environment. The greatest magnitude of effect and significance will therefore be equal to that of the operations and maintenance phase when all structures are installed.

1.11.5.3 The proposed developments of the Awel y Môr Offshore Wind Farm, Gwynt y Môr Offshore Wind Farm, and the Rhyl Flats Offshore Wind Farm are programmed for construction on the same schedule as the Mona Offshore Wind Project, therefore, cumulative impacts would also range from baseline environment (no presence of infrastructure) to the operations and maintenance phase. The greatest magnitude of cumulative effects and significance will therefore be equal to that of the operations and maintenance phase which is presented in the following section.

Operations and maintenance phase

Magnitude of impact

1.11.5.4 The presence of Mona Offshore Wind Project infrastructure may lead to changes in sediment transport and sediment transport pathways during the operations and maintenance phase of the Mona Offshore Wind Project. The magnitude of changes in sediment transport and sediment transport pathways during the operations and maintenance phase, has been assessed as low for the Mona Offshore Wind Project alone as described in section 1.9.5.

1.11.5.5 The proposed development of the Awel y Môr Offshore Wind Farm comprising of 50 wind turbines may be in operation during the operations and maintenance phase of the Mona Offshore Wind Project. The Awel y Môr Offshore Wind Farm array is 13.5 km from the Mona Array Area. The modelling carried out for Mona Offshore Wind Project concluded that the impact on sediment transport and sediment transport pathways was low when considering the development alone. Changes are observed in close proximity to the wind turbine structures with sediment transport returning to baseline levels beyond the array area. Therefore, no overlap is expected to create cumulative changes in the sediment transport and sediment transport pathways between the two wind farm developments.

1.11.5.6 The Gwynt y Môr Offshore Wind Farm operations and maintenance phase also overlaps with that of the Mona offshore Wind Project. Despite an increased number of wind turbine structures (160), the site is located further from the Mona Array Area (17.8 km) compared to the Awel y Môr Offshore Wind Farm. Given this further degree of separation it is not expected that an overlap would occur between the two sites, with changes to the sediment transport regime being observed in close proximity to the structures and decreasing rapidly with distance from the infrastructure.

1.11.5.7 The Rhyl Flats Offshore Wind Farm operations and maintenance phase also overlaps with that of the Mona offshore Wind Project. However given both reduced turbine numbers (25) and a greater distance of separation (24.8 km) from the Mona Array Area, than the Awel y Môr Offshore Wind Farm. No overlap is expected to create cumulative changes in the sediment transport regime between the two wind farm developments.

1.11.5.8 The cumulative effect is predicted to be of local spatial extent, long term duration, continuous and of high reversibility in the event of infrastructure being removed. It is predicted that the impact will affect the Menai Strait and Conwy Bay SAC features, Traeth Pensarn SSSI and Constable Bank indirectly. The magnitude is therefore, considered to be **low**.

Sensitivity of the receptor

1.11.5.9 The sensitivity of physical processes receptors to changes in sediment transport and sediment transport pathways is discussed in section 1.9.5.

1.11.5.10 The Menai Strait and Conwy Bay SAC features, Traeth Pensarn SSSI and Constable Bank is deemed to be of low vulnerability, recoverable and of high value. The sensitivity of the receptor is therefore, considered to be **low**.

Significance of effect

1.11.5.11 Overall, the magnitude of the cumulative impact is deemed to be **low**, and the sensitivity of the receptor is considered to be **low**. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.

1.11.5.12 A significance of **minor** or **negligible** can be established from a **low** magnitude and **low** sensitivity of receptor, in this case a **negligible adverse** significance is concluded due to the limited scale of the **low** cumulative effect, which does not affect all receptors.

Further mitigation and residual effect

1.11.5.13 No effects which are significant in EIA terms have been identified therefore further mitigation is not required.

Decommissioning phase

Magnitude of impact

1.11.5.14 The magnitude of changes in sediment transport and sediment transport pathways during the operations and maintenance phase, has been assessed as low for the Mona Offshore Wind Project alone as described in section 1.9.5. With a similar lifespan to the Mona Offshore Wind Project, Awel y Môr Offshore Wind Farm may be or have been decommissioned during the decommissioning phase of the Mona Offshore Wind Project. Residual structures left on the seabed from decommissioning will not cause a cumulative impact on changes to the sediment transport and sediment transport pathways and will result in a lesser magnitude of impact than that described in the operations and maintenance phase.

