Awel y Môr Offshore Wind Farm

Category 6: Environmental Statement

Volume 2, Chapter 3: Marine Water and Sediment Quality

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Glossary of terms

TERM	DEFINITION
Contaminants	Polluting substances, such as certain metals and organic substances, which may be detrimental to biota when present in sufficient concentrations in the marine environment.
Holocene	The Holocene is the current geological epoch. It began approximately 11,650 calibrated years before present, after the last glacial period, which concluded with the Holocene glacial retreat. The Holocene and the preceding Pleistocene together form the Quaternary period.
Suspended sediment concentrations	Sediment which is present within the water column and is transported by the movement of the water.
Water Framework Directive	The Water Framework Directive 2000/60/EC is an EU directive which commits European Union member states to achieve good qualitative and quantitative status of all water bodies by 2015.

Abbreviations and acronyms

TERM	DEFINITION
ATM	Anglesey Turbidity Maximum
AyM	Awel y Môr Offshore Wind Farm
BEIS	Department for Business, Energy and Industrial Strategy
BSL	Below Sea Level
CBRA	Cable Burial Risk Assessment
CEMP	Construction Environmental Management Plan (applicable to onshore works only)
CSIP	Cable Specification and Installation Plan
DECC	Department for Energy and Climate Change

TERM	DEFINITION
DCO	Development Consent Order
DCWW	Dwr Cymru/ Welsh Water
ECC	Export Cable Corridor
EIA	Environmental Impact Assessment
EQSs	Environmental Quality Standards
EQSD	Environmental Quality Standards Directive
ES	Environmental Statement
ETG	Expert Topic Group
EU	European Union
GBS	Gravity Base System
GyM	Gwynt y Môr offshore wind farm
HRA	Habitats Regulation Assessment
HDD	Horizontal Directional Drilling
IE	Intestinal Enterococci
JUVs	Jack-Up Vessels
LAT	Lowest Astronomical Tide
MAC	Maximum Allowable Concentration
MDS	Maximum Design Scenario
MFE	Mass Flow Excavator
MHWS	Mean High Water Springs
MPCP	Marine Pollution Contingency Plan
MSFD	Marine Strategy Framework Directive (2008/56/EC)
MW	Megawatt
MW&SQ	Marine Water and Sediment Quality
NAO	North Atlantic Oscillation

TERM	DEFINITION
NPS	National Policy Statement
NRW	Natural Resources Wales
OSP	Offshore Substation Platform
OWF	Offshore Wind Farm
O&M	Operation and Maintenance
PSA	Particle Size Analysis
PINS	Planning Inspectorate
PCBs	Polychlorinated biphenyls
PAHs	Polycyclic Aromatic Hydrocarbons
PEIR	Preliminary Environmental Information Report
PELs	Probable Effect Levels
PEMP	Project Environment Management Plan (applicable to offshore works only)
RIAA	Report to Inform Appropriate Assessment
rBWD	revised Bathing Water Directive (2006/7/EC)
RBMP	River Basin Management Plan
SEA	Strategic Environmental Assessment
SoS	Secretary of State
SPM	Suspended Particulate Matter
SPP	Scour Protection Plan
SSC	Suspended Sediment Concentrations
TELs	Threshold Effect Levels
TSHD	Trailer Suction Hopper Dredger
WFD	Water Framework Directive
WTGs	Wind Turbine Generators

TERM	DEFINITION
ZoI	Zone of Influence

Units

UNIT	DEFINITION
m	metres
m^2	Square metre
m^3	Cubic metre
mg/l	Milligrams per litre
mg/kg	Milligrams per kilogram
µg/kg	Micrograms per kilogram

3 Marine water and sediment quality

3.1 Introduction

1 This chapter has been prepared by GoBe Consultants Ltd and presents an assessment of the potential effects on marine water and sediment quality (MW&SQ) of the offshore works (including construction, operation and maintenance (O&M) and decommissioning) associated with the Awel y Môr Offshore Wind Farm (hereafter referred to as AyM).

2 This chapter has been informed by the following Environmental Statement (ES) chapters and annexes:

- Volume 2, Chapter 1: Offshore Project Description (application ref: 6.2.1);
- Volume 2, Chapter 2: Marine Geology, Oceanography and Physical Processes (application ref: 6.2.2);
- Volume 4, Annex 2.1: Physical Processes Technical Baseline (application ref: 6.4.2.1);
- Volume 4, Annex 2.3: Physical Processes Modelling Results (application ref: 6.4.2.3);
- Volume 2, Chapter 5: Benthic Subtidal and Intertidal Ecology (application ref: 6.2.5); and
- Volume 2, Chapter 6: Fish and Shellfish Ecology (application ref: 6.2.6).

3.2 Statutory and policy context

3 This section identifies legislation and national and local policy of relevance to marine water and sediment quality. The Planning Act 2008, Marine Works (Environmental Impact Assessment) Regulations 2007 (as amended), the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (collectively referred to as the 'the EIA Regulations') and Environment (Wales) Act 2016 are considered in addition to legislation specific to marine water and sediment quality.

4 A marine licence is required under the Marine and Coastal Access Act 2009 before carrying out any licensable marine activity. A marine licence must be applied for separately in Welsh waters (i.e. not deemed within the DCO). The responsibility for marine licencing in Wales lies with the Welsh Government, but day-to-day authority has been delegated to Natural Resources Wales (NRW). The marine licence application requires this EIA to be carried out under the Marine Works (Environmental Impact Assessment) Regulations 2007 (as amended).

5 The following section provides information regarding the legislative context surrounding the assessment of potential effects in relation to the MW&SQ.

6 The Environment Bill was granted Royal Assent on 9 November 2021, meaning it is now an Act of Parliament, the Environment Act 2021. With regard to water quality, the Environment Act 2021 provides powers to enable the Secretary of State (SoS) (and Welsh Ministers) to amend/ modify any legislation for the purpose of making provision about the substances to be taken into account and specifying standards in relation to those substances in assessing the chemical status of surface waters or ground waters. Therefore, the provisions of the Environment Act 2021 could result in amendments/ modifications to the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 which currently transposes the Water Framework Directive (WFD; 2000/60/EC) into Welsh Law. Whilst the UK left the European Union (EU) on 31 January 2020, the UK continues to be committed to meeting high environmental standards. The main provisions of the WFD have been retained in Welsh Law through the Floods and Water (Amendment etc.) (EU Exit) Regulations 2019.

7 In undertaking the assessment, the following policy and legislation has been considered:

- The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017;
- The Marine Works (Environmental Impact Assessment) Regulations 2007 (as amended);

- Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy (the Water Framework Directive (WFD));
- The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017;
- Directive 2008/105/EC of the European Parliament establishing Environmental Quality Standards for contaminants in water (Environmental Quality Standards Directive; EQSDs);
- Directive 2006/7/EC of the European Parliament concerning the management of Bathing Water quality (revised Bathing Water Directive);
- The Bathing Water Regulations 2013;
- Directive 2008/56/EC of the European Parliament an of the Council establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive; MSFD); and
- The International Convention for the Prevention of Marine Pollution by Ships (MARPOL Convention) 73/78.

8 Guidance on the issues to be assessed for offshore renewable energy developments has been obtained through reference to:

- The Overarching National Policy Statement (NPS) for Energy (NPS EN-1; Department for Energy and Climate Change (DECC), 2011a);
- The NPS for Renewable Energy Infrastructure (NPS EN-3, DECC, 2011b);
- The NPS for Electricity Networks Infrastructure (NPS EN-5; DECC, 2011c);
- The UK Marine Policy Statement (MPS; HM Government, 2011); and
- The Welsh National Marine Plan (Welsh Government, 2019).

9 In addition to the current NPS, draft revised NPSs were consulted upon in 2021 (consultation closed on 30 November 2021). The draft revised NPSs have been reviewed to determine the emerging expectations and changes from previous iterations of the NPSs. This includes the Draft revised Overarching NPS EN-1 (Department for Business, Energy and Industrial Strategy (BEIS), 2021a) Draft revised NPS for Renewable Energy Infrastructure EN-3 (BEIS, 2021b) and Draft revised NPS for Electricity Networks Infrastructure EN-5 (BEIS, 2021c).

10 Table 1 provides a summary of the key provisions of relevance to this assessment. Following a review of Future Wales: The National Plan 2040, no policies of specific relevance to MW&SQ receptors in the context of the proposed development were identified, beyond the linkages with the Welsh National Marine Plan which are addressed below in Table 1.

Table 1: Legislation and policy context.

LEGISLATION/ POLICY	KEY PROVISIONS	SECTION WHERE COMMENT ADDRESSED
NPS EN-1	Paragraph 5.15.1 states: "*Infrastructure development can have adverse effects on the water environment, including groundwater, inland surface waters, transitional waters and coastal waters. During the construction, operation and decommissioning phases, discharges would occur. There may also be an increased risk of spills and leaks of pollutants to the water environment. These effects could lead to adverse impacts on health or on protected species and habitats and could, in particular, result in surface waters, ground waters of protected areas failing to meet environmental objectives established under the Water Framework Directive*".	Sections 3.10 to 3.14 of this chapter present the assessment of the proposed development on MW&SQ receptors. Specifically, the risk of accidental releases and spills of materials is assessed for each phase of the project explicitly.
Draft NPS EN-1	Paragraph 5.16.1 states: "*Infrastructure development can have adverse effects on the water environment, including groundwater, inland surface waters, transitional waters and coastal waters. During the construction, operation and decommissioning phases, it can lead to increased demand for water, involve discharges to water and cause adverse ecological effects resulting from physical modifications to the water environment. There may also be an increased risk of spills*	Sections 3.10 to 3.14 of this chapter present the assessment of the proposed development on MW&SQ receptors. Specifically, the risk of accidental releases and spills of materials is assessed for each phase of the project explicitly.

LEGISLATION/ POLICY	KEY PROVISIONS	SECTION WHERE COMMENT ADDRESSED
	and leaks of pollutants to the water environment. These effects could lead to adverse impacts on health or on protected species and habitats and could, in particular, result in surface waters, groundwaters of protected areas failing to meet environmental objectives established under the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 and the Marine Strategy Regulations 2010".	
NPS EN-1	Paragraph 5.15.2 states: "*Where the project is likely to have effects on the water environment, the application should undertake an assessment of the existing status of, and impacts of the proposed project, on water quality, water resources and physical characteristics of the water environment as part of the ES or equivalent*".	Sections 3.10 to 3.14 of this chapter present the assessment of the proposed development on MW&SQ receptors. An assessment of the physical characteristics is presented in Volume 2, Chapter 2: Marine Geology, Oceanography and Physical Processes (application ref: 6.2.2). An assessment of freshwater resources and quality is presented in Volume 3, Chapter 7: Hydrology and Flood Risk (application ref: 6.3.7).
Draft NPS EN-1	Paragraph 5.16.2 states: "*Where the project is likely to have effects on the water environment, the application should undertake an assessment of the existing status of, and impacts of the*	Sections 3.10 to 3.14 of this chapter present the assessment of the proposed development on MW&SQ receptors. An assessment of the

LEGISLATION/ POLICY	KEY PROVISIONS	SECTION WHERE COMMENT ADDRESSED
	proposed project, on water quality, water resources and physical characteristics of the water environment as part of the ES or equivalent".	physical characteristics is presented in Volume 2, Chapter 2: Marine Geology, Oceanography and Physical Processes (application ref: 6.2.2). An assessment of freshwater resources and quality is presented in Volume 3, Chapter 7: Hydrology and Flood Risk (application ref: 6.3.7).
NPS EN-3	Paragraph 2.6.189 states: "*The construction, operation and decommissioning of offshore energy infrastructure (including the preparation an installation of the cable route, as noted in the Draft* [revised] *NPS EN-3) can affect the following elements of the physical offshore environment, which can have knock on impacts on other biodiversity receptors… water quality –disturbance of the seabed sediments or the release of contaminants can result in indirect effects on habitats and biodiversity and fish stocks thus affecting the fishing industry*".	As assessment of the disturbance of sediments and the potential risks is provided in Sections 3.10 to 3.14 of this chapter. The indirect effects on benthic ecology, fish ecology and habitats are provided in Volume 2, Chapter 5: Benthic Subtidal and Intertidal Ecology; Volume 2, Chapter 6: Fish and Shellfish and the Report 5.1: Report to Inform Appropriate Assessment (RIAA) (application refs: 6.2.5, 6.2.6, and 5.2, respectively).
Draft NPS EN-3	Paragraph 2.25.1 states: "The construction, operation and decommissioning of offshore energy infrastructure (including the preparation an installation of the cable route, as noted in the Draft	As assessment of the disturbance of sediments and the potential risks is provided in Sections 3.10 to 3.14 of this chapter. The indirect effects on

LEGISLATION/ POLICY	KEY PROVISIONS	SECTION WHERE COMMENT ADDRESSED
	[revised] NPS EN-3) can affect the following elements of the physical offshore environment, which can have knock on impacts on other biodiversity receptors... water quality –disturbance of the seabed sediments or the release of contaminants can result in indirect effects on habitats and biodiversity and fish stocks thus affecting the fishing industry".	benthic ecology, fish ecology and habitats are provided in Volume 2, Chapter 5: Benthic Subtidal and Intertidal Ecology; Volume 2, Chapter 6: Fish and Shellfish and the Report 5.1: Report to Inform Appropriate Assessment (RIAA) (application refs: 6.2.5, 6.2.6, and 5.2, respectively).
Welsh National Marine Plan	Policy ENV_06: Air and water quality states: "*Proposals should demonstrate that they have considered their potential air and water quality impacts and should, in order of preference: a. avoid adverse impacts; and/or b. minimize adverse impacts where they cannot be avoided; and/or c. mitigate adverse 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".*	An assessment of the significance of potentially adverse impacts on MW&SQ receptors are provided in Sections 3.10 to 3.14 of this chapter. The embedded mitigation measures which seek to reduce and/ or avoid adverse impacts are presented in Table 16. No significant adverse impacts, with the embedded mitigation measures in place, were identified and as such no additional mitigation measures are proposed by the Applicant.

3.2.1 Water Framework Directive

11 The EU WFD (2000/60/EC) was established in 2000 in order to provide a single framework for the protection of surface waterbodies (including rivers, lakes, coasts and estuaries) and groundwater. Each waterbody has an assigned ecological status. The ecological status is assigned by considering biological, hydromorphological, physico-chemical and specific chemical parameters. The different ecological statuses are:

- High;
- Good;
- Moderate;
- Poor; or
- Bad.

12 The WFD's objective of "Good chemical status" is defined in terms of compliance with all the quality standards established for chemical substances at European level. This will ensure at least a minimum chemical quality, particularly in relation to very toxic substances.

13 The WFD's objective of 'good ecological status' also requires certain chemical conditions. The chemical requirements include the achievement of environmental quality objectives for discharged priority substances. It also identifies any other substances liable to cause pollution or being discharged in significant quantities.

14 The Environmental Quality Standards Directive (EQSD) list[i] identifies priority substances and polluting chemicals which should be considered in WFD assessments for transitional and coastal waterbodies. The WFD and EQSD seek to reduce these substances entering into the marine environment, primarily from discharges and outfalls. Priority substances include, but are not limited to benzene, nickel and lead.

15 This ES chapter should be read in conjunction with Volume 4, Annex 3.1: Water Framework Directive Assessment (application ref: 6.4.3.1).

[i] https://www.gov.uk/government/publications/list-of-chemicals-for-water-framework-directive-assessments/environmental-quality-standards-directive-eqsd-list-for-wfd-assessments

16 No designated Shellfish Water Protected Areas have been identified within the project's Zone of Influence (ZoI)[ii] (see Section 3.4.1) and, as such, the requirements of the WFD in relation to shellfish waters have not been included in this chapter.

17 The Second State of Natural Resources Report (SoNaRR2020) (NRW, 2021a) highlights the role of River Basin Management Plans (RBMPs) integrating the measures and objectives of various legislation, including to reach good ecological status, as required under the WFD and UK Marine Strategy (framework for delivering marine policy at the UK level, originally developed to support implementation of the MSFD in the UK). The report highlights the many synergies between Good Status, sustainable management of natural resources and other initiatives to contribute to the wider ecosystem. The report also highlights that, whilst there are opportunities and benefits of addressing water quality, potential trade-offs may be required in order to achieve this, such as changes to agricultural processes to reduce dissolved inorganic nitrogen entering the marine environment.

3.2.2 Bathing Water Directive

18 The EU's revised Bathing Water Directive (rBWD) came into force in March 2006. The rBWD has been implemented in England and Wales via the Bathing Water Regulations 2013 (as amended), with Bathing Waters classified against the standards set by the rBWD since 2015. The rBWD provides more stringent standards than the previous Directive and places an emphasis on providing information to the public. The rBWD has four different classifications of performance, as follows:

- Excellent - the highest, cleanest class;
- Good - generally good water quality;
- Sufficient - water quality meets minimum required standards; and
- Poor - water quality does not meet the minimum required standards.

[ii] [redacted]

19 NRW measures, monitors and reports the number of certain types of bacteria which may indicate the presence of pollution, mainly from sewage or animal faeces. These are *Escherichia coli* (*E. coli*) and intestinal Enterococci (IE). An increase in the concentrations of these bacteria indicates a decrease in water quality.

20 NRW collects at least eight water samples from each Bathing Water in Wales each year during the bathing season (15 May to 30 September). All Bathing Waters of relevance for the purposes of this assessment are presented in Section 3.7.3 of this chapter. An overall classification for the Bathing Water is then determined by creating a distribution from the monitoring data for the last four years. A separate distribution is calculated for both *E. coli* and IE. This then enables the determination of the classification for each bacterium for the Bathing Water.

21 If the classification for both types of bacteria is different, then the overall compliance of the Bathing Water is the lowest classification achieved by either type. For example, if *E. coli* were performing at 'Good' but IE was performing at 'Sufficient', then the Bathing Water would be classified as performing at 'Sufficient'.

3.3 Consultation and Scoping

22 As part of the Environmental Impact Assessment (EIA) for AyM, consultation has been undertaken with various statutory and non-statutory authorities, through the agreed Evidence Plan process (being used for the EIA process as well as for the Habitats Regulation Assessment (HRA)). A formal Scoping Opinion was sought from the SoS following submission of the Scoping Report (innogy, 2020). The Scoping Opinion (the Planning Inspectorate (PINS), 2020) was issued in July 2020 by PINS. A Preliminary Environmental Information Report (PEIR) was subsequently published for formal consultation between 31 August and 11 October 2021. A record of key areas of consultation undertaken during the Scoping Opinion and Evidence Plan phases, as well as responses to the PEIR, is summarised within Table 2 and will be presented in full within the project consultation report (application ref: 5.1).

23 Note: All consultation relating specially to the WFD assessment is presented in Volume 4, Annex 3.1: Water Framework Directive Assessment (application ref: 6.4.3.1).

Table 2: Summary of consultation relating to MW&SQ.

DATE AND CONSULTATION PHASE/ TYPE	CONSULTATION AND KEY ISSUES RAISED	SECTION WHERE COMMENT ADDRESSED
NRW, November 2019 Pre scoping Evidence Plan meeting	It was agreed that key data sources for baseline characterisation include the Water Watch Wales website and the Bathing Waters explorer.	Data sources used to inform the characterisation of the baseline are provided in Section 3.4.3.
July 2020 Scoping Opinion	"The Inspectorate notes that the information provided to support the request in the Scoping Report relates to offshore oil and gas developments. The Inspectorate does not consider that this information is representative and applicable to the Proposed Development. Accordingly, the Inspectorate does not agree to scope these matters out of the ES. The Applicant should make effort to agree the approach to the assessment with relevant consultation bodies including NRW."	Following discussion with consultation bodies, including NRW, the scope of this assessment was agreed through the Evidence Plan via written submissions.
July 2020 Scoping Opinion	"The Inspectorate does not agree that potential impacts of scour on marine water and sediment quality, resulting from operation of the Proposed Development can be scoped out. The Inspectorate also notes that the anticipated	The potential impact arising from scour on MW&SQ receptors has been included within the scope of this assessment (Section 3.11).

DATE AND CONSULTATION PHASE/ TYPE	CONSULTATION AND KEY ISSUES RAISED	SECTION WHERE COMMENT ADDRESSED
	impacts will be relevant to the foundation type and location of the offshore ECC, which have not been determined at this stage. As such, the assertion that marine water and sediment quality receptors are unlikely to be affected has not been fully justified in the Scoping Report. The Applicant should ensure that likely significant effects associated with scour during operation are assessed in the ES."	
July 2020 Scoping Opinion	The Inspectorate does not agree that cumulative impacts... can be scoped out"	Cumulative impacts on MW&SQ receptors are considered in Section 3.13 of this chapter.
July 2020 Scoping Opinion	The Applicant should ensure that sediment samples used for the analysis of contaminants (e.g. metals, polycyclic aromatic hydrocarbon (PAHs), and Polychlorinated biphenyls (PCBs)) are collected separately from faunal samples and utilise suitable collection techniques. The ES [Environmental Statement] should include a detailed description of the survey methodology used. The Applicant should make effort to agree the approach with relevant consultation bodies including NRW.	The Applicant has collected site-specific samples, which have been analysed for contaminants including PAHs. The scope and methodology of this survey was agreed with NRW prior to the surveys being undertaken – further details provided in this table below. Volume 4, Annex 5.1, Annex 5.2 and Annex 5.3 (application refs: 6.4.5.1, 6.4.5.2 and 6.4.5.3) present the findings of the surveys

DATE AND CONSULTATION PHASE/ TYPE	CONSULTATION AND KEY ISSUES RAISED	SECTION WHERE COMMENT ADDRESSED
		and these are summarised in Section 3.7 of this chapter.
July 2020 Scoping Opinion	The ES should consider potential impacts of accidental release or spills of construction materials or chemicals on designated sites for all phases of the Proposed Development.	Accidental releases and spills are considered for all phased of AyM in Sections 3.10 to 3.12 of this chapter.
July 2020 Scoping Opinion	The Scoping Report does not address thermal impacts on Marine Water and Sediment Quality resulting from the operation of the offshore ECC. The Inspectorate considers that the ES should assess these impacts where significant effects are likely to occur. The Applicant should make effort to agree the approach to the assessment with relevant consultation bodies including NRW.	Following agreement with NRW, the potential thermal impacts on MW&SQ receptors have been scoped out from further consideration in this chapter. Section 3.4.2 presents the potential impacts which were agreed to be scoped out from further consideration within this assessment.
July 2020 Scoping Opinion	The ES should assess the interrelationship between impacts including turbid runoff of water from land on marine water quality. The Applicant should make effort to agree the approach to the assessment with relevant consultation bodies including NRW.	Following agreement with NRW, the potential for the inter-relationships between the fresh and marine water environments is assessed within Volume 4, Annex 3.1: Water Framework Directive Assessment (application ref: 6.4.3.1), and therefore has been scoped out from further consideration in this chapter.