1.11.5.15 The cumulative effect is predicted to be of local spatial extent, long term duration, continuous and of high reversibility in the event of infrastructure being removed. It is predicted that the impact will affect the Menai Strait and Conwy Bay SAC features, Traeth Pensarn SSSI and Constable Bank indirectly. The magnitude is therefore, considered to be **low**.

Sensitivity of the receptor

1.11.5.16 The sensitivity of physical processes receptors to changes in sediment transport and sediment transport pathways is discussed in section 1.9.5.

1.11.5.17 The Menai Strait and Conwy Bay SAC features, Traeth Pensarn SSSI and Constable Bank is deemed to be of low vulnerability, recoverable and of high value. The sensitivity of the receptor is therefore, considered to be **low**.

Significance of effect

1.11.5.18 Overall, the magnitude of the cumulative impact is deemed to be **low**, and the sensitivity of the receptor is considered to be **low**. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.

1.11.5.19 A significance of **minor** or **negligible** can be established from a **low** magnitude and **low** sensitivity of receptor, in this case a **negligible adverse** significance is concluded due to the limited scale of the **low** cumulative effect, which does not affect all receptors.

Further mitigation and residual effect

1.11.5.20 No effects which are significant in EIA terms have been identified therefore further mitigation is not required.

Tier 2

Construction phase

1.11.5.21 Assessment of the Mona Offshore Wind Project was carried out with and without the presence of infrastructure we can infer that during the construction phase there will be gradual changes to sediment transport and sediment transport pathways, with changes occurring from the baseline environment (no presence of infrastructure) to the operational phase (MDS). The greatest magnitude of effect and significance will therefore be equal to that of the operations and maintenance phase.

1.11.5.22 The proposed development of Morgan Generation Assets, Morecambe Generation Assets and Morgan and Morecambe Offshore Wind Farms: Transmission Assets are programmed for construction on the same schedule as the Mona Offshore Wind Project therefore cumulative impacts would also range from baseline environment (no presence of infrastructure) to the operations and maintenance phase. The greatest magnitude of cumulative effects and significance will therefore be equal to that of the operations and maintenance phase which is presented in the following section.

Operations and maintenance phase

Magnitude of impact

1.11.5.23 On similar project timelines, the construction and operation of both the Morecambe Generation Assets and the Morgan Generation Assets alongside the Morgan and Morecambe Offshore Wind Farms: Transmission Assets are expected to coincide with the construction and operations and maintenance phase of the Mona Offshore Wind Project. The impact of the Mona Offshore Wind Project on the sediment transport and sediment transport pathways has been modelled on its own, with a low magnitude of impact discussed in section 1.9.5. As highlighted above the increase in infrastructure will not cause a cumulative change on the sediment transport and sediment transport pathways as the impacts caused by the wind turbines are localised and return to baseline levels just beyond the infrastructure.

1.11.5.24 The sediment transport pathway in the east Irish Sea occurs in an easterly direction, with sediment carried into the region from the Irish Sea between Anglesey and the Isle of Man. The sediment which enters the Mona Array Area derives from the southern section of this corridor whilst the Morgan Generation Assets sediment transport is supplied from the northern section of this pathway, also from an easterly direction as it is located directly to the north of the Mona Array Area, (ABPmer, 2023). As such, any potential changes to sediment budgets or sediment transport regimes as a result of the Mona Offshore Wind Project will not cumulatively impact either Morecambe Generation Assets or the Morgan Generation Assets as they do not share a common sediment transport pathway.

1.11.5.25 The cumulative effect is predicted to be of local spatial extent, long term duration, continuous and of high reversibility in the event of infrastructure being removed. It is predicted that the impact will affect the Menai Strait and Conwy Bay SAC features, Traeth Pensarn SSSI and Constable Bank indirectly. The magnitude is therefore, considered to be **low**.

Sensitivity of the receptor

1.11.5.26 The sensitivity of physical processes receptors to changes in sediment transport and sediment transport pathways is discussed in section 1.9.5.

1.11.5.27 The Menai Strait and Conwy Bay SAC features, Traeth Pensarn SSSI and Constable Bank is deemed to be of low vulnerability, recoverable and of high value. The sensitivity of the receptor is therefore, considered to be **low**.

Significance of effect

1.11.5.28 Overall, the magnitude of the cumulative impact is deemed to be **low**, and the sensitivity of the receptor is considered to be **low**. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.

1.11.5.29 A significance of **minor** or **negligible** can be established from a **low** magnitude and **low** sensitivity of receptor, in this case a **negligible adverse** significance is concluded due to the limited scale of the **low** cumulative effect, which does not affect all receptors.

Further mitigation and residual effect

1.11.5.30 No effects which are significant in EIA terms have been identified therefore further mitigation is not required.

Decommissioning phase

Magnitude of impact

1.11.5.31 The magnitude of changes in sediment transport and sediment transport pathways during the operations and maintenance phase, has been assessed as low for the Mona Offshore Wind Project alone as described in section 1.9.5. The Morecambe Generation Assets and the Morgan Generation Assets, along with the Morgan and Morecambe Offshore Wind Farms: Transmission Assets, have a similar lifespan to that of the Mona Offshore Wind Project, however, residual structures left on the seabed from decommissioning will not cause a cumulative impact on changes to the sediment transport and sediment transport pathways and will result in a lesser magnitude of impact than that described in the operations and maintenance phase.

1.11.5.32 The cumulative effect is predicted to be of local spatial extent, long term duration, continuous and of high reversibility in the event of infrastructure being removed. It is predicted that the impact will affect the Menai Strait and Conwy Bay SAC features, Traeth Pensarn SSSI and Constable Bank indirectly. The magnitude is therefore, considered to be **low**.

Sensitivity of the receptor

1.11.5.33 The sensitivity of physical processes receptors to changes in sediment transport and sediment transport pathways is discussed in section 1.9.5.

1.11.5.34 The Menai Strait and Conwy Bay SAC features, Traeth Pensarn SSSI and Constable Bank is deemed to be of low vulnerability, recoverable and of high value. The sensitivity of the receptor is therefore, considered to be **low**.

Significance of effect

1.11.5.35 Overall, the magnitude of the cumulative impact is deemed to be **low**, and the sensitivity of the receptor is considered to be **low**. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.

1.11.5.36 A significance of **minor** or **negligible** can be established from a **low** magnitude and **low** sensitivity of receptor, in this case a **negligible adverse** significance is concluded due to the limited scale of the **low** cumulative effect, which does not affect all receptors.

Further mitigation and residual effect

1.11.5.37 No effects which are significant in EIA terms have been identified therefore further mitigation is not required.

1.12 Transboundary effects

1.12.1.1 A screening of transboundary impacts has been carried out and has identified that there was no potential for significant transboundary effects with regard to physical processes from the Mona Offshore Wind Project upon the interests of other states.

1.13 Inter-related effects

1.13.1.1 Inter-relationships are considered to be the impacts and associated effects of different aspects of the proposal on the same receptor. These are considered to be:

- Project lifetime effects: Assessment of the scope for effects that occur throughout more than one phase of the Mona Offshore Wind Project (construction, operations 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 phases (e.g. subsea noise effects from piling, operational wind turbines, vessels and decommissioning)
- Receptor led effects: Assessment of the scope for all effects to interact, spatially and temporally, to create inter-related effects on a receptor. As an example, all effects on physical processes, such as sediment plumes, may interact to produce a different, or greater effect on this receptor than when the effects are considered in isolation. Receptor-led effects may be short term, temporary or transient effects, or incorporate longer term effects.

1.13.1.2 A description of the likely interactive effects arising from the Mona Offshore Wind Project on physical processes is provided in Volume 2, Chapter 11: Inter-related effects – Offshore of the Environmental Statement.

1.14 Summary of impacts, mitigation measures and monitoring

1.14.1.1 Information on physical processes within the physical processes study area was collected through detailed desktop review of existing studies and datasets and supported by numerical modelling.