DATE AND CONSULTATION PHASE/ TYPE	CONSULTATION AND KEY ISSUES RAISED	SECTION WHERE COMMENT ADDRESSED
July 2020 NRW Scoping Opinion Consultation Response	NRW disagrees that the release of bentonite via Horizontal Directional Drilling (HDD) can be scoped out of the assessment.	The release of bentonite has been assessed in Section 3.10 of this chapter following agreement of the scope of this potential impact with NRW.
July 2020 NRW Scoping Opinion Consultation Response	NRW disagree that accidental spills on land can be scoped out of the assessment.	This is noted by the Applicant and considered in Volume 3, Chapter 7: Hydrology and Flood Risk (application ref: 6.3.7). The inter-relationship between the fresh and marine water environments is assessed within Volume 4, Annex 3.1: Water Framework Directive Assessment (application ref: 6.4.3.1), and therefore has been scoped out from further consideration in this chapter.
July 2020 NRW Scoping Opinion Consultation Response	Further information should be provided to inform the suspended particulate matter baseline in order to aid assessment of impacts.	A full characterisation of the suspended sediments baseline in the array and the offshore Export Cable Corridor (ECC) is provided in Section 3.7 of this chapter.

DATE AND CONSULTATION PHASE/ TYPE	CONSULTATION AND KEY ISSUES RAISED	SECTION WHERE COMMENT ADDRESSED
July 2020 NRW Scoping Opinion Consultation Response	Impacts on the saline/thermal structure of Liverpool Bay have not been considered and should be.	The potential impacts on the saline/ thermal structure of Liverpool Bay frontal system are considered in Volume 2, Chapter 2: Marine Geology, Oceanography and Physical Processes (application ref: 6.2.2).
July 2020 NRW Scoping Opinion Consultation Response	The risk of works on the beach to Bathing Waters has not been considered and should be.	The risk to Bathing Water compliance is considered in 3.10 to 3.12 of this chapter and in Volume 4, Annex 3.1: Water Framework Directive Assessment (application ref: 6.4.3.1).
July 2020 NRW Scoping Opinion Consultation Response	Further information should be provided to examine the baseline turbidity in the water column (i.e. suspended particulate matter).	A full characterisation of the suspended sediments baseline in the array and the offshore ECC is provided in Section 3.7 of this chapter, with full details provided in Volume 4, Annex 2.1: Physical Processes Technical Baseline (application ref: 6.4.2.1).
July 2020 NRW Scoping Opinion	To our knowledge there is no designated shellfish water at Llanddulas. It is not included in any NRW datasets, it is not on the CEFAS shellfish web pages, and it is not included in NRW's list of	This is noted and agreed by the Applicant.

DATE AND CONSULTATION PHASE/ TYPE	CONSULTATION AND KEY ISSUES RAISED	SECTION WHERE COMMENT ADDRESSED
Consultation Response	shellfish water protected areas. The applicant should clarify this with NRW.	
July 2020 NRW Scoping Opinion Consultation Response	NRW agrees that resuspension of sediments should be screened in. NRW welcome the approach to examine suspended sediments and their longevity in the water column.	This is agreed by the Applicant and is presented in 3.10 to 3.12 of this chapter.
July 2020 NRW Scoping Opinion Consultation Response	NRW advise that typically [contaminants] data should be a maximum of 3 years old. Contaminant levels should also be compared to CEFAS action levels, where available; if these are not available, then PELs and TELs can be used.	This is noted by the Applicant. The characterisation of the baseline contamination levels has been informed primarily by the site-specific survey undertaken in 2020 and has been supplemented with additional information to provide historical context. Details are provided in Section 3.7 of this chapter. All contaminants are compared against the most relevant standards including the Cefas Action Levels and the Canadian Marine Sediment Quality Guidelines (Section 3.4.4).
July 2020	NRW note that a Project Environment Management Plan (PEMP) will be generated. NRW	The Applicant can confirm that a PEMP will be produced for offshore works, and a

DATE AND CONSULTATION PHASE/ TYPE	CONSULTATION AND KEY ISSUES RAISED	SECTION WHERE COMMENT ADDRESSED
NRW Scoping Opinion Consultation Response	recommend the PEMP include terrestrial-based activities (such as where landfall installation may require some form of beach access for construction vehicles and their impacts on the water environment.	Construction Environmental Management Plan (CEMP) produced for onshore works to manage impacts on *inter alia* water and sediment quality.
July 2020 NRW Scoping Opinion Consultation Response	We advise on the use of Guidance for Pollution Prevention (GPP) note 5 (GPP5) Works and Maintenance In or Near Water to inform safe working via land-based activities.	This is noted and will be used to inform the development of the PEMP and CEMP.
July 2020 NRW Scoping Opinion Consultation Response	NRW note that activities at sea will be covered by a Marine Pollution Contingency Plan.	This is welcomed by the Applicant.
July 2020 NRW Scoping Opinion Consultation Response	NRW understand that works may take place on the beach and, as such, the risk to Bathing Waters via suspension of sediments and potential release of bacteria should be considered.	The risk to Bathing Water compliance is considered in Section 3.10 to 3.12 of this chapter and in Volume 4, Annex 3.1: Water Framework Directive Assessment (application ref: 6.4.3.1).

DATE AND CONSULTATION PHASE/ TYPE	CONSULTATION AND KEY ISSUES RAISED	SECTION WHERE COMMENT ADDRESSED
July 2020 NRW Scoping Opinion Consultation Response	NRW disagree that bentonite from HDD should be scoped out of the EIA (Table 32 [of the Scoping Report]). The reason for this is the designated Bathing Waters which are classified, to protect human health, based on their bacterial counts in the water column; shellfish waters can also be disturbed by suspended sediment, via bacteria in shellfish flesh and hindered feeding. Bacterial die off can be slowed by increased turbidity due to blocking of harmful UV radiation. Also, bacteria are thought to survive for longer in flocculated material, which would predominantly occur for fine muds. Therefore, due to the broad search area and the sensitivity of the Bathing Waters to elevated suspended sediment, NRW believe this activity should be screened into the assessment. Generally, it is unclear whether this topic has been screened in or out.	The release of bentonite from landfall activities is considered in Section 3.10 of this chapter. The risk to Bathing Water compliance is considered in Section 3.10 to 3.12 of this chapter and in Volume 4, Annex 3.1: Water Framework Directive Assessment (application ref: 6.4.3.1). This assessment includes consideration of the increased turbidity/ reduced mortality of bacteria as a result of the proposed activities is considered in Section 3.10 to 3.12 of this chapter.
July 2020 NRW Scoping Opinion Consultation Response	NRW do not believe bentonite plumes created via oil and gas platforms can be compared to drilling at the coast – these are two very different environments in terms of depth, wave action and currents. While NRW agree waves and currents	This is noted by the Applicant. The assessment of bentonite plumes is presented in Section 3.10.4.

DATE AND CONSULTATION PHASE/ TYPE	CONSULTATION AND KEY ISSUES RAISED	SECTION WHERE COMMENT ADDRESSED
	should add to the mixing component, NRW consider it should be given further thought.	
July 2020 NRW Scoping Opinion Consultation Response	NRW recommend quantifying the near-bed, springs and storm concentrations of SPM in order to appropriately assess conclusions reached.	An assessment of suspended sediment concentrations (SSC) near the bed under different environmental conditions is presented in Section 3.7.
July 2020 NRW Scoping Opinion Consultation Response	The Kinmel Bay discharge pipeline which was identified in earlier maps with an end point in the centre of the diamond shaped shellfish area. NRW recommend discussing data opportunities with Dwr Cymru/Welsh Water (DCWW).	The Applicant has consulted with DCWW regarding the locations and status of their assets. The known locations of wastewater assets discharging into the marine environment within the ZoI are presented in Section 3.13.1 of this chapter.
July 2020 Isle of Man Scoping Opinion Consultation Response	The responsible Departments of the Isle of Man Government note the inclusion of water quality deterioration, release and potential transport of contaminants from disturbed sediments, and highlights the relevance of these issues in relation to nearby sessile commercial fishery species grounds (notably scallop and queen scallop) (i.e. seafood quality and regional spawning	This is noted by the Applicant. The potential impacts of contamination on shellfish species are considered in Volume 2, Chapter 6: Fish and Shellfish Ecology (application ref: 6.2.6).

DATE AND CONSULTATION PHASE/ TYPE	CONSULTATION AND KEY ISSUES RAISED	SECTION WHERE COMMENT ADDRESSED
	Importance), and to higher trophic-levels such as marine mammals.	
August 2020 benthic survey consultation (NRW)	NRW reviewed the proposed benthic sampling strategy requested additional sample locations within the survey strategy.	Additional sampling locations for grabs and DDV were put forward and the scope of the benthic survey was agreed with NRW. This will be reported in the Evidence Plan Report that will accompany the final application.
NRW, September 2020 Post-scoping Evidence Plan meeting	It was agreed with NRW that a position paper would be provided to provide the necessary evidence to scope further impacts out from assessment. The report will present an evidence-based approach to confirming the scope of the assessment.	This paper was provided under the AyM Evidence Plan. The scope of this assessment was agreed with NRW – see "Awel y Môr Physical Processes Method Statement Consultation letter" rows of this table below.
NRW, September 2020 Email and consultation under the auspices of the EIA Evidence Plan.	"… we [NRW] agree with the proposed metals and PAHs as set out in the email below for sediment contaminants analysis and we agree that there is no requirement to analyse the other pollutants".	This is welcomed by the Applicant.

DATE AND CONSULTATION PHASE/ TYPE	CONSULTATION AND KEY ISSUES RAISED	SECTION WHERE COMMENT ADDRESSED
NRW, December 2020 Awel y Môr Physical Processes Method Statement Consultation letter	We acknowledge the clarification that any activity with the potential to generate SSC has been scoped in and will be included in the WFD assessment. We welcome the explicit inclusion of the release of bentonite via Horizontal Directional Drilling (HDD) in the assessment.	The Applicant has assessed all activities which may generate SSC as presented in Table 15. These impacts are assessed Sections 3.10 to 3.12 of this chapter and in Volume 4, Annex 3.1: Water Framework Directive Assessment (application ref: 6.4.3.1). Explicit assessment of the release of drilling mud (bentonite) is included in Section 3.10.2 of this chapter.
NRW, December 2020 Awel y Môr Physical Processes Method Statement Consultation letter	We cannot agree to scope out transboundary issues at this time. Clarification on the Inspectorates assessment is requested.	Section 3.15 presents consideration of transboundary impacts from AyM on MW&SQ receptors. The potential for transboundary effects has been scoped out from further consideration in this assessment. This is aligned with the Applicant's transboundary screening (Volume 1, Annex 3.2: Transboundary Screening) (application ref: 6.1.3.2).
NRW, December 2020	We note what has been said in 3.2.1 and Table 2 regarding the non-turbidity impacts on water	This is welcomed and acknowledged by the Applicant.

DATE AND CONSULTATION PHASE/ TYPE	CONSULTATION AND KEY ISSUES RAISED	SECTION WHERE COMMENT ADDRESSED
Awel y Môr Physical Processes Method Statement Consultation letter	quality through the release of bentonite and agree that this can be scoped out of the EIA for MW&SQ receptors.	
NRW, December 2020 Awel y Môr Physical Processes Method Statement Consultation letter	We note what has been said in 3.3.1 regarding the impacts on water temperature through the presence of cables and agree that any thermal heating from the cables would be minimal. We agree that this can be scoped out.	This is welcomed and acknowledged by the Applicant.
NRW, December 2020 Awel y Môr Physical Processes Method Statement	We are hesitant to scope out the impacts on water quality from scour (3.3.2) at this stage without further evidence that the sediment is not contaminated. There is not sufficient evidence to show that there are no contaminants in the sediment, further investigation and sediment sampling is required. The impacts of scour should	The Applicant has assessed the potential for deterioration of water quality from scour effects in Section 3.11.1.

DATE AND CONSULTATION PHASE/ TYPE	CONSULTATION AND KEY ISSUES RAISED	SECTION WHERE COMMENT ADDRESSED
Consultation letter	be included in the coastal and physical processes section of the EIA.	
NRW, December 2020 Awel y Môr Physical Processes Method Statement Consultation letter	We agree that the impacts on the marine environment from onshore activities (3.4.1) will be covered in the WFD assessment and so it can be scoped out of the EIA. However, we ask that there is a linkage between the assessment of the methods and the potential for turbid run-off in the Hydrology, Hydrogeology and the Flood Risk chapter and the MW&SQ chapter of the Awel y Môr EIA.	This is addressed by the Applicant in Volume 4, Annex 3.1: Water Framework Directive Assessment (application ref: 6.4.3.1), which presents a holistic approach across both offshore and onshore environments.
Pre-PEIR ETG March 2021	NRW requested details of the surveys contaminants results to be provided in advance of the publication of the PEIR.	The Applicant provided the contaminant analysis results from the site-specific surveys to the Expert Topic Group (ETG). These results are presented in Section 3.7 of this chapter, Volume 4, Annex 5.1, Annex 5.2 and Annex 5.3 (application refs: 6.4.5.1, 6.4.5.2 and 6.4.5.3).
Member of Public, September 2021	Are there studies in place which will model changes to water/ sediment movements caused by so many turbines etc and any impact this will have on the local environment?	Following consultation with NRW, the Applicant commissioned an extensive site-specific hydrodynamic modelling exercise to ensure potential impacts associated with

DATE AND CONSULTATION PHASE/ TYPE	CONSULTATION AND KEY ISSUES RAISED	SECTION WHERE COMMENT ADDRESSED
PEIR, public representation		changes in tidal and wave regime are fully understood. The outputs of the study are presented in Volume 4, Annex 2.3: Marine Processes Results Report (application ref: 6.4.2.3) and have been taken into account in the MW&SQ assessment.
NRW, October 2021 PEIR Section 42 Response	NRW note that GPP5 Works in or near water has been recognised by the applicant (Volume 4, Chapter 3, Table 2, pg 29, row 1). However, it is not mentioned in other places in PEIR documents related to potential spills and working near water.	Text added in Table 16 noting Guidance for Pollution Prevention 5 (GPP5): Works and maintenance in or near water will be used to inform the development of the PEMP.
NRW, October 2021 PEIR Section 42 Response	Paragraph 6 pg 14 contains errors and requires clarification.	Text amended to reflect the Environment Bill receiving Royal Assent on 9 November 2021, and thus now an Act of Parliament, the Environment Act 2021.
NRW, October 2021 PEIR Section 42 Response	The legend on the maps on Figure 6 (pg 59) is difficult to read as it only has two numbers and 3 markings on it; NRW advise considering lengthening the legend and adding markings to ease reading the contour plot.	Figure 6 updated to improve clarity of Suspended Particulate Matter (SPM) range in the legend.

DATE AND CONSULTATION PHASE/ TYPE	CONSULTATION AND KEY ISSUES RAISED	SECTION WHERE COMMENT ADDRESSED
NRW, October 2021 PEIR Section 42 Response	NRW agree that the sediments within the array (Holocene sands and gravels) are unlikely to contain elevated levels of anthropogenic contaminants (paragraph 72 pg 64).	This is welcomed and acknowledged by the Applicant.
NRW, October 2021 PEIR Section 42 Response	NRW note that only at one station (12) are the concentrations of 3 PAHs above the Canadian Threshold Effects Level (Table 9, pg 68). NRW also note that TELs are only marginally exceeded and that the site is outside the array area and other infrastructure zone (Figure 10, pg 67). NRW have no concern with respect to this site and note that all metal concentrations are below their Cefas Action Level 1 definitions within the array area.	This is welcomed and acknowledged by the Applicant.
NRW, October 2021 PEIR Section 42 Response	With reference to the cable corridor, NRW note that all PAH and metal concentrations were below their respective levels (Tables 11 and 12, pgs 75-77).	This response is noted by the Applicant.
NRW, October 2021 PEIR Section 42 Response	In paragraph 93 pg 78 it is stated that Marine Lake Rhyl is not connected to the sea. To clarify, it is connected to the sea via the Afon Clwyd estuary and could be filled with sea water if the tidal	Marine Lake, Rhyl Bathing Water has been included in the baseline description in Section 3.7.3 and considered as part of the assessment.

DATE AND CONSULTATION PHASE/ TYPE	CONSULTATION AND KEY ISSUES RAISED	SECTION WHERE COMMENT ADDRESSED
	gates were operated to allow water to enter on the flooding tide.	
NRW, October 2021 PEIR Section 42 Response	The sentences in the second paragraph of row 2 under *"Justification"* on pg 88 do not make sense. Clarification is needed. For example, it is not clear what *"one fifth"* refers to considering the volume presented here is 3,570 m^3 which is considerably smaller than the 8,000,000 m^3 presented on pg 85. Furthermore, NRW advise that the worst-case scenario must be evaluated and it is not clear whether this is the case here.	Text amended in Table 15 to ensure clarity in reporting the maximum design scenario. In terms of maximum volume of drill cuttings and drilling mud (bentonite) to be released by all drills: 3 HDD (or other trenchless technique) bores x 7,677 m^3 (back reaming and duct install fluid lost to sea) = 23,031 m^3. The large volumes reported elsewhere in Table 15 relate to sediment disturbance during, for example, seabed preparation for foundations, drill arisings and export/inter-array cable burial as opposed to HDD (or other trenchless technique) bores.
NRW, October 2021 PEIR Section 42 Response	NRW note that oil filled cables will not be used (pg 89).	This response is noted by the Applicant.
NRW, October 2021	NRW note that a Pollution Environment Management Plan (PEMP) will be produced and	The Applicant plans to provide a final Project Environment Management Plan

DATE AND CONSULTATION PHASE/ TYPE	CONSULTATION AND KEY ISSUES RAISED	SECTION WHERE COMMENT ADDRESSED
PEIR Section 42 Response	will contain the Marine Pollution Contingency Plan. NRW understand this will be secured as part of the marine licence and welcome the opportunity to view the PEMP.	(PEMP; note difference in abbreviation from NRW comment) post-consent, but does not see it as advantageous to create a detailed outline PEMP at the point of application as it would be based on outline information. It is therefore proposed that the requirement to submit a PEMP for approval by NRW will be included as a condition in the Marine Licence (see Other Consents and Licences; application ref: 5.4). This condition will also specify the areas the PEMP would cover (e.g., to include a Marine Pollution Contingency Plan (MPCP) to provide protocols to cover accidental spills and potential contaminant release, and to include key emergency contact details). NRW would review the detailed design proposals as part of the PEMP and give sign off prior to construction. This approach was discussed and agreed in principle with NRW during various ETG meetings, who acknowledged the detail would not be necessary in order to reach agreement on assessment conclusions within the ES.

DATE AND CONSULTATION PHASE/ TYPE	CONSULTATION AND KEY ISSUES RAISED	SECTION WHERE COMMENT ADDRESSED
NRW, October 2021 PEIR Section 42 Response	SSCs are presented in section 3.10.1 starting pg 98 from modelling work shown in Volume 4, Appendix 2.3. Near-bed plumes generated from the MFE is predicted to result in concentrations 5-10 mg/l after a tidal cycle and 1-2 mg/l after 3 days (paragraph 103). There is no detail here regarding how the modelling has been conducted (e.g. the percentage of fines vs sands) but this information is presented in the modelling Appendix; it would therefore be useful if a cross reference could be added around the modelling strategy. With reference to the TSHD (paragraph 104) there is no mention of what depth the sediment is released though this is mentioned in the modelling appendix. However, NRW note that concentrations are predicted to reach 50-100 mg/l after 1 day and 2 mg/l after 3 days. The drill arisings release indicates concentrations of 5-10 mg/l after a half tidal cycle (paragraph 107) though again the percentage of fines modelled or the depth of release are not presented.	Additional details of modelling and referencing to Volume 2, Chapter 2: Marine Geology, Oceanography and Physical Processes and appendices included (application refs: 6.2.2, 6.4.2.1, 6.4.2.2 and 6.4.2.3).
NRW, October 2021	While NRW agree that no nutrient pathways have been identified (paragraph 110 pg 101), the potential impact of elevated SSC has been missed	Text added to Section 3.10.2 to consider potential impacts to phytoplankton due to increased SSCs/ turbidity during the

DATE AND CONSULTATION PHASE/ TYPE	CONSULTATION AND KEY ISSUES RAISED	SECTION WHERE COMMENT ADDRESSED
PEIR Section 42 Response	in the discussion around "Magnitude of Impact". Paragraph 111 goes on to discuss how 100 mg/l would be ranked as intermediate by UKTAG but says no more. There should be further discussion on this topic in relation to phytoplankton.	construction phase. NRW's opinion relating to no nutrient pathways is welcomed and acknowledged by the Applicant.
NRW, October 2021 PEIR Section 42 Response	Paragraph 113 (pg 102) presents the magnitude of impact for bacteria. NRW agree that any bacterial increases in the water column will occur for a matter of days before returning to background levels. NRW also agree that elevated values are likely to be similar to those found in storm events, noting that the storm event shown was recorded in February 2005, i.e. not a summer event as would occur during the Bathing Season (15th May to 30th September).	This is welcomed and acknowledged by the Applicant.
NRW, October 2021 PEIR Section 42 Response	However, Bathing Waters at Rhyl, Rhyl East and Prestatyn are subject to Water Quality Prediction models which warn people not to swim when water quality is likely to deteriorate as a result of elevated rainfall (i.e. a storm) in order to protect human health. Daily prediction models are not available for predicting elevated SSC as a result of construction works. In the first instance, it would be	Additional consideration has been made in Sections 3.10.2 and 3.10.4 regarding the potential impacts to Bathing Waters from the plume generated during the construction phase, including potential SSC uplift and release of drilling fluid (bentonite).