- Table 1.19 presents a summary of the potential impacts, proposed measures adopted as part of the project and residual effects in respect to physical processes. The impacts assessed include:
  - Increase in suspended sediments due to construction, operations and maintenance and/or decommissioning related activities, and the potential impact to physical features
  - Changes to tidal regime, wave climate and sediment transport due to presence of infrastructure and the associated potential impacts along adjacent shorelines
- Overall, it is concluded that there will be **no significant effects** arising from the Mona Offshore Wind Project during the construction, operations and maintenance or decommissioning phases
- Table 1.20 presents a summary of the potential cumulative impacts, proposed mitigation measures and residual effects. The cumulative impacts assessed include:
  - Increase in suspended sediments due to construction, operations and maintenance and/or decommissioning related activities, and the potential impact to physical features
  - Changes to tidal currents, wave climate, littoral currents and sediment transport
- Overall, it is concluded that there will be **no significant cumulative effects** from the Mona Offshore Wind Project alongside other projects/plans.

- **No potential transboundary impacts** have been identified in regard to effects of the Mona Offshore Wind Project.

Table 1.19: Summary of potential environmental effects, mitigation and monitoring.

[a] C=construction, O=operations and maintenance, D=decommissioning

Description of impact	Phase[a] C	O	D	Measures adopted as part of the project	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
Increase in suspended sediments due to construction, operations and maintenance and/or decommissioning related activities, and the potential impact to physical features.	✓	✓	✓	• Development and adherence to an Offshore CMS which includes a CSIP that will only permit sandwave clearance on the Constable Bank within the swept path width (20m) of the cable burial tool and does not permit sandwave clearance in the Menai Strait and Conwy Bay SAC. • Development and adherence to a Landfall Method Statement which commits to the installation of Mona export cables via trenchless techniques under the intertidal area from below MLWS, where the exit pits will be located, to onshore. There will be no open-cut trenching or placement of cable protection within the intertidal area.	C: Low O: Negligible D: Low	C: Low O: Low D: Low	C: Negligible - adverse O: Negligible - adverse D: Negligible - adverse	N/A	Negligible - adverse	N/A
Impacts to the tidal regime due to presence of infrastructure and the associated potential impacts along adjacent shorelines.	✓	✓	✓	• Development and adherence to an Offshore CMS including a CSIP which will include cable burial where possible and cable protection. • Development and adherence to an Offshore CMS will include details of scour protection management to be used around offshore structures and foundations to reduce scour. The scour protection measures will be	C: Negligible O: Low D: Low	C: Low O: Low D: Low	C: Negligible - adverse O: Negligible - adverse D: Negligible - adverse	N/A	Negligible - adverse	N/A

Description of impact	Phase[a] C	O	D	Measures adopted as part of the project	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
Impacts to the wave regime due to presence of infrastructure and the associated potential impacts along adjacent shorelines.	✓	✓	✓	subject to engineering design to ensure they minimise as much as practical the occurrence of scour. • Development and adherence to a Landfall Method Statement which commits to the installation of Mona export cables via trenchless techniques under the intertidal area from below MLWS, where the exit pits will be located, to onshore. There will be no open-cut trenching or placement of cable protection within the intertidal area. • Development and adherence to an Offshore CMS which includes a CSIP that does not permit cable protection higher than 70 cm to be installed within in the Menai Strait and Conwy Bay SAC and does	C: Negligible O: Low D: Low	C: Low O: Low D: Low	C: Negligible - adverse O: Negligible - adverse D: Negligible - adverse	N/A	Negligible - adverse	N/A

Description of impact	Phase[a] C	O	D	Measures adopted as part of the project	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
Impacts to sediment transport and sediment transport pathways due to presence of infrastructure and associated potential impacts to physical features and bathymetry.	✓	✓	✓	not permit the installation of cable protection within Constable Bank.. • If and where cable protection is required within the SAC the cable protection measure used will be with sufficiently low profile to cause minimal changes to wave, tide and sediment transport. • No more than 5% reduction in water depth (referenced to Chart Datum) will occur at any point along the Mona offshore cable corridor without prior written approval from the Licensing Authority in consultation with the MCA. • Development and adherence to an Offshore CMS which includes a CSIP that will only permit sandwave clearance on the Constable Bank within the swept path width (20m) of the cable burial tool and does not permit sandwave clearance in the Menai Strait and Conwy Bay SAC. • Development and adherence to an Offshore CMS which includes a CSIP which require material arising from drilling and/or sandwave clearance to be deposited in close proximity to the works and within the licenced disposal area applied for.	C: Negligible O: Low D: Low	C: Low O: Low D: Low	C: Negligible - adverse O: Negligible - adverse D: Negligible - adverse	N/A	Negligible - adverse	N/A

Table 1.20: Summary of potential cumulative environmental effects, mitigation and monitoring.

[a] C=construction, O=operations and maintenance, D=decommissioning

Description of effect	Phase[a]			Measures adopted as part of the project	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
	C	O	D							
Tier 1										
Increase in suspended sediments due to construction, operations and maintenance and/or decommissioning related activities, and the potential impact to physical features.	✓	✓	✓	• Development and adherence to an Offshore CMS which includes a CSIP that will only permit sandwave clearance on the Constable Bank within the swept path width (20m) of the cable burial tool and does not permit sandwave clearance in the Menai Strait and Conwy Bay SAC. • Development and adherence to a Landfall Method Statement which commits to the installation of Mona export cables via trenchless techniques under the intertidal area from below MLWS, where the exit pits will be located, to onshore. There will be no open-cut trenching or placement of cable protection within the intertidal area.	C: Low O: Negligible D: Low	C: Low O: Low D: Low	C: Negligible - adverse O: Negligible - adverse D: Negligible - adverse	N/A	Negligible - adverse	N/A
Impacts to the tidal regime due to presence of infrastructure and the associated potential impacts along adjacent shorelines.	✓	✓	✓	• Development and adherence to an Offshore CMS including a CSIP which will include cable burial where possible and cable protection. • Development and adherence to an Offshore CMS will include details of scour protection management to be used around offshore structures and foundations to reduce scour. The scour protection measures will be subject to engineering design to	C: Negligible O: Low D: Low	C: Low O: Low D: Low	C: Negligible - adverse O: Negligible - adverse D: Negligible – adverse	N/A	Negligible - adverse	N/A
Impacts to the wave regime due to presence of infrastructure and the associated potential	✓	✓	✓		C: Negligible O: Low D: Low	C: Low O: Low D: Low	C: Negligible - adverse O: Negligible - adverse	N/A	Negligible - adverse	N/A

Description of effect	Phase[a] C	O	D	Measures adopted as part of the project	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
impacts along adjacent shorelines.				ensure they minimise as much as practical the occurrence of scour • Development and adherence to a Landfall Method Statement which commits to the installation of Mona export cables via trenchless techniques under the intertidal area from below MLWS, where the exit pits will be located, to onshore. There will be no open-cut trenching or placement of cable protection within the intertidal area. • Development and adherence to an Offshore CMS which includes a CSIP that does not permit cable protection higher than 70 cm to be installed within in the Menai Strait and Conwy Bay SAC and does not permit the installation of cable protection within Constable Bank. If and where cable protection is required within the SAC the cable protection measure used will be with sufficiently low profile to cause minimal changes to wave, tide and sediment transport. • No more than 5% reduction in water depth (referenced to Chart Datum) will occur at any point along the Mona offshore cable corridor without prior written approval from the Licensing Authority in consultation with the MCA. • Development and adherence to an Offshore CMS which includes a CSIP that will only permit sandwave			D: Negligible – adverse			
Impacts to sediment transport and sediment transport pathways due to presence of infrastructure and associated potential impacts to physical features and bathymetry.	✓	✓	✓		C: Negligible O: Low D: Low	C: Low O: Low D: Low	C: Negligible - adverse O: Negligible - adverse D: Negligible – adverse	N/A	Negligible - adverse	N/A