DATE AND CONSULTATION PHASE/ TYPE	CONSULTATION AND KEY ISSUES RAISED	SECTION WHERE COMMENT ADDRESSED
	useful to be presented with an understanding of how far the plumes are likely to reach in respect of the Bathing Waters. Furthermore, it would be beneficial to understand the timing of any developments occurring which may impact the Bathing Waters. As a result, NRW cannot agree the conclusions in paragraphs 115 or 138 (pg 108). NRW also, therefore, cannot agree that impacts on the Bathing Waters will be Minor Adverse.	
NRW, October 2021 PEIR Section 42 Response	NRW agree with the comments in paragraph 135 (pg 107).	This is welcomed and acknowledged by the Applicant (i.e., impact pathways associated with potential release of bentonite limited to changes in turbidity).
NRW, October 2021 PEIR Section 42 Response	Paragraph 149 states there is no pathway to impact the Bathing Waters from oil and grease. Whilst the presence of oil or grease will not result in deterioration of the Bathing Water in terms of its classification, it can result in the declaration of an Abnormal Situation which will close the beach for as long as it takes to clear up the pollution event, which in turn may have an impact on tourism.	Text amended to reflect potential for 'Abnormal Situation' at Bathing Waters due to the presence of oil/ grease (or other substance) as a result of an accidental spillage during construction (Section 3.10.5), O&M (Section 3.11.3) and decommissioning (Section 3.12.2) phases.

DATE AND CONSULTATION PHASE/ TYPE	CONSULTATION AND KEY ISSUES RAISED	SECTION WHERE COMMENT ADDRESSED
NRW, October 2021 PEIR Section 42 Response	The statements in paragraphs 150 and 151 (pgs 110-111) are not correct and do not represent the purpose of the WFD. NRW recommends revision of the wording in these paragraphs to better reflect the aim of the WFD to get all waterbodies to Good status. NRW agree, however, that the sensitivity is low.	Wording amended to reflect the objectives of the WFD and reference to Volume 4, Annex 3.1: Water Framework Directive Assessment (application ref: 6.4.3.1). NRW's opinion on low sensitivity to potential small spillages is welcomed and acknowledged by the Applicant.
NRW, October 2021 PEIR Section 42 Response	In paragraph 158 it would be useful to have a full reference for Chapter 2, for example citing page numbers. It would be worth mentioning within this paragraph that sediment contaminants were observed to be at low levels and cross-reference to where those data are shown. NRW agree that impacts are likely to be negligible.	Additional referencing to Volume 2, Chapter 2: Marine Geology, Oceanography and Physical Processes (application ref: 6.2.2) included. NRW's opinion on negligible impacts is welcomed and acknowledged by the Applicant.

3.4 Scope and methodology

3.4.1 Study area

24 The study area for this assessment is presented in Figure 1. This study area is consistent with that presented in the Scoping Report and PEIR.

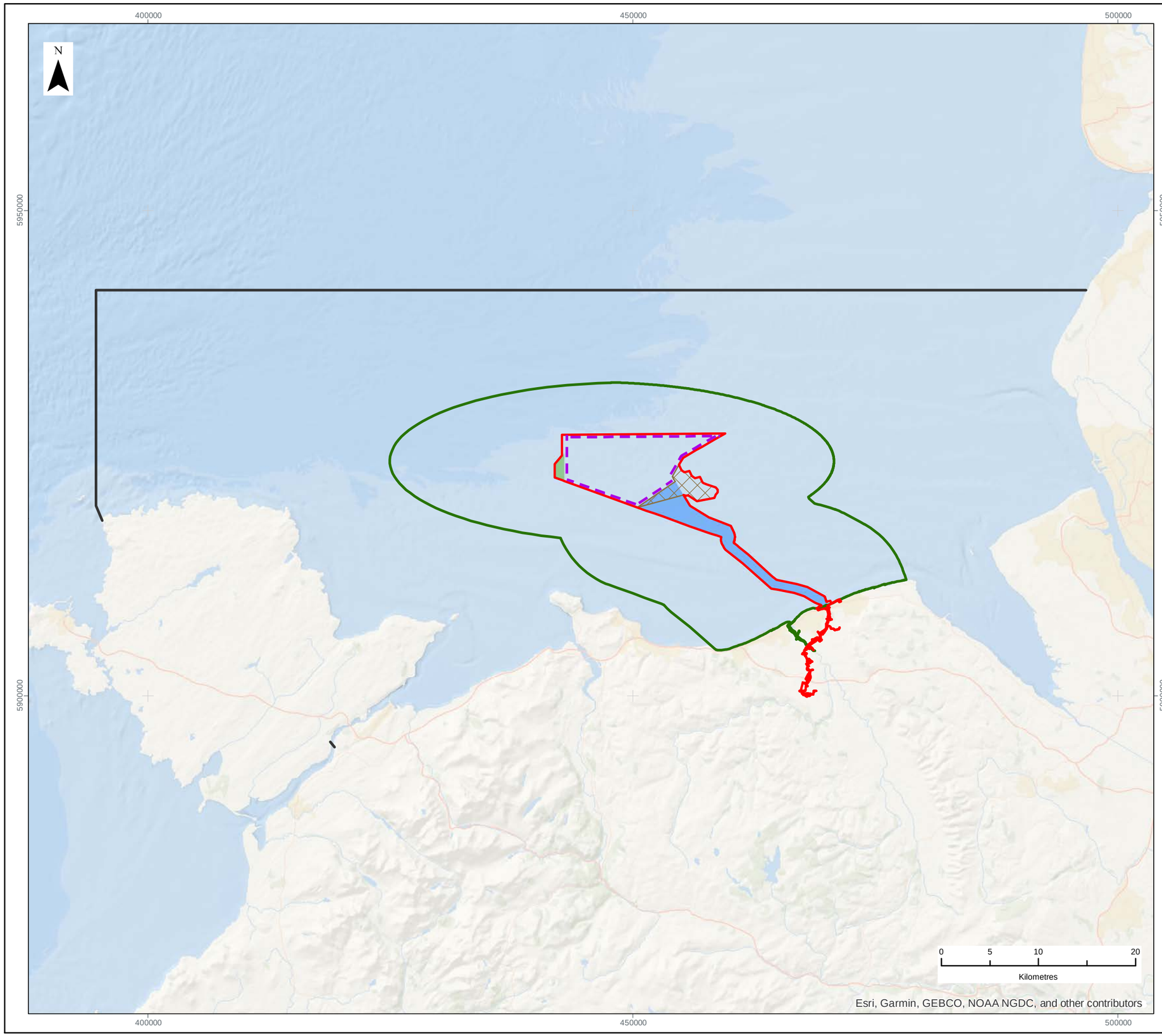
25 The characterisation presented in this chapter provides a regional overview before focusing on the study area. The study area encompasses the AyM array area as well as the offshore ECC, up to and including the intertidal zone in Rhyl, defined as ending at Mean High Water Springs (MHWS).

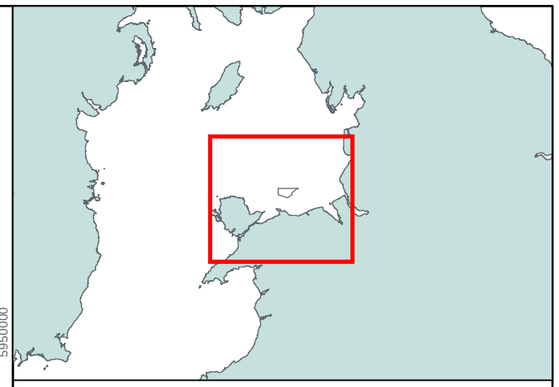
26 The study area has been broken down into three sections, and these sections have been assessed individually in terms of their potential impacts on MW&SQ for each stage of the proposed development. The sections considered within this chapter comprise the following:

- Array area (including Wind Turbine Generators (WTGs), Offshore Substation Platforms (OSP) and inter-array cables);
- Offshore ECC; and
- The seabed and water column surrounding these areas that may be influenced by changes to MW&SQ due to the proposed development.

Zone of Influence

27 For the purpose of identifying MW&SQ receptors with the potential to be significantly affected by AyM, a Zone of Influence (ZoI) has been defined based on the project specific hydrodynamic modelling undertaken (Volume 4, Annex 2.3: Marine Processes Results Report (application ref: 6.4.2.3)). The ZoI is presented in Figure 1 (note, the ZoI has marginally changed between the PEIR stage and the application due to a small reduction in the Other Wind Farm Infrastructure Zone). The ZoI for this assessment has been defined as an 8.5 km buffer around the offshore ECC which encapsulates the maximum extent of measurable plumes predicted by the modelling from activities within the ECC (see Figure 2). An ellipse around the array has been used to define the ZoI for the activities within the array, owing to the plumes generally moving in parallel relative to the coast in less disperse plumes. This ellipse similarly encapsulates the maximum extent of measurable plumes predicted by the modelling (see Figure 3). Figure 2 and Figure 3 present a time series illustration of nearshore sandwave clearance and/or drilling, and the resultant plumes. The figures initially (top left) illustrate the plume during the first 12 hours of activity, followed by the maximum extent of the plume at any given time (bottom right).





LEGEND

- Order Limits
- Array Area
- Offshore Export Cable Corridor
- Other Wind Farm Infrastructure Zone
- GyM Interlink Zone
- Study Area
- Zone of Influence

Data Source:

PROJECT TITLE:

AWEL Y MÔR OFFSHORE WINDFARM

FIGURE TITLE: Study area and zone of influence for MW&SQ assessment

VER	DATE	REMARKS	Drawn	Checked
1	15/09/2021	For Issue for PEIR	BPHB	SM
2	03/03/2022	For Issue For ES	BPHB	DH

FIGURE NUMBER:

Figure 1

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:400,000	A3	WGS84	UTM30N

Fferm Wynt Alltraeth
AWEL Y MÔR Offshore Wind Farm

G:\GIS\GIS_Projects\0141 AyM\GIS\Figures\ES\MW&SQ\AYM_MWSQ_Fig1_Study_Area.mxd

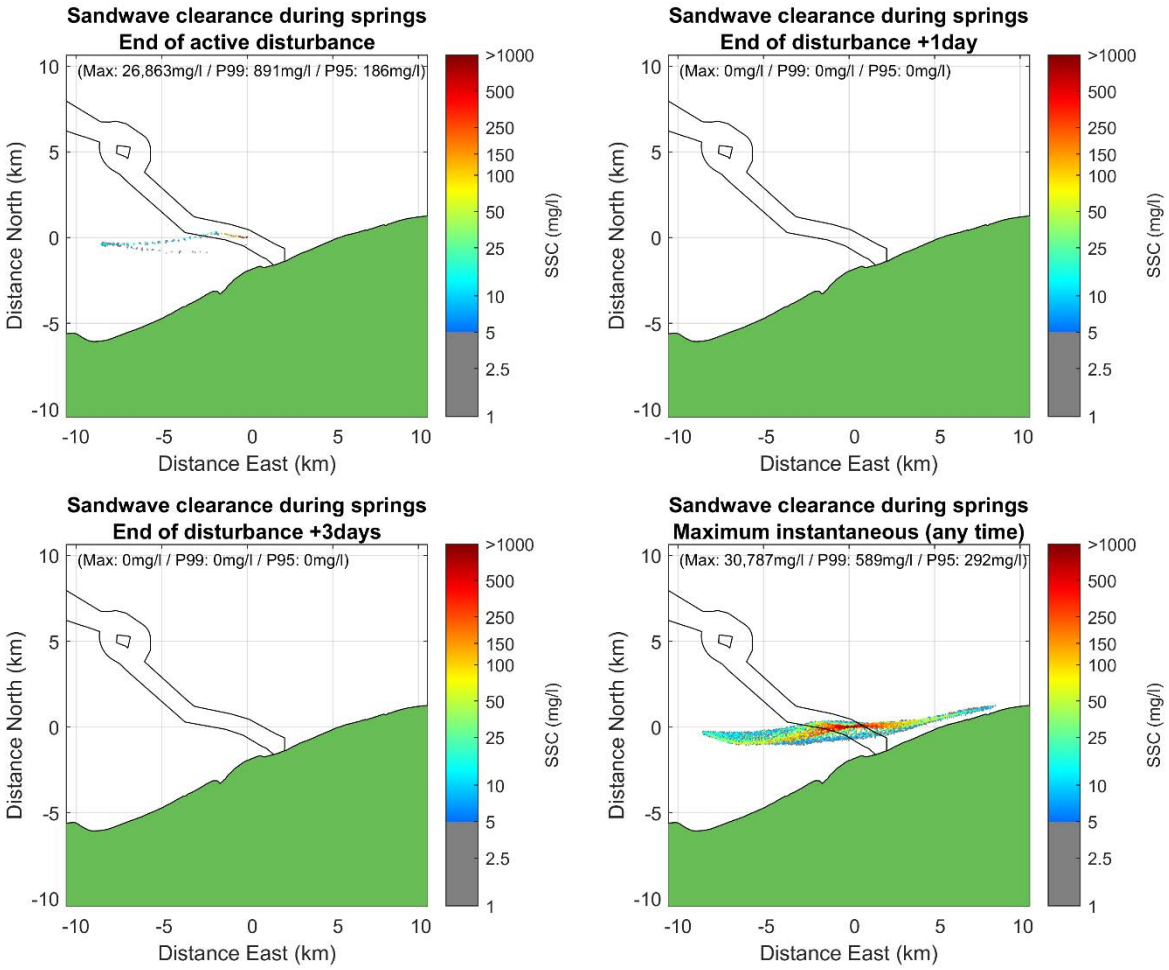


Figure 2: Plume extents from sandwave clearance in the nearshore of the offshore ECC[iii].

[iii] The project boundaries presented in these figures represent the project at the point in time when modelling was undertaken, and it should be noted that the project boundaries have since been further refined (see the Order Limits presented in Figure 1).

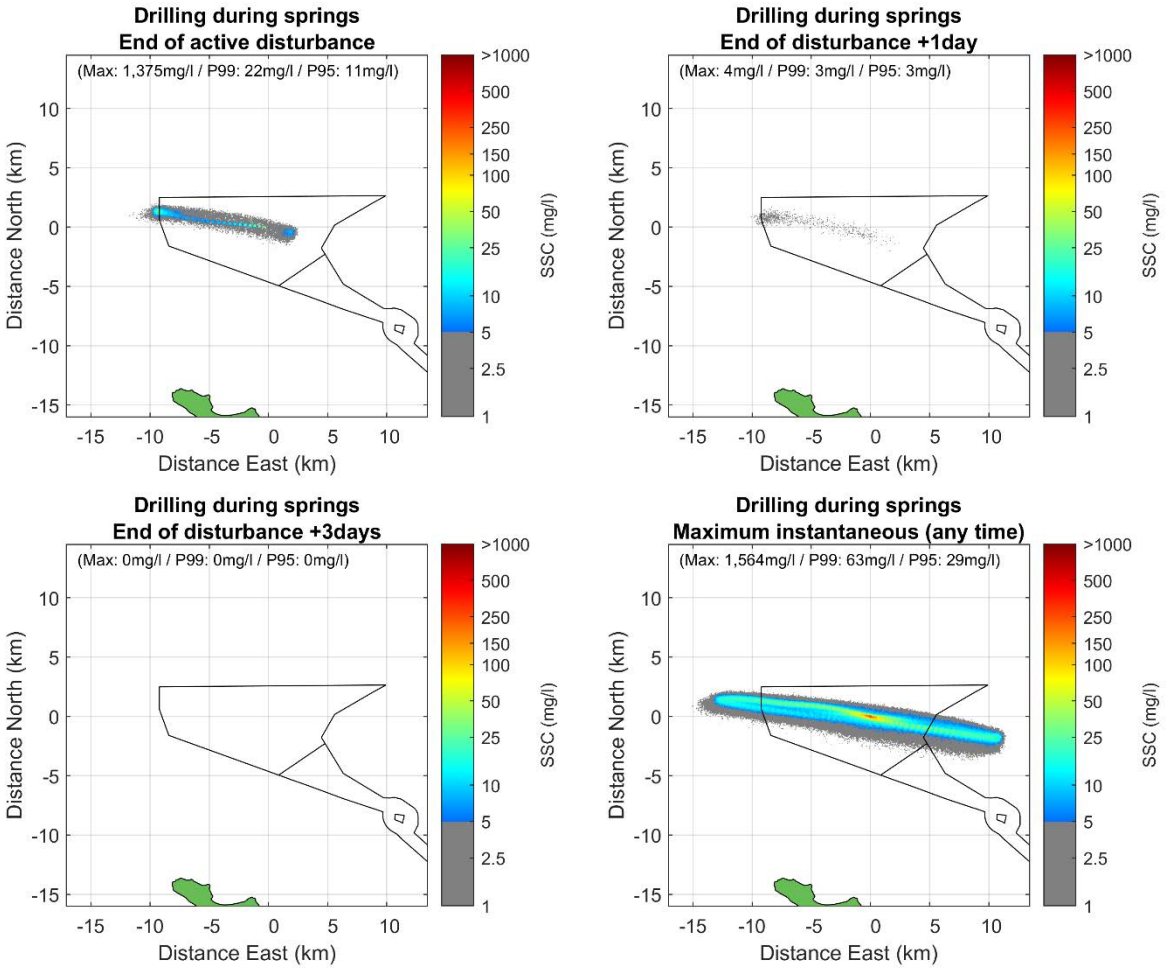


Figure 3: Plume extents from drill arisings within the array[iv].

[iv] The project boundaries presented in these figures represent the project at the point in time when modelling was undertaken, and it should be noted that the project boundaries have since been further refined (see the Order Limits presented in Figure 1).

3.4.2 Scope of the assessment

28 Table 3 presents the potential impacts scoped out from further consideration in this assessment, as agreed via the Evidence Plan process following the receipt of the Scoping Opinion. Agreement to scope out the potential impacts of scour of water quality was not reached and so they have been assessed in Section 3.11.1 of this chapter.

Table 3: Impacts scoped out from further consideration.

IMPACT	PROJECT PHASE	DETAILS
Non-turbidity impacts on water quality through the release of bentonite	Construction only	A technical justification for scoping out these potential impacts was provided to the Evidence Plan Expert Topic Group. Agreement to scope out this impact was provided by NRW in writing (see Table 2).
Impacts on water temperature through the presence of cables	O&M only	
Impacts on the marine environment through cable breakages	O&M only	
Impacts on the marine environment from onshore activities	All project phases	

3.4.3 Data sources and gap analysis

29 Site-specific geophysical surveys for AyM have been undertaken to characterise the seabed conditions throughout the array and the offshore ECC (Volume 4, Annex 5.1, Annex 5.2 and Annex 5.3 (application refs: 6.4.5.1, 6.4.5.2 and 6.4.5.3)). This survey comprised of a full geophysical survey of the array area and offshore ECC, supplemented with drop down camera data and grab samples to allow a characterisation of the sediment features and composition within the study area. The survey additionally included sediment Particle Size Analysis (PSA) and contaminant analysis using the grab samples.

30 The scope of these surveys was agreed under the Evidence Plan (Table 2) and agreement was reached that they provide adequate coverage for the purposes of EIA characterisation. In addition, as presented in Table 2, agreement was reached on the list of contaminants to be analysed in the sediment samples from the intertidal and subtidal surveys.

31 Where relevant, data from surveys undertaken for Gwynt y Môr OWF (GyM) has been used in the characterisation of the AyM study area, complemented by the primary sources of information including site-specific surveys undertaken for AyM.

32 NRW's Bathing Water classification data based on water samples/ monitoring data for the Bathing Waters, within the ZoI, from 2017 to 2020 have been included in this assessment[v]. Data from the Water Watch Wales website[vi] have also been used to characterise the status of the WFD waterbodies within the study area.

3.4.4 Assessment methodology

Cefas Action Levels

33 There are no Environmental Quality Standards (EQSs) for *in situ* sediments in the UK. In the absence of any defined EQSs, data from the surveys is analysed relative to the Centre for Environment, Fisheries and Aquaculture Science (Cefas) Action Guideline Levels for the disposal of dredged material. This may be used to provide evidence for decision makers about the disposal of dredged material, they are not however statutory standards or limits. The Cefas Guideline Action Levels are presented in Table 4. These levels are used in this assessment to determine whether further assessment is required rather than a pass/ fail criterion.

34 For dredging projects, contaminants below Action Level 1 are generally not considered to be of concern and thus acceptable for disposal at sea. Contaminant levels above Action Level 2 are not considered suitable for disposal at sea without further consideration.

[v] https://environment.data.gov.uk/wales/bathing-waters/profiles
[vi] https://waterwatchwales.naturalresourceswales.gov.uk/en

35 It is noted that AyM is not solely a proposed dredging scheme but, given the project involves the proposal to dredge, drill and dispose of seabed material within the Order Limits, and in keeping with common practice, contaminants have been contextualised against the Cefas Guideline Action Levels to provide an indicative risk to the environment.

Table 4: Cefas Guideline Action Levels.

CONTAMINANT/ COMPOUND	UNITS	ACTION LEVEL 1	ACTION LEVEL 2
Arsenic	mg/kg	20	100
Mercury	mg/kg	0.3	3
Cadmium	mg/kg	0.4	5
Chromium	mg/kg	40	400
Copper	mg/kg	40	400
Nickel	mg/kg	20	200
Lead	mg/kg	50	500
Zinc	mg/kg	130	800
Organotins; TBT DBT MBT	mg/kg	0.1	1
PCB's, sum of ICES 7	mg/kg	0.01	none
PCB's, sum of 25 congeners	mg/kg	0.02	0.2
*DDT	mg/kg	*0.001	N/A
*Dieldrin	mg/kg	*0.005	N/A

*as set in 1994

Canadian Marine Sediment Quality Guidelines

36 In addition to the Cefas Guideline Action Levels, the Canadian Sediment quality guidelines have been utilised to provide further context, and for contaminants such as PAHs that are not captured within the Cefas Guideline Action Levels. The Canadian Sediment quality guidelines were developed by the Canadian Council of Ministers of the Environment as broadly protective tools to support the functioning of healthy aquatic ecosystems. They are based on field research programmes that have demonstrated associations between chemicals and biological effects by establishing cause and effect relationships in particular organisms.

37 Comparison of measured concentrations of various contaminants within the sediments with these guideline values will provide a basic indication on the degree of contamination and likely impact on ecology.

38 The guidelines consist of Threshold Effect Levels (TELs) (also known as interim sediment quality guidelines) and Probable Effect Levels (PELs). The TELs and PELs are used to identify the following three ranges of chemical concentrations with regard to biological effects:

- Below the TEL - the minimal effect range within which adverse effects rarely occur;
- Between the TEL and PEL - the possible effect range within which adverse effects occasionally occur; and
- Above the PEL - the probable effect range within which adverse effects frequently occur.

39 Table 5 presents the guidelines for the TELs and PELS. As agreed with NRW (Scoping Opinion in July 2020; see Table 2), where Cefas Guideline Action Levels are not available for a substance then TELs and PELs have been used to characterise the baseline environment (Table 2 and Section 3.7).

Table 5: Canadian Marine Sediment Quality Guidelines.

SUBSTANCE	UNITS	TEL	PEL
Metals			
Arsenic	mg/kg	7.24	41.6
Cadmium	mg/kg	0.7	4.2
Chromium	mg/kg	52.3	160
Copper	mg/kg	18.7	108
Lead	mg/kg	30.2	112
Mercury	mg/kg	0.13	0.7
Zinc	mg/kg	124	271
Polychlorinated byphenyls (PCB)			
PCBs: total PCBs	mg/kg	21.5	189
Polyaromatic hydrocarbons (PAH)			
Acenaphthene	µg/kg	6.71	88.9
Acenaphthylene	µg/kg	5.87	128
Anthracene	µg/kg	46.9	245
Benz(a)anthracene	µg/kg	74.8	693
Benzo(a)pyrene	µg/kg	88.8	763
Chrysene	µg/kg	108	846
Dibenz(a,h)anthracene	µg/kg	6.22	135
Fluoranthene	µg/kg	113	1,494
Fluorene	µg/kg	21.2	144
2-Methylnaphthalene	µg/kg	20.2	201
Naphthalene	µg/kg	34.6	391
Phenanthrene	µg/kg	86.7	544
Pyrene	µg/kg	153	1,398

40 The proposed construction, O&M and decommissioning activities may release contaminants into the water column from the sediments and thus has the potential to reduce the water quality locally. Consequently, the potential for a reduction in water quality will be assessed in terms of the presence of contaminants in the sediment.

Assessing designated waters

41 Water quality at Bathing Waters is contextualised against the baseline performance of each Bathing Water relative to the rBWD. Further assessment will be required if there is the potential for the Bathing Waters to have reduced performance against the rBWD as a direct or indirect result of the proposed AyM activities.

3.5 Assessment criteria and assignment of significance

42 This assessment is consistent with the EIA methodology presented in Volume 1, Chapter 3: EIA methodology (application ref: 6.1.3).

43 The magnitude of identified impacts is defined in Table 6. It is noted here that a distinction is made throughout the assessment between the magnitude, extent and duration of 'impacts' and the resulting significance of the 'effects' upon MW&SQ receptors. Various actions may result in impacts: for instance, the installation of the export cable, causing a localised and short-term change to SSC (which is defined as a water quality receptor). The significance of effect associated with the impact will be dependent upon the sensitivity/ importance of the receptor, with particular consideration given to the receptor's ability to tolerate and recover from the impact, as well as its status.

44 The descriptions of magnitude are specific to the assessment of marine water quality impacts and are considered against the magnitude descriptions presented in Table 6. Potential impacts have been considered in terms of permanent or temporary, and adverse or beneficial effects. Where an effect could reasonably be assigned more than one level of magnitude, professional judgement has been used to determine which rating is applicable.

45 As set out in Volume 1, Chapter 3: EIA methodology (application ref: 6.1.3), the sensitivity of a receptor is a function of its capacity to accommodate change and reflects its ability to recover if it is affected. It is quantified via a consideration of adaptability, tolerance, recoverability and value. Table 7 sets out the criteria used in defining the sensitivity of the marine water quality receptor. Where a receptor could reasonably be assigned more than one level of sensitivity, professional judgement has been used to determine which level is applicable. The inclusion of internationally or nationally important features within the high sensitivity definition provides the opportunity to increase the sensitivity of the water quality receptor if required, even if capacity for dilution exists.

46 The matrix used for the determination of significance is shown in Table 8. The combination of the magnitude of the impact with the sensitivity of the receptor determines the assessment of significance of effect. For the purposes of this assessment, any effect that is of major or moderate significance is considered to be significant in EIA terms. Any effect that has a significance of minor or negligible is not considered to be significant in EIA terms. An assessment of the significance of potential effects is described in Sections 3.10 to 3.13.

47 Where relevant, mitigation measures that are incorporated as part of the project design process and/ or can be considered to be industry standard practice (referred to as 'embedded mitigation') are considered throughout the chapter and are reflected in the outcome of the impact assessment. Mitigation is prescribed only to reduce 'significant' effects. Under EIA guidelines, 'Moderate' and ‘Major' effects are regarded as being significant. Mitigation measures that were identified and adopted as part of the evolution of the project design (embedded into the project design) are described separately, in Section 3.9 of this chapter.

Table 6: Impact magnitude definitions.

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

Table 7: Sensitivity/importance of the environment.

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

Table 8: Matrix to determine effect significance.

		SENSITIVITY			
		HIGH	MEDIUM	LOW	NEGLIGIBLE
ADVERSE MAGNITUDE	HIGH	Major	Major	Moderate	Minor
	MEDIUM	Major	Moderate	Minor	Negligible
	LOW	Moderate	Minor	Minor	Negligible
	NEGLIGIBLE	Minor	Minor	Negligible	Negligible
BENEFICIAL MAGNITUDE	NEGLIGIBLE	Minor	Minor	Negligible	Negligible
	LOW	Moderate	Minor	Minor	Negligible
	MEDIUM	Major	Moderate	Minor	Negligible
	HIGH	Major	Major	Moderate	Minor

Note: Effects of 'moderate' significance or greater are defined as significant with regards to the EIA Regulations.

3.6 Uncertainty and technical difficulties encountered

48 Many aspects of the baseline are well understood. However, in some instances, data sources or assumptions are less well studied and/ or quantified for the study area. This Section identifies areas of uncertainty and potential data gaps.

49 Grab sampling, while providing detailed information on the sediment types (and fauna) present, cannot cover wide swaths of the seabed and consequently represent point samples that must be interpreted in combination with the other appropriate datasets. As noted, several surveys undertaking grab samples have been conducted in the area which show good validation against the regional data. The seabed morphology and sediments in the area are well studied and surveyed. As such, the available evidence base is considered sufficiently robust to underpin the assessment presented here and an overall high confidence is placed in the baseline characterisation.

50 There is some uncertainty associated with the assessment of sediment plumes and accompanying changes to bed levels due to project-related activities and analogous developments. This arises due to uncertainty regarding how the seabed geology will respond to drilling and jetting. The exact volume of material entrained into the water column will be dependent upon a number of factors including the type of drilling/ cable installation equipment used, the variability of the forcing conditions (i.e. the waves and tidal states) and the mechanical properties of the geological units. In the absence of detailed information, a series of potential release scenarios have been considered in Volume 2, Chapter 2: Marine Geology, Oceanography and Physical Processes (application ref: 6.2.2). Together, these scenarios capture the worst-case impacts in terms of the highest concentration suspended sediment plumes, the most persistent suspended sediment plumes, the maximum changes in bed level elevation and the greatest spatial extent of change in bed level.

51 Where a modelled activity occurs within the resolution of one model cell, the behaviour of the sediment plume can be considered to occur at a sub-grid scale. Therefore, it is not appropriate to draw conclusions for the size or concentration of the plume within the cell in which the activity occurs. Therefore, this has been supplemented with information based on expert judgement and analogous projects to allow meaningful interpretation.

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

3.7 Existing environment

53 A technical report and ES chapter were produced, as part of the GyM application, for physical processes (which included water quality). A review of the key findings from those documents have been incorporated into the description of the existing environment provided below to supplement the site-specific data and provide historical context as appropriate.

3.7.1 The array

Sediment characterisation

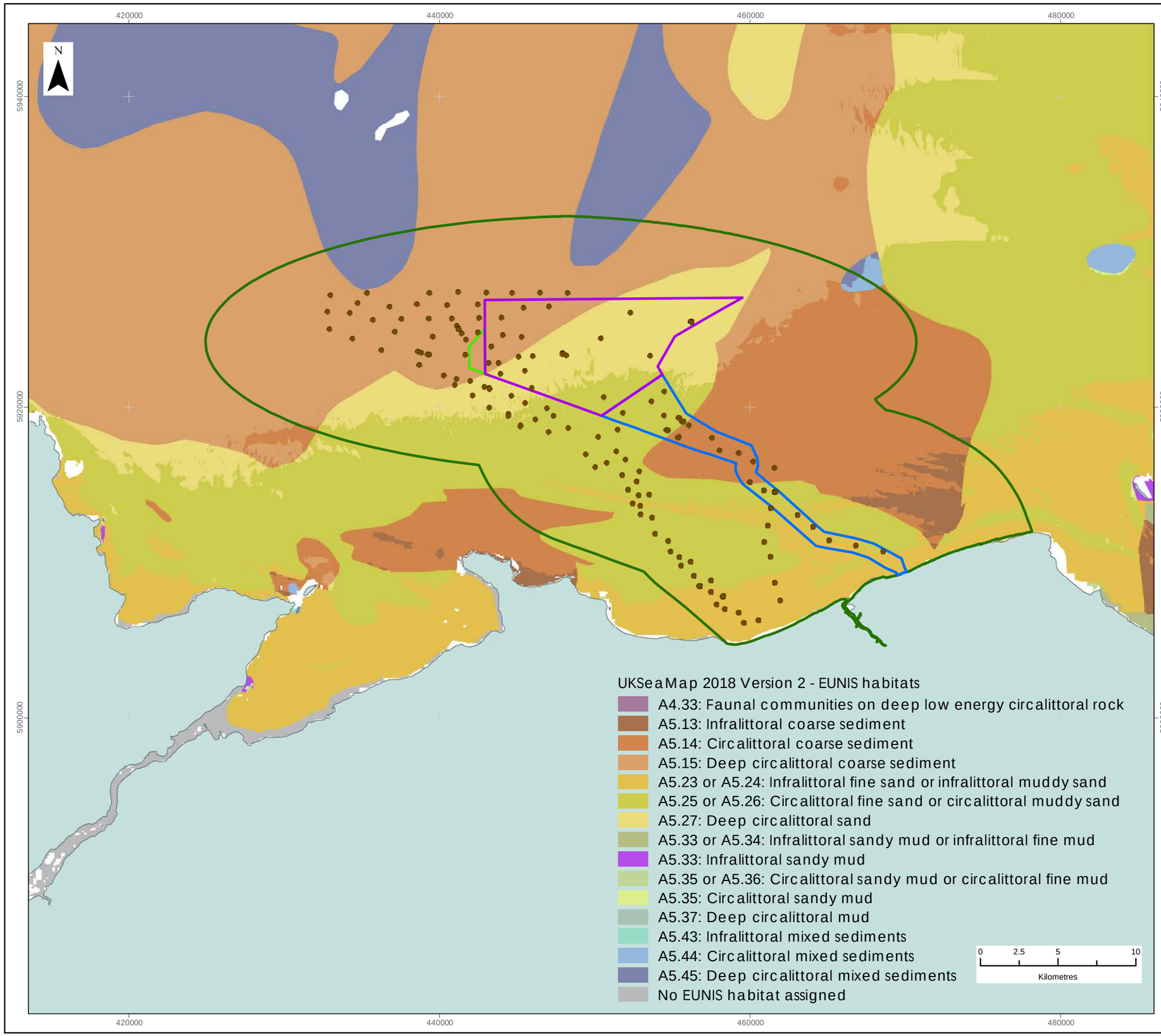
54 Liverpool Bay is characterised by three main seabed formations:

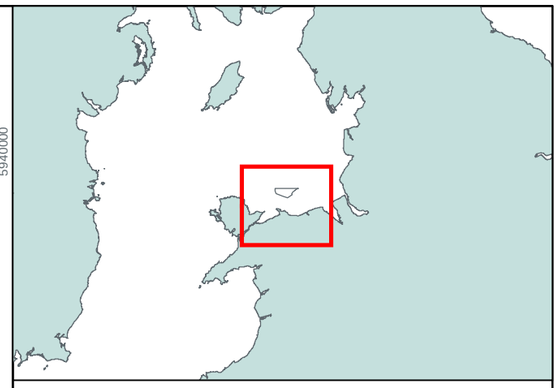
- Sand ribbons and patches with mega-ripple relief of less than 0.3 m;
- Sandwave fields, the sandwaves having amplitudes of around 2 m and wavelengths of between 10 and 20 m; and
- Individual sandwaves with amplitudes of up to 12 m and often carrying minor transverse waves.

55 A number of bank features are present within the general Liverpool Bay region. Apart from small banner banks tied to the headlands of Anglesey, there are many banks in the wide embayment of the approaches to the Mersey Estuary and others filling a large proportion of the many wide-mouthed estuaries.

56 The array is located on a seabed characterised by Holocene sands and gravels (Figure 4; Golding et al., 2004; Holmes and Tappin, 2005). Project specific surveys confirm the presence of gravelly sand in the west of the array and coarse sand in the south-east (Fugro, 2020a; Figure 4 and Figure 5). All of the 62 sample stations are characterised by the EUNIS biotope 'Sublittoral coarse sediment': "coarse sediments including coarse sand, gravel, pebbles, shingle and cobbles which are often unstable due to tidal currents and/or wave action. These habitats are generally found on the open coast or in tide-swept channels of marine inlets. They typically have a low silt content and a lack of a significant seaweed component. They are characterised by a robust fauna including venerid bivalves" (EEA, 2019).

57 The absence of finer seabed sediments suggests active near-bed currents. Indeed, the project specific survey observed the presence of numerous sandwaves and megaripples to the south-east of the array (Fugro, 2020a). Further, the survey noted that the sandwaves were actively mobile, migrating significantly in the time between adjacent survey lines.





LEGEND

- Array Area
- Offshore Export Cable Corridor
- Other Wind Farm Infrastructure Zone
- Zone of Influence
- Benthic Stations

Data Source:
UKSeaMap 2018 Version 2 from JNCC

PROJECT TITLE:

AWEL Y MÔR OFFSHORE WINDFARM

FIGURE TITLE:

Surficial seabed sediments within the study area

VER	DATE	REMARKS	Drawn	Checked
1	15/09/2021	For Issue for PEIR	BPHB	SM
2	17/01/2022	For Issue For ES	BPHB	DH

FIGURE NUMBER:

Figure 4

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:250,000	A3	WGS84	UTM30N

Fferm Wynt Alltraeth
AWEL Y MÔR
Offshore Wind Farm

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Figure 5: Sediment images from the west (right; sample MA_ST04)) and south-east (left; sample MA_ST66) of the array area, as captured during the project specific survey (Fugro, 2020a).

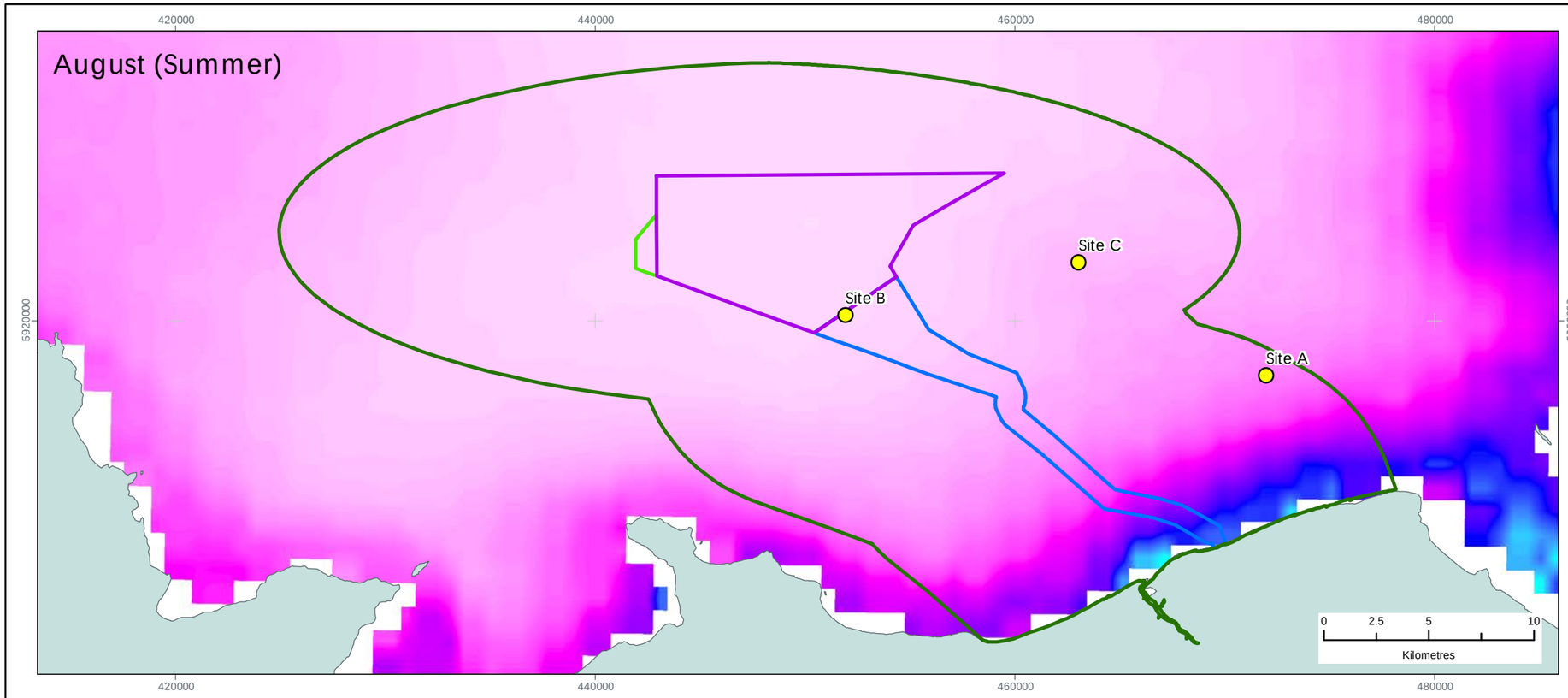
58 This is further supported by the sediment distribution analysis undertaken for GyM, which indicated that within the GyM array, the surficial seabed sediments are characterised by sand with gravels and some areas of boulders.