Description of effect	Phase[a] C	O	D	Measures adopted as part of the project	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
				clearance on the Constable Bank within the swept path width (20m) of the cable burial tool and does not permit sandwave clearance in the Menai Strait and Conwy Bay SAC. • Development and adherence to an Offshore CMS which includes a CSIP which require material arising from drilling and/or sandwave clearance to be deposited in close proximity to the works and within the licenced disposal area applied for.						
Tier 2										
Increase in suspended sediments due to construction, operations and maintenance and/or decommissioning related activities, and the potential impact to physical features.	✓	✓	✓	• Development and adherence to an Offshore CMS which includes a CSIP that will only permit sandwave clearance on the Constable Bank within the swept path width (20m) of the cable burial tool and does not permit sandwave clearance in the Menai Strait and Conwy Bay SAC. • Development and adherence to a Landfall Method Statement which commits to the installation of Mona export cables via trenchless techniques under the intertidal area from below MLWS, where the exit pits will be located, to onshore. There will be no open-cut trenching or placement of cable protection within the intertidal area.	C: Low O: Negligible D: Low	C: Low O: Low D: Low	C: Negligible - adverse O: Negligible - adverse D: Negligible - adverse	N/A	Negligible - adverse	N/A

Description of effect	Phase[a] C	O	D	Measures adopted as part of the project	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
Impacts to the tidal regime due to presence of infrastructure and the associated potential impacts along adjacent shorelines.	✓	✓	✓	• Development and adherence to an Offshore CMS including a CSIP which will include cable burial where possible and cable protection. • Development and adherence to an Offshore CMS will include details of scour protection management to be used around offshore structures and foundations to reduce scour. The scour protection measures will be subject to engineering design to ensure they minimise as much as practical the occurrence of scour • Development and adherence to a Landfall Method Statement which commits to the installation of Mona export cables via trenchless techniques under the intertidal area from below MLWS, where the exit pits will be located, to onshore. There will be no open-cut trenching or placement of cable protection within the intertidal area. • Development and adherence to an Offshore CMS which includes a CSIP that does not permit cable protection higher than 70 cm to be installed within in the Menai Strait and Conwy Bay SAC and does not permit the installation of cable protection within Constable Bank. If and where cable protection is required within the SAC the cable protection measure used will be with sufficiently low profile to cause	C: Negligible O: Low D: Low	C: Low O: Low D: Low	C: Negligible - adverse O: Negligible - adverse D: Negligible – adverse	N/A	Negligible - adverse	N/A
Impacts to the wave regime due to presence of infrastructure and the associated potential impacts along adjacent shorelines.	✓	✓	✓		C: Negligible O: Low D: Low	C: Low O: Low D: Low	C: Negligible - adverse O: Negligible - adverse D: Negligible – adverse	N/A	Negligible - adverse	N/A
Impacts to sediment transport and sediment transport pathways due to presence of infrastructure and associated potential impacts to physical features and bathymetry.	✓	✓	✓		C: Negligible O: Low D: Low	C: Low O: Low D: Low	C: Negligible - adverse O: Negligible - adverse D: Negligible – adverse	N/A	Negligible - adverse	N/A

Description of effect	Phase[a] C	O	D	Measures adopted as part of the project	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
				minimal changes to wave, tide and sediment transport. • No more than 5% reduction in water depth (referenced to Chart Datum) will occur at any point along the Mona offshore cable corridor without prior written approval from the Licensing Authority in consultation with the MCA. • Development and adherence to an Offshore CMS which includes a CSIP that will only permit sandwave clearance on the Constable Bank within the swept path width (20m) of the cable burial tool and does not permit sandwave clearance in the Menai Strait and Conwy Bay SAC. • Development and adherence to an Offshore CMS which includes a CSIP which require material arising from drilling and/or sandwave clearance to be deposited in close proximity to the works and within the licenced disposal area applied for.						
Tier 3										
Increase in suspended sediments due to construction, operations and maintenance and/or decommissioning related activities, and the potential impact to physical features.	✓	×	×	• Development and adherence to an Offshore CMS which includes a CSIP that will only permit sandwave clearance on the Constable Bank within the swept path width (20m) of the cable burial tool and does not permit sandwave clearance in the Menai Strait and Conwy Bay SAC.	C: Low O: Negligible D: Low	C: Low O: Low D: Low	C: Negligible - adverse O: Negligible - adverse D: Negligible - adverse	N/A	Negligible - adverse	N/A

Description of effect	Phase[a] C	O	D	Measures adopted as part of the project	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
				• Development and adherence to a Landfall Method Statement which commits to the installation of Mona export cables via trenchless techniques under the intertidal area from below MLWS, where the exit pits will be located, to onshore. There will be no open-cut trenching or placement of cable protection within the intertidal area.						

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