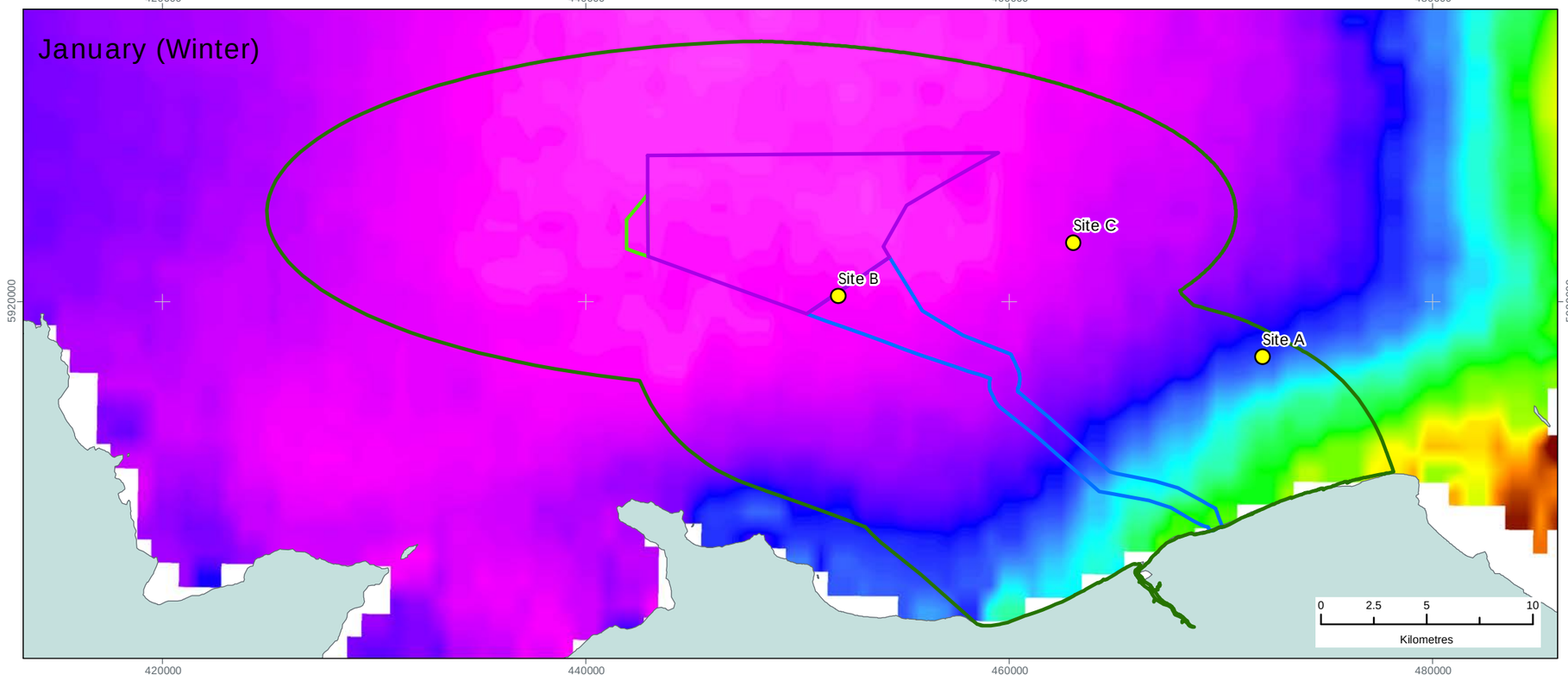
Suspended sediments

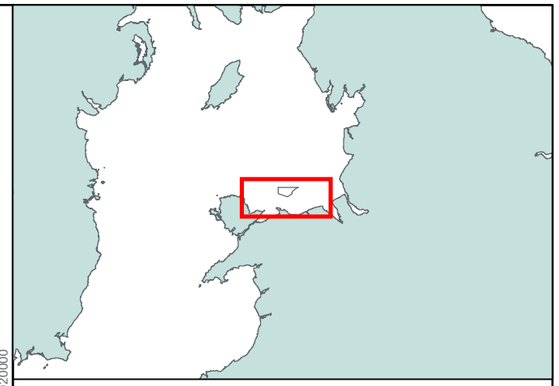
59 The Irish Sea is characterised by a high degree of spatial and temporal (both annual and inter-annual) variability in SSCs. In general, there exists an inshore to offshore gradient in SSC, with the highest concentrations observed close to, and especially at the mouths of, large estuaries such as the Dee and Mersey.

60 The AyM array is located approximately 45 km to the east of the Anglesey Turbidity Maximum (ATM), maintained in position by high tidal flows, and defined as a maximum due to its SSC levels (5 mg/l in summer and 10 to 15 mg/l in winter) relative to the surrounding waterbody (3 to 4 mg/l; Ellis *et al.*, 2008).

61 Located sufficiently offshore, 10.6 km, monthly averaged satellite imagery of (surface) Suspended Particulate Matter (SPM), from the period 1998 to 2015, shows limited variation within the array area. Values within this temporal period do not exceed 5 mg/l. Research has shown that it is the tidal forcing that results in predictable patterns and temporal variability in the Irish Sea turbidity levels (Bowers et al., 1998; Bowers *et al.*, 2002). Within the array, maximum SPM values are shown to be in the range of 1.25 to 5 mg/l in August and January, respectively (Figure 6).







LEGEND

- Array Area
- Offshore Export Cable Corridor
- Other Wind Farm Infrastructure Zone
- Zone of Influence
- SSC Stations

Suspended particulate (inorganic) matter (SPIM) 1998 - 2015

High : 35

Low : 0

Data Source:
Suspended particulate (inorganic) matter (SPIM) from CEFAS

PROJECT TITLE:

AWEL Y MÔR OFFSHORE WINDFARM

FIGURE TITLE: SPM levels for the period 1998 to 2015, for Summer and Winter

VER	DATE	REMARKS	Drawn	Checked
1	15/09/2021	For Issue for PEIR	BPHB	SM
2	17/01/2022	For Issue For ES	BPHB	DH

FIGURE NUMBER:

Figure 6

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:250,000	A3	WGS84	UTM30N

Fferm Wynt Alltraeth
AWEL Y MÔR
Offshore Wind Farm

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62 Near-bed suspended sediment data is available from the GyM array area and for two locations within the array. This information, given its distance offshore and proximity to AyM, provides an overview of the likely natural variation in near-bed SSC levels throughout the tidal cycle and in response to storm events. The available data, as shown in Figure 7 and Figure 8:

- In the absence of storm events, typical concentrations throughout the tidal cycle are less than 25 mg/l;
- Storm events elevate the SSC levels. The data shows that a storm event with a significant wave height of approximately 4.5 m has results in levels in excess of 300 mg/l;
- There is typically a short temporal lag between the maximum wave height and corresponding maximum SSC levels.

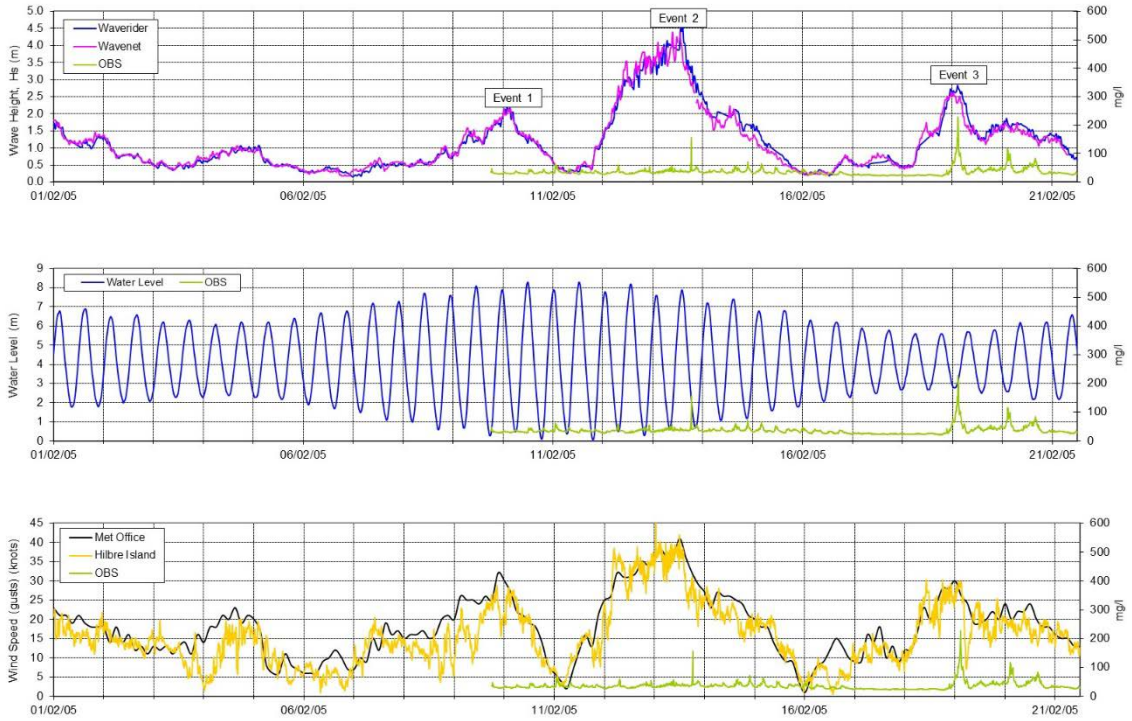


Figure 7: Natural variation of suspended sediment concentrations throughout a tidal cycle and under the influence of storm events – Site B.

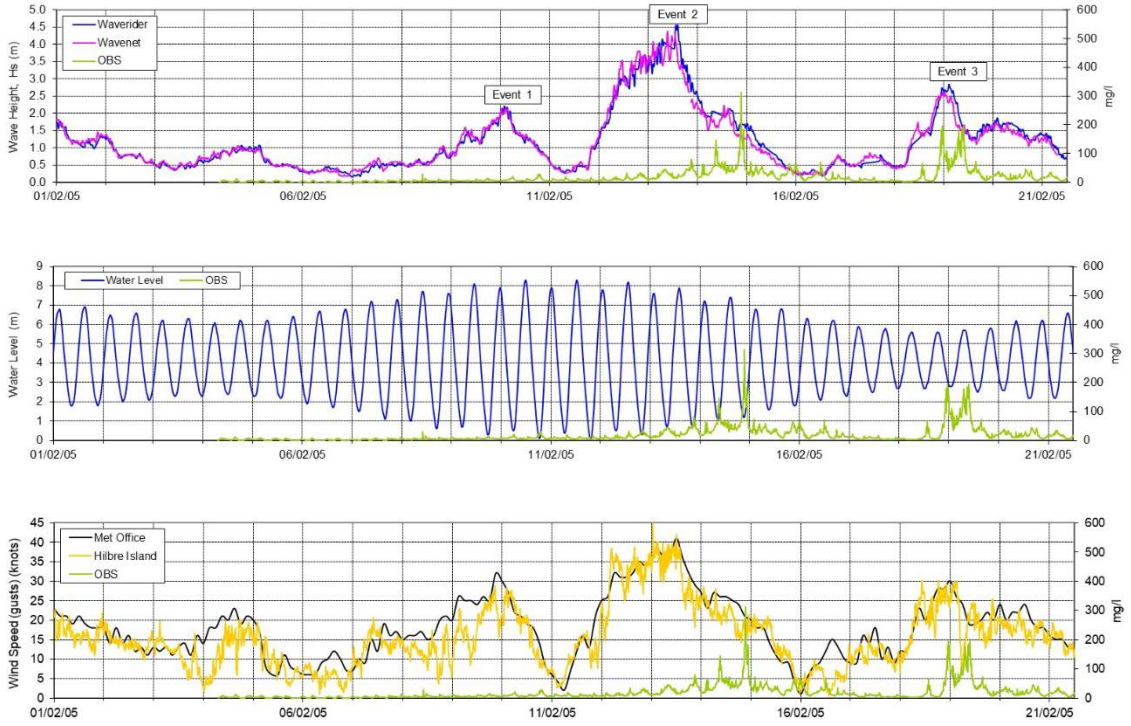


Figure 8: Natural variation of suspended sediment concentrations throughout a tidal cycle and under the influence of storm events – Site C.

63 Seasonal variation is exhibited through higher concentrations in the winter months, with maximum values coincidental with a high North Atlantic Oscillation (NAO) index. In such circumstances, high wind stresses result in a greater wave generation and thus higher turbidity levels (Figure 9; White *et al.*, 2015). Of note, and with reference to Figure 9, is that metocean influences are particularly apparent in the shallower coastal waters. Recent analyses of remote sensing data within UK Territorial Waters have shown an increase in turbidity since the beginning of the 20th Century. Within the Irish Sea, this increase is observed, for the period 1998 to 2015, during the spring and of the order of 2.7 mg/l (MOAT, 2019). The elevated substance irradiance reflectance (R) value within the entirety of the Irish Sea occurs during a period of high NAO index (White *et al.*, 2015).

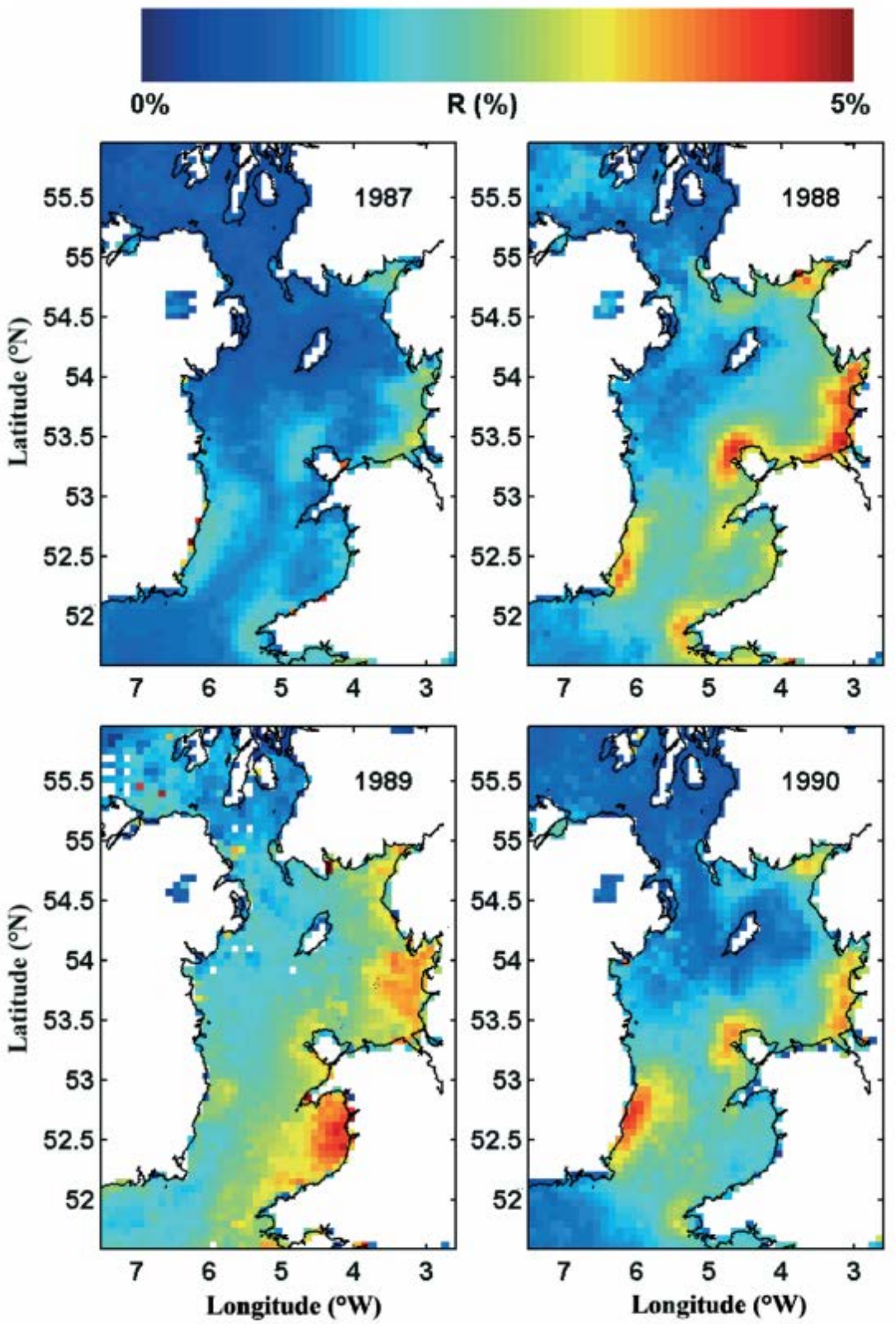


Figure 9: Turbidity levels, as inferred from substance irradiance reflectance (R), for the Irish Sea for the years 1987 to 1990.

Water chemistry

64 Due to the hydrophobic nature of many organic compounds and the partitioning of metals to suspended particles, the concentrations of dissolved contaminants in seawater samples are often low or below detection limits (Cefas, 2005).

65 Water quality in the offshore part of Liverpool Bay is affected predominantly by contaminants from rivers, sewage effluent or industrial discharges. A variety of contaminants can be present in seawater, including:

- Radioactive isotopes;
- Hydrocarbons; and
- Trace metals.

66 Radioactive isotopes are relatively soluble in seawater and are dispersed throughout the eastern Irish Sea from the Sellafield reprocessing plant on the Cumbrian coastline, which represents the largest single input of radioactive material in the Irish Sea (DEFRA, 2000). However, the resulting exposure levels to marine species in the eastern Irish Sea and Liverpool Bay remain well below those known to cause adverse effects (Npower, 2005).

67 The UK Department of Trade and Industry's offshore energy Strategic Environmental Assessment (SEA) programme concluded that for the SEA6 area (which encapsulates the study area for this assessment), contaminants (both metals and non-metals, anthropogenic and natural sources of contamination) in the Irish Sea predominantly originated from riverine rather than direct inputs (Cefas, 2005). In addition, metal concentrations were generally found to fall significantly in water samples taken further offshore; with the highest concentrations typically found in estuarine and coastal waters subject to industrial and wastewater inputs, such as the Mersey Estuary.

68 Within Liverpool Bay, the levels of trace metals from trade and sewage outfalls and levels of lead, cadmium and mercury are known to be higher than Background Reference Concentration values, set by OSPAR in 1997. Historical studies regarding metal concentration in the waters of the Irish Sea have been carried out by Abdullah *et al*. (1973) and Preston (1972) and recorded a gradient of metal concentrations from high levels near the Mersey and Dee Estuaries to lower concentrations further offshore, tending to confirm the importance of rivers and estuaries as legacy sources for these pollutants. These metals tend to persist in marine sediments.

69 Historically, much of Liverpool Bay has been contaminated with mercury (MAFF, 1991), which has been attributed to inputs from the Mersey Estuary, primarily as the result of industrial effluents and specifically from the chlor-alkali industry. The Irish Sea also receives the largest single input of lead nationally from the River Mersey (DEFRA, 2005). Elevated copper levels in the region (when compared with the rest of the Irish Sea) are also attributed to inputs from the River Dee and River Mersey (MPMMG, 1998). River discharge is also a major source of cadmium and zinc in the region (Norton *et al*., 1984).

70 Chemicals are used for a variety of functions in the Oil and Gas industry. The discharge of production and drilling chemicals, residual oil and compounds released from gas extraction and production, in the Irish Sea, can contribute to the contaminant concentration in sediments and water (Cefas, 2005). Operators are required to source alternative products to avoid the use of those which contain chemicals that are very persistent, bio-accumulative or toxic or have a combination of these properties. For details of oil and gas production in the vicinity see Volume 2, Chapter 12: Other Marine Users and Activities (application ref: 6.2.12) of this ES.

Sediment chemistry

71 In the Irish Sea, seabed sediment contaminant concentrations are generally higher than those found in seawater (Cefas, 2005). The distribution of contaminants in sediments is generally similar to that of surface water. The sediment type is an important factor when considering the potential presence of contaminants within sediments. Sediments with a finer particle size, such as clays and muds, can act as adsorption surfaces for contaminants that may be released into the water column if the sediment is disturbed (Cefas, 2001).

72 Sediments with larger particle sizes (e.g. sands) are not typically associated with elevated concentrations of anthropogenic contaminants. Hydrocarbons in particular are closely linked to the spatial distribution of sediment types. The concentrations of metals in sediments are generally higher in the coastal zone and around estuaries, decreasing offshore, indicating that river input and run-off from land are significant sources. As noted above, the sediments within the array area have been characterised as Holocene sands and gravels and as such would not be expected to contain elevated concentrations of anthropogenic contaminants.

73 As part of the baseline characterisation at GyM, surface sediments were tested for a range of contaminants at 24 sites both within and around the GyM array including inshore locations along the export cable route corridor. Both organochlorine and PCB residues were below the minimum limit of detection at all of the sampling sites. The concentrations of PAHs within the GyM sediments were also below the limits of detection, or below the equivalent TEL or PEL values in most cases. The results for the trace metals analysis showed low concentrations within the sediments sampled, with all being below TEL, with the exception of arsenic which was recorded at concentrations slightly above the TEL (but well below PEL) at nine sites. The GyM ES concluded that arsenic in the area may be attributable to lithogenic inputs from the north Wales region as a result of the geological weathering.

Site-specific surveys

74 Figure 10 presents the locations within the array area where site-specific sampling and contaminants analysis has been undertaken for the purposes of characterisation in this EIA. Following a refinement of the AyM Order Limits between scoping and the application, three samples are now located outside the Order Limits. They are presented here in order to provide context within the wider region. Further information regarding the survey is presented in Volume 4, Annex 5.1, Annex 5.2 and Annex 5.3 (application refs: 6.4.5.1, 6.4.5.2 and 6.4.5.3).

Polycyclic Aromatic Hydrocarbons (PAHs)

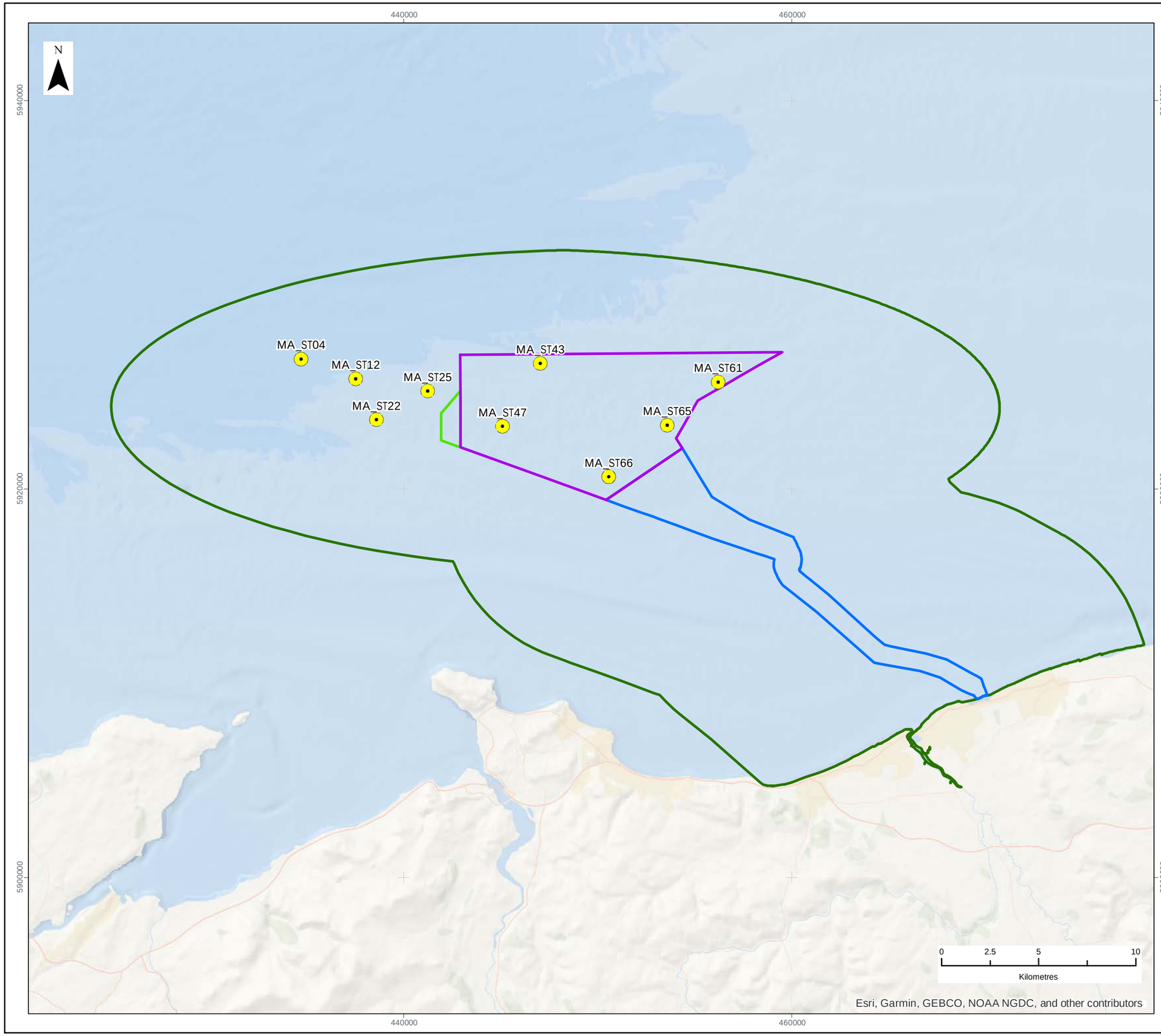
75 PAHs are a group of structurally related hydrocarbons. PAHs are not typically released into the environment intentionally, however, they are naturally present in fossil fuels and other hydrocarbon-based materials (such as bitumen on roads). PAHs persist in the environment and have the potential to bioaccumulate with consequential potential adverse effects on aquatic life and humans (Environment Agency, 2019). PAHs are classed as priority hazardous substances and ubiquitous persistent, bio-accumulative and toxic compounds under the WFD in the related EQSD (2008/105/EC amended by 2013/39/EU).

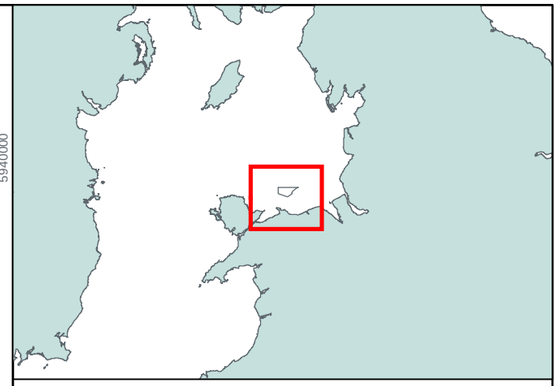
76 As presented in Table 9, nine out of ten of the sampled stations within the array area had PAHs below the TEL threshold. Therefore, these stations can be characterised as 'the minimal effect range within which adverse effects rarely occur' with respect to PAHs. Station 'MA_ST12' (which is to the west of the array outwith the Order Limits) exceeded the TEL threshold for Acenaphthene, Fluoranthene and Dibenzo(a,h)anthracene. This station was notably higher for all the PAHs analysed relative to other stations. Nevertheless, it is noted that these substances remained below the PEL thresholds (see Table 9). The presence of these PAHs can be characterised as 'the possible effect range within which adverse effects occasionally occur' as per definitions of the Marine Sediment Quality Guidelines (Section 3.4.4).

77 Acenaphthene is generally a product of crude oil and a product of combustion, however, it can also enter the environment through trade effluents as a manufacturing by-product. Acenaphthene typically biodegrades readily in the environment in oxic conditions, with a reported half-life of 1 to 10 days in surface waters (Chandra, 2005). However, it may persist under anoxic conditions. Acenaphthene is one of the 13 priority hazardous substance as defined under the WFD and EQSD.

78 Fluoranthene is also a priority substance as defined under the WFD and EQSD. Fluoranthene enters the environment through the combustion of organic matter including fossil fuels. Fluoranthene has a low water solubility and will rapidly be adsorbed to organic matter and sediments. In this form it can persist in the environment for decades and has a high potential to bioaccumulate (Pooter, 2020).

79 Dibenzo(a,h)anthracene is produced by the incomplete combustion of organic matter such as fossil fuels. There have been few studies and the toxicity data is limited for Dibenzo(a,h)anthracene. Dibenzo(a,h)anthracene is not currently explicitly included as a priority substances and certain other polluting chemicals in the WFD and EQSD.





LEGEND

- Array Area
- Offshore Export Cable Corridor
- Other Wind Farm Infrastructure Zone
- Zone of Influence
- Array Contamination Points

Data Source:

PROJECT TITLE:

AWEL Y MÔR OFFSHORE WINDFARM

FIGURE TITLE: Sediment contaminant analysis locations within the Array

VER	DATE	REMARKS	Drawn	Checked
1	15/09/2021	For Issue for PEIR	BPHB	SM
2	17/01/2022	For Issue For ES	BPHB	DH

FIGURE NUMBER:

Figure 10

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:200,000	A3	WGS84	UTM30N

Fferm Wynt Alltraeth
AWEL Y MÔR
Offshore Wind Farm

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Table 9: Polycyclic aromatic hydrocarbon (PAH) sediment analysis results from the array.

CONTAMINANT	CANADIAN MARINE SEDIMENT QUALITY GUIDELINES (µG/KG)		PAH (µG/KG OF DRY SEDIMENT)									
	TEL	PEL	MA_ST04	MA_ST12	MA_ST22	MA_ST25	MA_ST43	MA_ST47	MA_ST59	MA_ST61	MA_ST65	MA_ST66
Acenaphthene	6.71	88.9	0.1	12.9	0.1	0.1	0.1	< 0.1	< 0.1	0.2	< 0.1	< 0.1
Acenaphthylene	5.87	128	<0.1	0.2	< 0.1	< 0.1	0.1	< 0.1	< 0.1	0.1	< 0.1	< 0.1
Anthracene	46.9	245	0.2	24	0.1	0.1	0.3	0.1	< 0.1	0.4	< 0.1	< 0.1
Benzo(a)anthracene	74.8	693	0.7	61.4	0.7	0.6	1.2	0.3	0.1	1.9	0.1	0.2
Benzo(a)pyrene	88.8	763	0.8	77.5	0.6	0.6	1.4	0.2	0.1	2.3	0.1	0.1
Benzo(b)fluoranthene	N/A*	N/A*	2.3	84.3	1.6	2.1	3.5	0.8	0.5	5.3	0.3	0.6
Benzo(ghi)perylene	N/A*	N/A*	1.4	54.5	0.9	1.1	2.3	0.5	0.2	3.6	0.1	0.3
Benzo(k)fluoranthene	N/A*	N/A*	0.7	33.1	0.4	0.6	1.1	0.2	0.1	1.7	0.1	0.1
Chrysene	108	846	1	53.9	0.9	0.9	1.6	0.4	0.2	2.2	0.1	0.2
Dibenzo(a,h)anthracene	6.22	135	0.3	11.1	0.2	0.2	0.5	0.1	< 0.1	0.8	< 0.1	< 0.1
Fluoranthene	113	1494	1.4	137	1.2	1.3	2.2	0.5	0.3	3.3	0.2	0.3
Fluorene	21.2	144	0.4	7.9	0.2	0.3	0.5	0.1	0.1	0.7	< 0.1	< 0.1

CONTAMINANT	CANADIAN MARINE SEDIMENT QUALITY GUIDELINES (µG/KG)		PAH (µG/KG OF DRY SEDIMENT)									
	TEL	PEL	MA_ST04	MA_ST12	MA_ST22	MA_ST25	MA_ST43	MA_ST47	MA_ST59	MA_ST61	MA_ST65	MA_ST66
Indeno(1,2,3-cd)pyrene	N/A*	N/A*	1.6	59.7	0.9	1.2	2.5	0.4	0.2	3.7	0.1	0.2
Naphthalene	34.6	391	0.8	6.6	0.7	0.6	1.8	0.2	0.1	1.4	< 0.1	0.1
Phenanthrene	86.7	544	1.6	76	1.9	1.7	2.7	0.4	0.6	3.2	0.1	0.2
Pyrene	153	1398	1.1	120	1.2	1	1.8	0.5	0.3	2.9	0.1	0.4
**Cells highlighted in green	Above TEL											
*N/A	Not threshold defined under the Canadian Marine Sediment Quality Guidelines											

Metals

80 All metals analysed as part of the site-specific survey within the array were below Cefas Guideline Action Level 1 (Table 10). Therefore, these metal contaminants are not considered to be of concern and the sediment in which they are bound is considered suitable for disposal at sea.

Table 10: Metal sediment analysis results from the array.

	MG/KG IN DRY SEDIMENT										
	ACTION LEVEL 1	MA_ST04	MA_ST12	MA_ST22	MA_ST25	MA_ST43	MA_ST47	MA_ST59	MA_ST61	MA_ST65	MA_ST66
Al	N/A	5260	4700	2420	2800	4700	2480	2500	4800	1700	2120
As	20	8.92	12.3	11.4	9.78	12.6	16.5	13.3	10.4	7.68	14.3
Ba	N/A	23.1	17.7	8.43	8.34	22.2	8.01	7.99	16.8	10.2	6.08
Cd	0.4	<0.0	<0.0	<0.0	<0.0	<0.0	<0.0	<0.0	<0.0	<0.0	<0.0
Cr	40	14.5	10.1	6.37	7.39	12.6	7.33	6.94	11.5	5.02	5.75
Cu	40	4.58	3.14	4.16	2.53	2.84	1.86	1.66	3.07	1.12	1.48
Hg	0.3	<0.0	<0.0	<0.0	<0.0	<0.0	<0.0	<0.0	<0.0	<0.0	<0.0
Ni	20	7.7	7.57	4.32	4.95	8.02	5.97	5.39	7.17	3.56	4.29
Pb	50	13.8	15.5	7.93	9.77	13.3	7.97	5.42	11.6	4.62	4.85
Sn	N/A	1.35	2.46	0.34	0.29	0.53	0.30	0.25	5.11	0.21	0.43
Zn	130	27.8	24.7	15.3	16.6	24.8	18.9	18.8	26.1	13.6	14

3.7.2 The export cable corridor

Sediment characterisation

81 Within the offshore ECC area, the seabed sediments are primarily characterised by the presence of Holocene sands and gravels (Holmes and Tappin, 2005) and as illustrated in Figure 4. The sediments become finer with varying contributions of mud-sized material towards the east of the area, where the influence of the Dee Estuary begins to occur.

82 Surficial sediment characterisation is available from a suite of project specific surveys (Fugro, 2020b; 2020c). These surveys, with illustrations provided in Figure 11, confirm the following:

- Surficial sediments are coarser at the offshore extent of the ECC. Sediments include sands gravels, shingle and cobbles;
- Finer sediments characterise the seabed towards the shore, with the closest sample to shore (at 8 m Below Sea level (BSL)) shown to predominately comprise muds; and
- The eastern extent of the ECC has a greater presence of fines, likely due to the relative proximity of the Dee Estuary.

Figure 11: Sediment images from the offshore extent (right; sample W_ST13_03)) and south-east (left; sample W_ST48) of the ECC, as captured during the project specific survey (Fugro, 2020a).

83 In the inter-tidal area, the surficial sediments become coarser, with an absence of finer material explained by the increased hydrodynamic energy experienced at the shoreline. This active environment is also indicated by the requirement for rock (boulder) sea defences located seaward of a cement seawall (Fugro, 2020d).

Suspended sediments

84 Annual and monthly averaged satellite imagery of SPM, as presented in Figure 6, suggests that the AyM offshore ECC study area shows some spatial variation, with the highest values in the southern extents near the coast. The offshore ECC study area shows a greater seasonality than the array area, increasing in the winter months to mean values between 5 to 25 mg/l.

85 Near-bed suspended sediment data is available from one location within the GyM export cable corridor. This information, given its distance offshore and relative to AyM, provides an overview of the likely natural variation in near-bed SSC levels throughout the tidal cycle and in response to storm events. Of note however, is that the closer location of this data site to the River Dee may result in higher SSC levels than within the AyM offshore ECC (Figure 6). The available data, as shown in Figure 12, clearly shows the following:

- In the absence of storm events, typical concentrations throughout the tidal cycle are less than 50 mg/l;
- Storm events elevate the SSC levels. The data shows that a storm event with a significant wave height of approximately 4.5 m has results in levels in excess of 600 mg/l;
- There is typically a short temporal lag between the maximum wave height and corresponding maximum SSC levels.

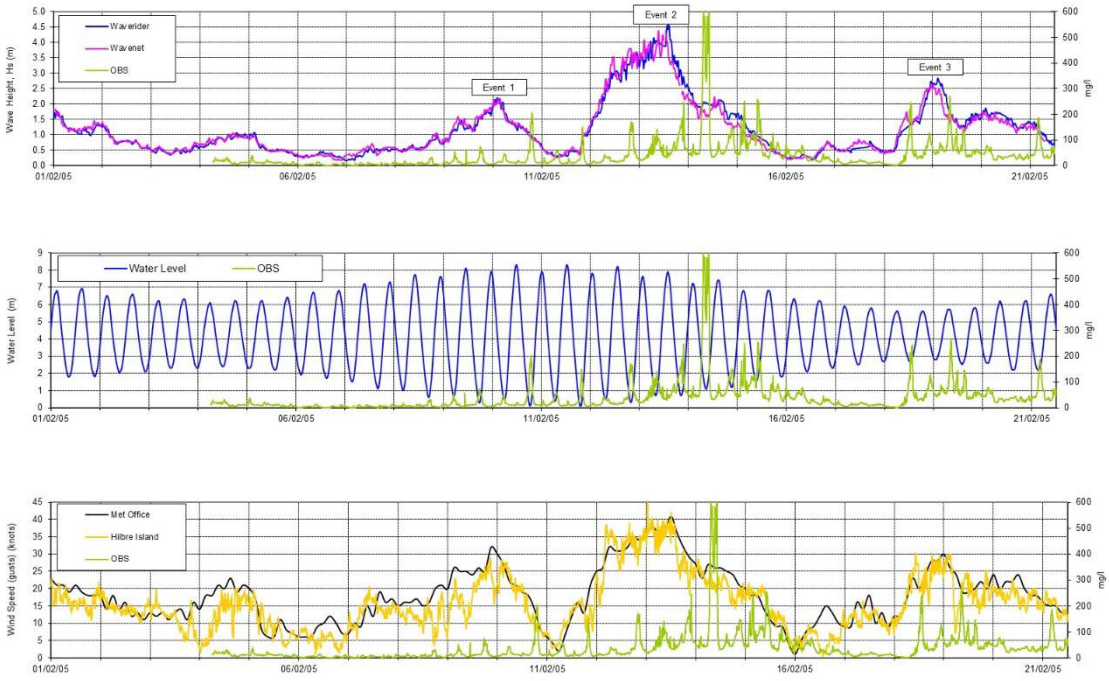


Figure 12: Natural variation of suspended sediment concentrations throughout a tidal cycle and under the influence of storm events.

86 The spatial variation from the offshore to coastal ECC regions results from the increased influence of wave stirring in the shallower waters, in addition to the increased presence of finer seabed sediments (Fugro, 2020b; 2020c). Along the coast and within the offshore ECC, there is also a spatial gradient of increasing SPM towards the River Dee. The SSC levels within the Dee are influenced by river channel erosion and surface runoff (Walling and Collins, 2005).

Water chemistry

87 The information presented in Section 3.7.1 is also applicable to the offshore ECC for water chemistry.

Sediment chemistry

88 The information presented in Section 3.7.1 is also applicable to the offshore ECC for sediment chemistry.

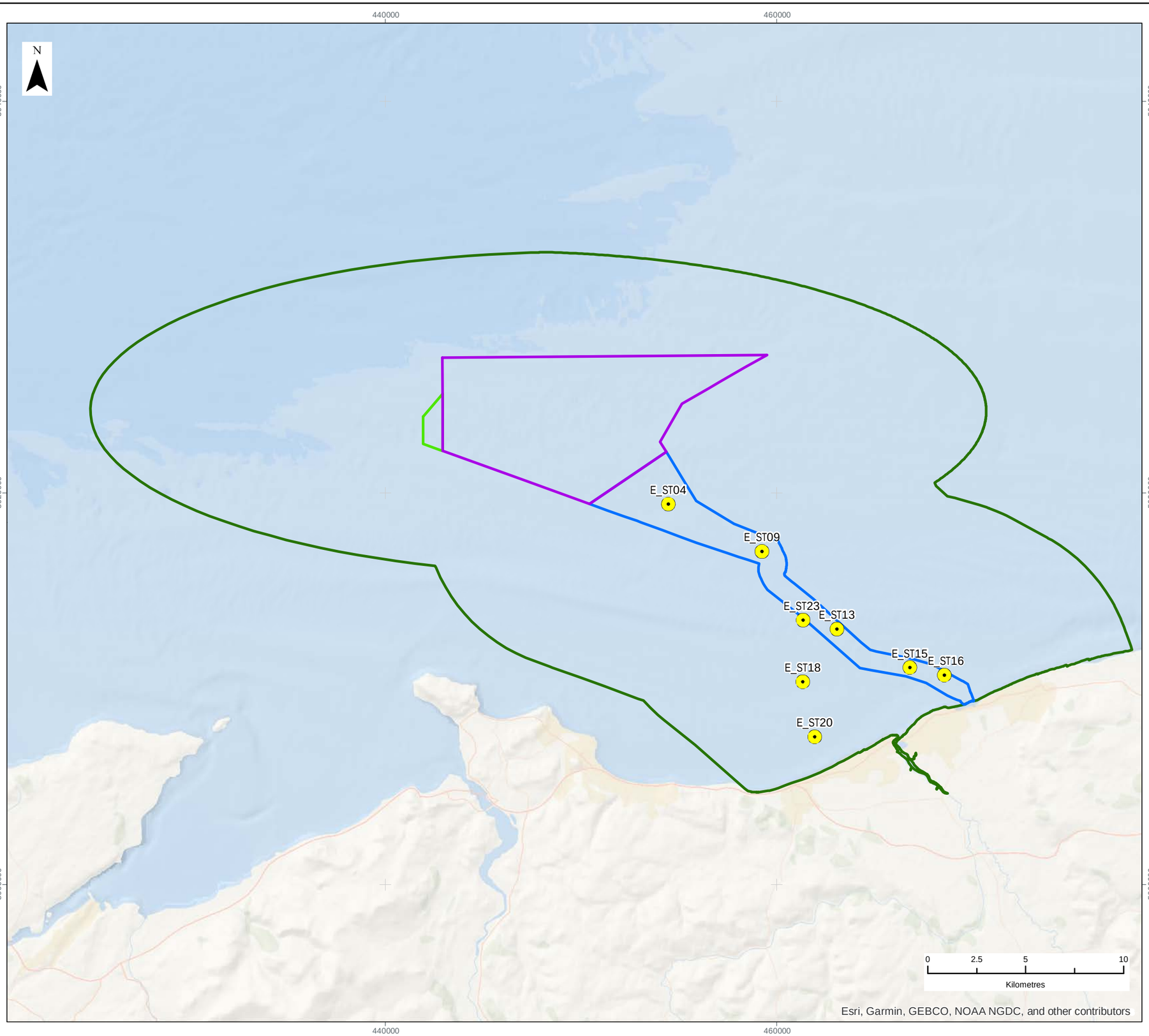
Site-specific surveys

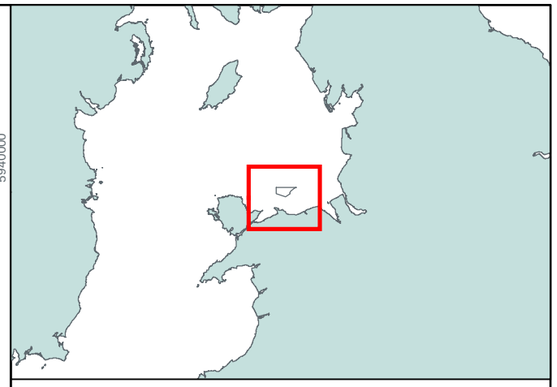
89 Figure 13 presents the locations within the ECC where site-specific sampling and contaminants analysis have been undertaken for the purposes of characterisation in this EIA. Following a refinement of the Order Limits between scoping and the application, some of these samples are outside the Order Limits but have been presented to provide context of the wider region. Additional information regarding the survey is presented in Volume 4, Annex 5.1, Annex 5.2 and Annex 5.3 (application refs: 6.4.5.1, 6.4.5.2 and 6.4.5.3).

Polycyclic Aromatic Hydrocarbons (PAHs)

90 As presented in Table 11, all of the sampled stations in the offshore ECC[vii] had PAHs below the TEL threshold. Therefore, these stations can be characterised as 'the minimal effect range within which adverse effects rarely occur' with respect to PAHs.

[vii] E_ST20 and E_ST18 are outside of the AyM offshore ECC but have been included to provide context for the wider study area (see Figure 13).





LEGEND

- Array Area
- Offshore Export Cable Corridor
- Other Wind Farm Infrastructure Zone
- Zone of Influence
- ECC Contamination Points

Data Source:

PROJECT TITLE:

AWEL Y MÔR OFFSHORE WINDFARM

FIGURE TITLE: Sediment contaminant analysis locations within the ECC

VER	DATE	REMARKS	Drawn	Checked
1	15/09/2021	For Issue for PEIR	BPHB	SM
2	17/01/2022	For Issue For ES	BPHB	DH

FIGURE NUMBER:

Figure 13

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:200,000	A3	WGS84	UTM30N

Fferm Wynt Alltraeth
AWEL Y MÔR
Offshore Wind Farm

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Table 11: Polycyclic aromatic hydrocarbon (PAH) sediment analysis results from the ECC.

CONTAMINANT	CANADIAN MARINE SEDIMENT QUALITY GUIDELINES (µG/KG)		PAH (µG/KG OF DRY SEDIMENT)							
	TEL	PEL	E_ST04	E_ST09	E_ST13	E_ST15	E_ST16	E_ST18	E_ST20	E_ST23
Acenaphthene	6.71	88.9	0.3	<0.1	<0.1	<0.1	0.1	<0.1	0.1	<0.1
Acenaphthylene	5.87	128	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	46.9	245	0.7	0.1	<0.1	0.1	0.2	0.1	0.3	0.1
Benzo(a)anthracene	74.8	693	2.8	0.2	0.2	0.2	0.9	0.3	1.1	0.2
Benzo(a)pyrene	88.8	763	3.2	0.2	0.2	0.2	1.1	0.5	1.3	0.2
Benzo(b)fluoranthene	N/A*	N/A*	6.9	0.8	0.7	0.8	3.1	1.4	3.4	0.8
Benzo(ghi)perylene	N/A*	N/A*	4.8	0.4	0.3	0.4	1.5	0.9	1.3	0.3
Benzo(k)fluoranthene	N/A*	N/A*	2.1	0.2	0.2	0.2	0.9	0.4	1.0	0.2
Chrysene	108	846	3.4	0.3	0.2	0.2	1.0	0.4	1.3	0.2
Dibenzo(a,h)anthracene	6.22	135	1.1	0.1	0.1	0.1	0.3	0.2	0.3	0.1
Fluoranthene	113	1,494	4.9	0.4	0.3	0.4	1.7	0.6	2.0	0.3
Fluorene	21.2	144	1.1	0.1	0.1	0.1	0.3	0.1	0.4	0.1
Indeno(1,2,3-cd)pyrene	N/A*	N/A*	4.8	0.4	0.4	0.5	1.9	1.1	1.8	0.4

CONTAMINANT	CANADIAN MARINE SEDIMENT QUALITY GUIDELINES (µG/KG)		PAH (µG/KG OF DRY SEDIMENT)							
	TEL	PEL	E_ST04	E_ST09	E_ST13	E_ST15	E_ST16	E_ST18	E_ST20	E_ST23
Naphthalene	34.6	391	2.3	0.1	0.1	0.1	0.6	0.2	0.9	0.1
Phenanthrene	86.7	544	6.6	0.4	0.2	0.2	1.4	0.5	1.9	0.3
Pyrene	153	1,398	4.5	0.4	0.3	0.3	1.5	0.5	1.7	0.3
**Cells highlighted in green	Above TEL									
*N/A	Not threshold defined under the Canadian Marine Sediment Quality Guidelines									

Metals

91 All metals collected for the site-specific survey within the offshore ECC were below Cefas Guideline Action Level 1 (Table 12). Therefore, these metal contaminants are not considered to be of concern and are considered suitable for disposal at sea.

Table 12: Metal sediment analysis results from the ECC.

	MG/KG IN DRY SEDIMENT								
	CAL1	E_ST04	E_ST09	E_ST13	E_ST15	E_ST16	E_ST18	E_ST20	E_ST23
Al	N/A	2250	1940	1970	2490	2670	2250	2980	1910
As	20	8.31	8.42	7.07	7.34	5.82	11.4	6.84	7.36
Ba	N/A	7.9	6.12	6.06	9.97	13	7.24	23	7.7
Cd	0.4	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Cr	40	8.19	5.88	5.4	8.36	7.73	8.85	14.5	6.22
Cu	40	1.2	1.89	1.16	1.36	1.8	1.6	1.99	1.1
Hg	0.3	<0.04	<0.05	<0.06	<0.07	<0.08	<0.09	<0.10	<0.11
Ni	20	4.3	4.39	3.36	4.4	4.22	4.05	5.03	3.29
Pb	50	5.01	6.23	4.05	5.25	6.57	8.12	7.08	4
Sn	N/A	0.224	0.213	0.194	0.318	0.38	0.402	0.462	0.205
Zn	130	14.3	16.8	13.1	17	21.4	25.1	22.7	12.7

3.7.3 Designated sites

92 The AyM offshore ECC crosses the North Wales coastal waterbody (GB641011650000) (Figure 14). There are no other coastal waterbodies are within the ZoI. The Clwyd transitional waterbody (GB541006608000) is also with the ZoI. No other transitional waterbodies have been identified within the ZoI (Figure 14). The current status of the North Wales coastal and Clwyd transitional waterbodies are provided in Table 13.

93 Within the ZoI, there are six designated Bathing Waters (Figure 14). This includes the Marine Lake, Rhyl Bathing Water which, whilst scoped out during the PEIR stage, has been included within this assessment at the request of, and following consultation with, NRW. The classifications of the identified Bathing Waters, reported between 2017 and 2021, are presented in Table 14. There are no designated Shellfish Water Protected Areas or nutrient sensitive areas are within the ZoI.

Table 13: Current status of identified coastal and transitional waterbodies (source: Cycle 2 Interim Classifications (NRW, 2018) and Draft River Basin Management Plan Consultation Data (NRW, 2020).

NAME	NORTH WALES	CLWYD
ID	GB641011650000	GB541006608000
TYPE	Coastal	Transitional
DISTANCE FROM AYM (KM)	0 (the offshore ECC overlaps with the waterbody)	0 (the onshore ECC overlaps with the waterbody)
WATERBODY AREA (HA)	14,627.8[viii]	64.4[viii]
OVERALL CURRENT POTENTIAL STATUS	Moderate	Moderate
CURRENT STATUS (ECOLOGICAL)	Moderate	Moderate
CURRENT STATUS (CHEMICAL)	Fail	Good
TARGET[ix]	Good by 2033	Moderate by 2027
IS THE WATERBODY HEAVILY MODIFIED (HMWB)?	Yes	Yes

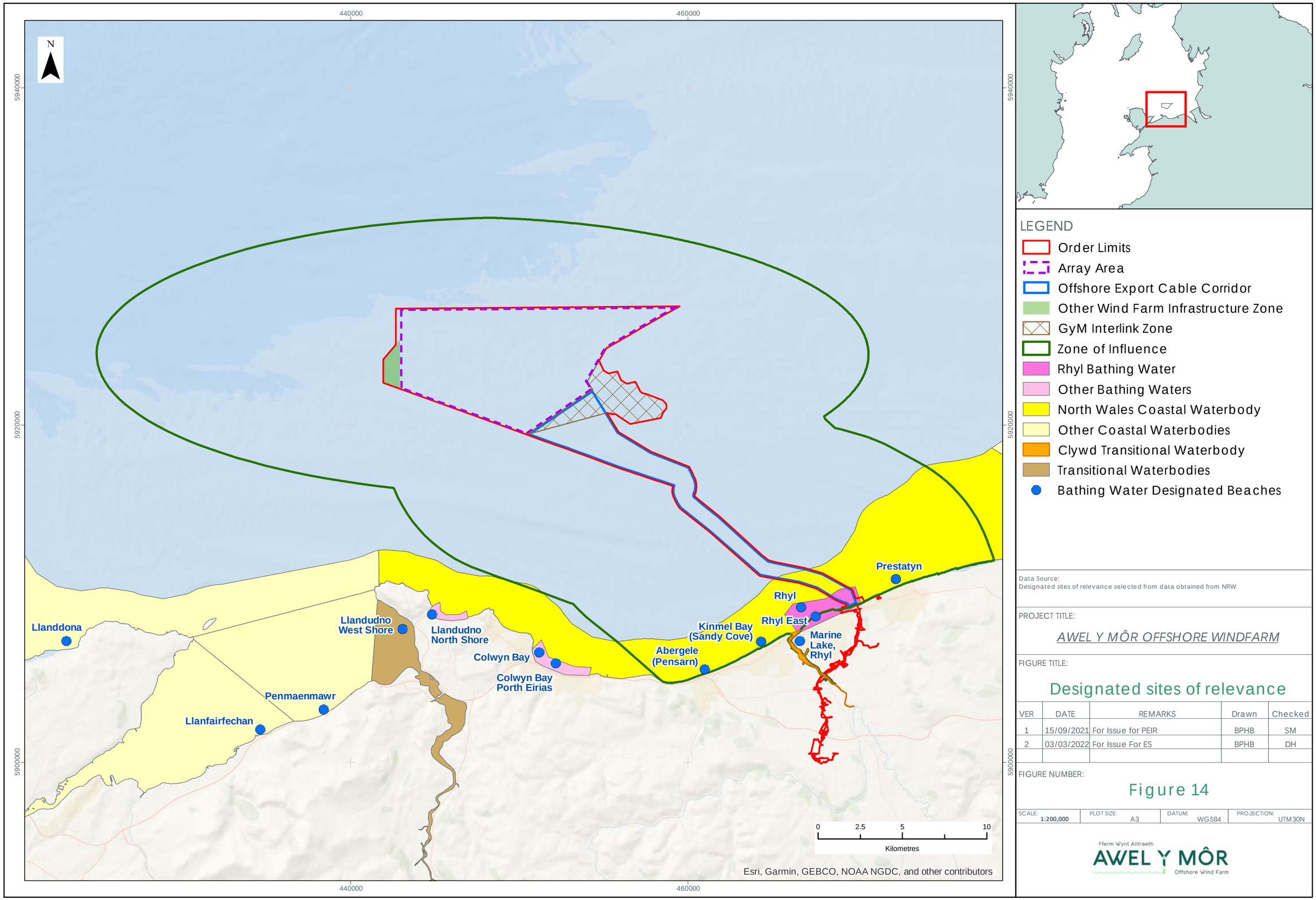
[viii] Calculated from GIS analysis

[ix] As defined in Draft River Basin Management Plan (RBMP) Consultation Data (NRW, 2020)

DRIVING ECOLOGICAL QUALITY ELEMENT	Phytoplankton blooms	Dissolved Inorganic Nitrogen; Mitigation Measures Assessment
WFD PHYTOPLANKTON CLASSIFICATION	Moderate	Not recorded
ANNEX 8 CHEMICALS	High	Not Assessed
DISSOLVED INORGANIC NITROGEN	Good	Moderate

Table 14: Bathing Water classification (NRW, 2021) and distance to offshore ECC.

NAME	CLASSIFICATION					DISTANCE TO OFFSHORE ECC (KM)
	2021	2020	2019	2018	2017	
Abergele (Pensarn)	Sufficient	Sufficient	Sufficient	Good	Good	9.3
Kinmel Bay (Sandy Cove)	Good	Sufficient	Good	Good	Good	5.6
Rhyl	Sufficient	Good	Sufficient	Sufficient	Sufficient	2.8
Rhyl East	Good	Good	Good	Good	Good	2.0
Marine Lake, Rhyl	Sufficient	Sufficient	Sufficient	Good	Good	3.5
Prestatyn	Excellent	Excellent	Excellent	Excellent	Excellent	2.7



LEGEND

- Order Limits
- Array Area
- Offshore Export Cable Corridor
- Other Wind Farm Infrastructure Zone
- GyM Interlink Zone
- Zone of Influence
- Rhyl Bathing Water
- Other Bathing Waters
- North Wales Coastal Waterbody
- Other Coastal Waterbodies
- Clywd Transitional Waterbody
- Transitional Waterbodies
- Bathing Water Designated Beaches

Data Source:
Designated sites of relevance selected from data obtained from NRW

PROJECT TITLE:

AWEL Y MÔR OFFSHORE WINDFARM

FIGURE TITLE:

Designated sites of relevance

VER	DATE	REMARKS	Drawn	Checked
1	15/09/2021	For Issue for PEIR	BPHB	SM
2	03/03/2022	For Issue For ES	BPHB	DH

FIGURE NUMBER:

Figure 14

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:200,000	A3	WGS84	UTM30N

Fferm Wynt Alltraeth
AWEL Y MÔR
Offshore Wind Farm

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3.7.4 Evolution of the baseline

94 The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 require that "a description of the relevant aspects of the current state of the environment (baseline scenario) and an outline of the likely evolution thereof without implementation of the 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 ES (Infrastructure Planning (Environmental Impact Assessment) Regulations 2017, Schedule 4, Paragraph 3). From the point of assessment, over the course of the development and operational lifetime of AyM (operational lifetime anticipated to be 25 years from first power), long-term trends mean that the condition of the baseline environment is expected to evolve. This section provides a qualitative description of the evolution of the baseline environment, on the assumption that AyM is not constructed, using available information and scientific knowledge of marine water quality. A description of the future baseline conditions has been carried out (in the event of no development) and is described within this section.

95 SoNaRR2020 (NRW, 2021a) highlights that 'major improvements' in water quality in Wales have been achieved in recent years through successive investment, alteration in agriculture practices in specific catchments and the management of chemicals. However, in European marine sites, up to 38% and 28% of the habitat features assessed failed to meet good condition for chemical contaminants and one or more nutrient elements respectively. The SoNaRR2020 concluded the following future trends in marine and coastal waters from the present to 2030:

- Bacterial load is projected to improve through reduced inputs from wastewater treatment, however diffuse sources is less certain;
- Nutrients are projected to be a 'mixed picture' owing to the nitrogen loads being primarily from diffuse agriculture which will need to balance intensification of agriculture and the reduction of sources; and

- Contaminants are a ‘mixed picture’ with current control measures projected to be effective in reducing some chemicals, however local approaches may be required to reduce the inputs of other chemicals. New legislation may also be required for emerging chemicals.

96 Seawater chemistry, such as reductions in pH and to salinity, have been observed and attributed to anthropogenic climate change. These changes may result indirectly in changes in coastal dynamics, water column stability and water quality. In the absence of AyM being constructed, no alterations to the evolving baseline environment, in respect of MW&SQ, are anticipated to occur.

3.8 Key parameters for assessment

97 This section identifies the maximum design scenario (MDS) of relevance to the assessment of impacts on MW&SQ, defined by the project design envelope (Volume 2, Chapter 1: Offshore Project Description (application ref: 6.2.1). The method adopted is in accordance with the requirements of the Rochdale Envelope approach to environmental assessment as set out in the PINS Advice note nine: 'Using the Rochdale Envelope' (PINS, 2018), and as detailed in Volume 1, Chapter 3: EIA methodology (application ref: 6.1.3).

98 The MDS assessed for MW&SQ are described in Table 15. These scenarios will be taken forward to assess the realistic worst-case scenario for each of the identified potential impacts. The principals of this approach were presented and agreed with the Evidence Plan in March 2021.

99 The use of jack-up vessels (JUVs) and anchors during the construction, operation and decommissioning phases is considered to be inconsequential relative to the activities assessed in Table 15. This is primarily as they will bring sediments into suspension which will rapidly settle from suspension within the immediate area. Therefore, the use of the JUVs and anchors will not result in notable changes of SSC and associated sediment deposition on MW&SQ receptors.

Table 15: Maximum design scenario.

POTENTIAL EFFECT	MAXIMUM ADVERSE SCENARIO ASSESSED	JUSTIFICATION
CONSTRUCTION		
Deterioration in water quality due to suspension of sediments Release of sediment-bound contaminants from disturbed sediments	Greatest volume of sediment disturbed and released from seabed preparation for foundations: • Method: Trailer suction hopper dredger (TSHD) and disposal at the water surface • It is assumed that the material can be disposed of anywhere within the Order Limits but is likely to be disposed of close to the location of the dredging. • 50 WTGs x 2,500 m^2 x Multi-leg gravity base (Gravity Base System (GBS)) seabed preparation area x 4 m (depth) = 500,000 m^3 • 2 x 10,800 m^2 (GBS OSP seabed preparation) x 4 m (depth) = 86,400 m^3 • This assessment assumes no seabed preparation is required for the met mast. • Total volume from seabed prep = 500,000 m^3 + 86,400 m^3 = **586,400 m^3** Greatest volume of sediment disturbed and released from drill arisings from foundation installation:	This design scenario results in the greatest volumes of sediment being disturbed for all construction activities. The worst-case methods have also been selected which results in the most energetic releases of sediment, such as the use of mass flow excavation (MFE) and disposal of sediments using a (TSHD) releasing sediment at the water surface. In the event that cofferdams are used, during the landfall activities, then the release of the maximum volume of bentonite into the environment will not be necessary. Therefore, this assessment has

POTENTIAL EFFECT	MAXIMUM ADVERSE SCENARIO ASSESSED	JUSTIFICATION
	▲ It is assumed that the material can be disposed of anywhere within the Order Limits but is likely to be disposed of in the array. ▲ 50 WTGS x 9,005 m^3 (drill arisings per monopile) x up to 60% of locations may require drilling = 270,161 m^3 ▲ 2 OSPs x 12,064 m^3 (drill arisings per OSP) = 24,127 m^3 ▲ Total volume from drill arisings = 270,161 m^3 + 24,127 m^3 = **294,288 m^3** Greatest volume of sediment disturbed from seabed preparation for export cable installation: ▲ 100% of the offshore export cable length may require boulder clearance; ▲ Up to 63 km of the offshore ECC may require sandwave clearance via MFE; ▲ Maximum volume of sediment disturbed from sandwave clearance in the offshore ECC: **6,281,000 m^3**; and ▲ Material from the export cable corridor to be disposed of anywhere within the offshore ECC or within a nominated disposal area in close proximity. Material from the export cable corridor to be disposed of anywhere within the export cable route corridor or within a nominated disposal area in close proximity. Material from the array to be disposed of anywhere	considered the release as the worst-case.

POTENTIAL EFFECT	MAXIMUM ADVERSE SCENARIO ASSESSED	JUSTIFICATION
	within the array area or within a nominated disposal area in close proximity. Greatest volume of sediment disturbed from seabed preparation for inter-array cable installation: • 100% of the inter-array cable length may require boulder clearance; • Up to 80 km (~69% of length) of the inter-array cables may require sandwave clearance via TSHD; • Maximum volume of sediment disturbed from sandwave clearance in the array = **7,600,000 m³**; and • Material to be disposed of anywhere within the array area or within a nominated disposal area in close proximity. Greatest volume of sediment disturbed from inter-array cable installation: • Installation method: MFE; • Total length: 116 km; • Width: 18 m; • Depth: 4 m; and • Volume of disturbed during inter-array cable installation: 116 km x 18 m x 4 m x 0.5 (V-shaped trench) x 50% (material ejected from trench) = **2,089,854 m³.**	

POTENTIAL EFFECT	MAXIMUM ADVERSE SCENARIO ASSESSED	JUSTIFICATION
	Greatest volume of sediment disturbed from export cable installation: • Installation method: MFE; • Number of cables: 2; • Total length: 79.4 km in total; • Width: 18 m; • Depth: 4 m; and • Volume: 79.4 km x 18 m x 4 m x 0.5 (V-shaped trench) x 50% (material ejected from trench) = **1,429,560 m³** Greatest volume of sediment disturbed from HDD (or other trenchless technique) exit pit excavation: • HDD (or other trenchless technique) pits will be between MHWS and 1,000 m seaward of MHWS; • Stage 1: Up to 3 HDD (or other trenchless technique) exit pits (10 m width x 75 m length x 2.5 m depth) excavated via backhoe dredger (or similar) with material sidecast for backfill. Following duct installation the pit may be secured by temporary rock bags or similar for up to 2.5 years; • Stage 2: Prior to cable installation, MFE (or similar) may be required to remove accumulated loose sediment, and to retrieve rock bags. Following cable installation, any intertidal HDD (or other trenchless technique) exit	

POTENTIAL EFFECT	MAXIMUM ADVERSE SCENARIO ASSESSED	JUSTIFICATION
	pits will be refilled to natural beach level using a backhoe dredger (or similar) with the previously side case material; and • Maximum volume: 3 HDD (or other trenchless technique) exit pits x 10 m width x 75 m length x 2.5 m depth x 2 (stages) = **11,250 m³**. Total volume of disturbed sediment for construction activities = **18,292,352 m³ (~0.0183 km³)**	
Deterioration in water clarity due to the release of drilling mud	• Landfall methodology: trenchless installation techniques such as HDD; • Maximum volume of drill cuttings and drilling mud (bentonite) to be released by all drills: 3 HDD (or other trenchless technique) bores (back reaming and duct install fluid lost to sea) = **18,117 m³**; and • This assessment assumes punch out in the intertidal.	The maximum volume of bentonite which could be released as part of the landfall activities is considered. For this assessment, it is considered that the bentonite would not be captured and is released into the marine environment, i.e. no measures have been implemented to prevent bentonite entering the marine environment. It should be noted that the maximum volume of bentonite that could be released and thus used in this assessment presents a worst-case scenario (i.e. precautionary approach), but a realistic volume

POTENTIAL EFFECT	MAXIMUM ADVERSE SCENARIO ASSESSED	JUSTIFICATION
		to be released is likely to be much less.
Accidental releases or spills of materials or chemicals	▲ Oil filled cables will not be used; ▲ Up to 35 construction vessels operating on the site at any given time; ▲ Up to 3,436 vessel round trips under the smaller WTG scenario; ▲ Up to 530 return trips by 2 helicopters with refuelling only taking place on an onshore base; and ▲ There is the potential for synthetic compound, heavy metal and hydrocarbon contamination resulting from the construction of the WTGs and OSPs: o A larger WTG is expected to contain 1,317 litres of grease, 2,487 litres of hydraulic oil, 4,883 litres of gear oil, 159,467 litres of liquid nitrogen, 17,849 kg of transformer silicone/ ester oil, 180 kg of SF6, 34,527 litre of glycol/ coolants and 4,000 kg of batteries; and o A typical OSP is expected to contain 340,000 litre/kg of transformer silicon/ ester oil, 20,000 litre of diesel fuel, 5,000 kg of SF6 gas, 350,000 kg of batteries, 5,000 litres of grey water and 3,000 litres of black water. Minimal amount of	These parameters are considered to represent the maximum adverse scenario with regards to vessel movement during the construction period. These parameters present the maximum volumes of compounds which could be associated with the project infrastructure.

POTENTIAL EFFECT	MAXIMUM ADVERSE SCENARIO ASSESSED	JUSTIFICATION
	grease, hydraulic oil, nitrogen and glycol/ coolants may also be within the OSPs.	
OPERATION		
Deterioration in water quality due to suspension of sediments from scour	▲ Defined from the outputs of the scour assessment (see Volume 4, Annex 2.3: Physical Processes Modelling Results (application ref: 6.4.2.3)). For the purposes of assessment, it will be assumed that scour protection around foundations is not installed.	This design configuration of foundations and foundation types are most likely to result in the development of scour pits on the seabed. In addition, the worst-case cable protection and crossings designs which could result in scour have been considered.
Deterioration in water quality due to suspension of sediments from O&M activities	▲ Up to 30,000 m^2 of the seabed may be disturbed due to inter-array cable repairs; ▲ Up to 5 km of inter-array cables may require reburial/ remedial works via jetting (or laying additional rock protection); ▲ Up to 30,000 m^2 of the seabed may be disturbed due to export cable repairs; and ▲ Up to 5 km of export cables may require reburial/ remedial works via jetting (or laying additional rock protection).	The maximum lengths of cables which may require maintenance and repair works have been considered in this assessment to provide a reasonable worst-case for the purposes of this assessment.

POTENTIAL EFFECT	MAXIMUM ADVERSE SCENARIO ASSESSED	JUSTIFICATION
Accidental releases or spills of materials or chemicals during operation	• Up to 22 O&M vessels operating on the site at any given time; • Up to 1,208 annual vessel round trips under the smaller WTG scenario; • Up to 200 helicopters round trips annually with refuelling only taking place on an onshore base; • There is the potential for synthetic compound, heavy metal and hydrocarbon contamination resulting from the operation of the WTGs and OSPs: ▪ A larger WTG is expected to contain 1,317 litres of grease, 2,487 litres of hydraulic oil, 4,883 litres of gear oil, 159,467 litres of liquid nitrogen, 17,849 kg of transformer silicone/ ester oil, 180 kg of SF6, 34,527 litre of glycol/ coolants and 4,000 kg of batteries; and	These parameters are considered to represent the maximum adverse scenario with regards to vessel movement during the O&M period. These parameters present the maximum volumes of compounds which could be associated with the project infrastructure.

POTENTIAL EFFECT	MAXIMUM ADVERSE SCENARIO ASSESSED	JUSTIFICATION
	▪ A typical OSP is expected to contain 340,000 litre/kg of transformer silicon/ ester oil, 20,000 litre of diesel fuel, 5,000 kg of SF6, 350,000 kg of batteries, 5,000 litres of grey water and 3,000 litres of black water. Minimal amount of grease, hydraulic oil, nitrogen and glycol/ coolants may also be within the OSPs.	
DECOMMISSIONING		
Deterioration in water quality due to suspension of sediments	The decommissioning is expected to take place in reverse order of construction, and hence the MDS for decommissioning is predicted to be equal to or less than that during the construction phase: ▲ The decommissioning phase will last up to 3 years. ▲ Buried cables to be left *in situ* (but to be determined in consultation with key stakeholders as part of the decommissioning plan and following best practice at the time); ▲ Scour and cable protection left *in situ;* ▲ Landfall infrastructure to be left *in situ* where considered appropriate (but to be determined in consultation with	This scenario represents the maximum design scenario for the decommissioning of AyM at the time of writing.

POTENTIAL EFFECT	MAXIMUM ADVERSE SCENARIO ASSESSED	JUSTIFICATION
	key stakeholders as part of the decommissioning plan and following best practice at the time); and • Structures in the array to be cut off at or below the seabed.	
Accidental releases or spills of materials or chemicals during decommissioning	The decommissioning is expected to take place in reverse order of construction, and hence the MDS for decommissioning is predicted to be equal to or less than that during the construction phase: • There is the potential for synthetic compound, heavy metal and hydrocarbon contamination resulting from the operation of the WTGs and OSPs: ▪ A larger WTG is expected to contain 1,317 litres of grease, 2,487 litres of hydraulic oil, 4,883 litres of gear oil, 159,467 litres of liquid nitrogen, 17,849 kg of transformer silicone/ ester oil, 180 kg of SF6, 34,527 litre of glycol/ coolants and 4,000 kg of batteries; and	These parameters are considered to represent the maximum adverse scenario with regards to vessel movement during the decommissioning period. These parameters present the maximum volumes of compounds which could be associated with the project infrastructure.

POTENTIAL EFFECT	MAXIMUM ADVERSE SCENARIO ASSESSED	JUSTIFICATION
	A typical OSP is expected to contain 340,000 litre/kg of transformer silicon/ ester oil, 20,000 litre of diesel fuel, 5,000 kg of SF6, 350,000 kg of batteries, 5,000 litres of grey water and 3,000 litres of black water. Minimal amount of grease, hydraulic oil, nitrogen and glycol/ coolants may also be within the OSPs.	
CUMULATIVE EFFECTS		
Cumulative deterioration in water quality due to suspension of sediments	Presented in Table 18 (in Section 3.13).	
Cumulative release of sediment-bound contaminants from disturbed sediments	Presented in Table 18 (in Section 3.13).	

3.9 Mitigation measures

100 Mitigation measures that were identified and adopted as part of the evolution of the project design (embedded into the project design) and that are relevant to MW&SQ are listed in Table 16. The mitigation included embedded measures, such as design changes, and applied mitigation which is subject to further study or approval of details; these include avoidance measures that will be informed by pre-construction surveys, and necessary additional consents where relevant. The composite of embedded and applied mitigation measures apply to all parts of the AyM development works, including pre-construction, construction, O&M and decommissioning.

101 General mitigation measures, which would apply to all parts of the project, are set out first. Thereafter, mitigation measures that would apply specifically to MW&SQ issues associated with the array, offshore ECC and landfall are described separately.

Table 16: Mitigation measures relating to MW&SQ.

PARAMETER	MITIGATION MEASURES
GENERAL	
Project design	The development boundary selection was made following a series of constraints analyses, with the array area and offshore ECC route selected to ensure the impacts on the environment and other marine users are minimised.
Pollution prevention	A Project Environment Management Plan (PEMP) is proposed to be produced to ensure that the potential for contaminant release is strictly controlled. The PEMP will include a Marine Pollution Contingency Plan (MPCP) and will also incorporate plans to cover accidental spills, potential contaminant release and include key emergency contact details (e.g. NRW, Maritime Coastguard Agency and the project site co-ordinator). Guidance for Pollution Prevention 5 (GPP5): Works and maintenance in or near water[x] will be used to inform the development of the PEMP. The PEMP will be secured as a condition in the Marine Licence.
Pollution prevention	Typical measures will include: • storage of all chemicals in secure designated areas with impermeable bunding (generally to 110% of the volume); and • double skinning of pipes and tanks containing hazardous materials. The purpose of these measures is to ensure that potential for contaminant release is strictly controlled and provides protection to marine life across all phases of the life of the wind farm. It is envisaged these measures will be secured as a condition in the Marine Licence.
Pollution prevention	The Applicant commits to the disposal of sewage and other waste in a manner which complies with all regulatory requirements, including but not limited to the

x [redacted]

PARAMETER	MITIGATION MEASURES
	IMO MARPOL requirements[xi]. It is envisaged these measures will be secured as a condition in the Marine Licence.
CONSTRUCTION	
Cable Specification and Installation Plan (CSIP)	Development of, and adherence to, a Cable Specification and Installation Plan (CSIP) post consent. The CSIP will set out appropriate cable burial depth in accordance with industry good practice, minimising the risk of cable exposure. The CSIP will also ensure that cable crossings are appropriately designed to mitigate environmental effects. These crossings will be agreed with relevant parties in advance of CSIP submission. The CSIP will include a detailed Cable Burial Risk Assessment (CBRA) to enable informed judgements regarding burial depth to maximise the chance of cables remaining buried whilst limiting the amount of sediment disturbance to that which is necessary. The CSIP will be secured as a condition in the Marine Licence.
OPERATION	
Project design	Where burial depth cannot be achieved, cable armouring will be implemented (e.g. mattressing, rock placement, etc.). The suitability of installing rock or mattresses for cable protection will be investigated, based on (*inter alia*) the seabed current data at the location of interest and the assessed risk of impact damage.
Project design	In areas where there is potential for scour pits to develop around the foundations of structure, then scour protection will be implemented.
Scour Protection Management Plan	Development of a Scour Protection Plan (SPP) which set out the details of the protection where there is the potential for scour to develop around wind farm infrastructure, including turbine and substation/ platform foundations and cables. The plan will be secured as a condition in the Marine Licence.

xi [redacted]

PARAMETER	MITIGATION MEASURES
DECOMMISSIONING	
Decommissioning Plan	A Decommissioning Plan will be developed to cover the decommissioning phase as required under Chapter 3 of the Energy Act 2004. As the decommissioning phase will be a similar process to the construction phase but in reverse (i.e., increased project vessels on-site, partially deconstructed structures) the embedded mitigation measure will be similar to those for the construction phase. The Decommissioning Plan will be secured as a condition in the Marine Licence.

3.10 Environmental assessment: construction phase

3.10.1 Summary of the project specific modelling

102 A full assessment of the potential increases in SSC is presented in Volume 2, Chapter 2: Marine Geology, Oceanography and Physical Processes (application ref: 6.2.2) for all phases of the proposed development. The findings presented in this Section are based primarily on the project specific modelling undertaken to support this EIA. Full details are provided in Volume 4, Annex 2.3: Physical Processes Modelling Results (application ref: 6.4.2.3), with summary figures illustrated in Figure 2 and Figure 3 in this chapter. This sub-section provides a summary of the key results of the modelling undertaken to inform this MW&SQ assessment. This sub-section should be read in conjunction with Sections 3.10.2, 3.10.3, 3.11.2 and 3.12.1.

Mass flow excavator (MFE) – moving and static locations

103 Modelling of sediment disturbance scenarios from the use of a MFE has been undertaken for cable trenching and sandwave clearance activities within the array and ECC areas. This has included consideration of static and moving point sources, with an assumed sediment composition of gravel (25%), coarse sand (10%), medium sand (63%) and silt (2%) in the array area, and medium sand (95%) and silt (5%) in ECC. Modelling assumes a release of sediment at 3 m above the seabed. Refer to Volume 4, Annex 2.3: Physical Processes Modelling Results (application ref: 6.4.2.3) for further details on modelling scenarios.

104 The use of a MFE results in a relatively low height of initial suspension of sediment above the seabed. Only silt sized sediments are likely to persist in suspension for long enough to cause any effect on SSC beyond approximately 5 m for gravels, 30 m for coarse sand, 90 m for medium sand, and ~250-300 m for finer sands, from the trench over which the MFE is operating. The uplift in SSC caused by all sediment types together is realistically expected to be locally very high at the location of active trenching (where sediment is being put into suspension at a rate of the order 800 to 1,000 kg/s). Within 5 m of the activity, SSC might be millions of mg/l, i.e. more sediment than water in parts of the local plume. The effect is very localised and would last only while the MFE is active over that section of the trench.

105 During the first half tidal cycle (~6 hours), the plume width increases through dispersion to 50-100 m, all non-silt sediments have settled to the seabed, and SSC consequentially reduces rapidly to 5-10 mg/l. During spring tidal conditions, the disturbed sediment is carried away from the working area at a faster rate, dispersing the sediment mass over a larger area and water volume, and so the resulting SSC in the plume is relatively lower than on a comparable neap tide. After three days, the width of the measurable plume will spread to 250-500 m and SSC reduces to 1-2 mg/l as a result of ongoing sediment dispersion and settlement.

TSHD – dredged spoil disposal

106 The use of THSD for spoil disposal was explicitly modelled, based on a sudden static release at the water surface, and is summarised within this section. Fine sand and silt sized sediments persist in suspension for longer than relatively coarser sediment grain sizes (i.e. medium sand, coarse sand and gravels) and so contribute the majority of the effect on SSC beyond the above durations/ distances. The plume model indicates that dispersion will increase the plume width to approximately 1-2 km after one tidal cycle (approximately 12 hours), 3 km after one day and to approximately 5 km after 3 days, with an associated reduction in SSC.

107 The SSC levels associated with all sediment fractions are realistically expected to be locally very high at the spoil release location (millions of mg/l within 5 m of the activity, i.e. more sediment than water in the local plume). This level of detail is not resolved directly by the sediment plume model, which indicates a more dispersed initial concentration of 1,000 to 10,000 mg/l. Due to ongoing dispersion and the settlement of non-silt sediment to the seabed during the first half tidal cycle, the level of SSC associated with the remaining silt in the advected plume will reduce with time from 50 to 100 mg/l in central parts of the plume after one day, to less than 2 mg/l after three days.

Drilling arisings release

108 For drill arising release scenarios, modelling has assumed sediment is released at the water surface, with a sediment composition including gravel (20%), coarse sand (20), medium sand (20%), fine sand (20%) and silt (20%). Model outputs suggest that this activity results in a long, relatively thin plume extending downstream from the point of active disturbance. The level of SSC caused by all sediment types together is realistically expected to be locally very high at the location of active drilling. Within 5 m of the activity, SSC might be millions of mg/l, i.e. more sediment than water in parts of the local plume. The effect is very localised and of very short duration. Sediment in the plume is redeposited and dispersed both vertically and horizontally with distance and time downstream. SSC is expected to reduce to thousands or high hundreds of mg/l within tens to low hundreds of metres.

109 During the first half tidal cycle (~6 hours), the width of the plume increases through dispersion to 50-100 m, all non-silt sediments have settled to the seabed, and SSC consequentially reduces rapidly to 5-10 mg/l.

3.10.2 Deterioration in water quality due to suspension of sediments

110 As described in Table 15, offshore construction activities associated with AyM have the potential to increase SSC in the marine environment through the generation of sediment plumes. Increases in SSC and so turbidity may result in a decrease in the depth to which natural light can penetrate into the water column. This in turn may result in a reduction in primary productivity and/ or an increase in bacterial growth (of importance to designated Bathing Water classification). The disturbance of the seabed sediments may also result in the release of additional nutrients which were sediment-bound, therefore increasing their concentrations in the water column.

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

Magnitude of impact

112 The proposed activities are not anticipated to affect phytoplankton or dissolved oxygen as no nutrients are anticipated to be released in significant concentrations from the seabed beyond typical storm conditions. Further, the effects are anticipated to be temporary in nature. In addition to no significant nutrient releases, there will not be any outfalls or discharges associated with the project and so the proposed activities are not expected to cause a reduction in the dissolved oxygen in the water column. Consequently, no source-receptor-pathways are identified for a deterioration of dissolved oxygen, phytoplankton blooms or eutrophication as a result of the proposed construction activities.

113 As noted in Section 3.10.1, the maximum SSC at the centre of the plume anticipated after one day of cessation of the MFE or the disposal of spoil will be less than 100 mg/l. This would be classified as 'intermediate' in the UKTAG (2014) water turbidity ranking (10–100 mg/l). After three days, the SSC within the plume would be immeasurable in practice (less than 2 mg/l) and may be classified as 'clear' (<10 mg/l; UKTAG, 2014). While increased SSCs would locally increase turbidity, and thus temporarily reduce available light levels for photosynthetic organisms, these uplifts will be localised to the plume and highly transient. Furthermore, elevated SSCs are likely to be similar to those observed during storm events (see Section 3.7) for which impacts to phytoplankton through changes in turbidity are short-lived and localised. It is considered unlikely that changes in water quality through increased SSCs during the construction phase of AyM will result in notable changes in phytoplankton abundance and/ or assemblage.

114 The mortality of bacteria, including *E. coli* and IE, within the water column is strongly influenced by the amount of ultraviolet (UV) light penetrating the water column. Under higher UV scenarios the mortality of bacterium is higher. Therefore, the reduced water clarity due to works in the coastal waters could result in temporary increases in bacterial counts within the water column due to decreased bacterial mortality and UV light within the water column, and the potential release of sediment bound bacteria (including *E. coli* and IE). These elevated bacterial counts could theoretically cause a deterioration in the water quality and, if present at the identified Bathing Waters during the designated bathing season[xii], could theoretically cause a deterioration in their performance classifications (see Table 14). It is important to recognise that Bathing Water classifications are based on monitoring data from the previous four bathing seasons; therefore, any increases in bacterial abundance, which could arise from increases in SSCs due to activities which disturb seabed sediments (even if relatively short-term), could have a long-term impact on Bathing Water classification well beyond the reported event.

[xii] 15 May to 30 September

115 However, given the predicted dilution levels, the temporary nature of the activities, and SSC dispersion from tidal currents, it is expected that any bacterial increases in the water column would be in the order of days, i.e. as long as the plumes persisted. Following the sediment plumes dispersion, and subsequent increases in UV light, the bacterial counts in the water column will return to "do-nothing" baseline conditions. The resultant decrease in water clarity would be analogous to storm events (see Section 3.7). These potential changes are within the natural variation of the marine environment in the study area during high energy low frequency events and the high observed concentrations which coincide with the NAO.

116 The timings of the AyM construction activities are currently unknown, and thus could coincide with the bathing season (15 May to 30 September). The following six designated Bathing Waters have been identified within in the AyM ZoI:

- Abergele (Pensarn);
- Kinmel Bay (Sandy Cove);
- Rhyl;
- Rhyl East;
- Marine Lake, Rhyl; and
- Prestatyn.

117 In addition, the offshore ECC directly overlaps the Rhyl Bathing Water Sensitive Area (designated under the Urban Waste Water Treatment Directive) and, therefore, has been included as part of this assessment. Table 14 provides an indication of the distance between the proposed marine works (i.e., landfall, cable installation within the offshore ECC) and the respective monitoring points of designated Bathing Waters. The Rhyl (2.8 km) and Rhyl East (2.0 km) Bathing Waters are the nearest to the west of ECC, while Prestatyn (2.7 km) is the only Bathing Water to the east within the AyM ZoI. The Rhyl Bathing Water Sensitive Area directly overlaps the offshore EEC.

118 Figure 15 and Figure 16 present the maximum SSC plume extents anticipated to arise through the use of Mass Flow Excavation (MFE) within the offshore ECC during spring and neap tides, respectively. This activity is considered to present the worst case in terms of potential uplift in SSC. It should be noted that the plume extents shown are not simultaneous (i.e., they do not capture a specific moment in time), and instead present the maximum spatial extent that could be covered by the movement of the plume during typical conditions of a spring or neap tidal cycle. The plume will be expected to move back and forth and disperse with the prevailing tidal currents.

119 Monitoring points for the six designated Bathing Water identified within the AyM ZoI are also shown in Figure 15 and Figure 16. Increased SSCs due to the use of MFE may be observed at the monitoring points of the nearest Bathing Waters to the offshore ECC, namely Rhyl, Rhyl East and Prestatyn (separate consideration of Marine Lake, Rhyl provided below).

120 During spring tides, SSCs could be in the range of 50 to 100 mg/l at Rhyl Bathing Water, while concentrations at Rhyl East and Prestatyn Bathing Waters could be in the range of 5 to 50 mg/l. The maximum spatial extent of SSC plumes during neap tides are likely to be much reduced, with concentrations at Rhyl and Prestatyn Bathing Waters in the range of 1 to 5 mg/l (plume unlikely to reach Rhyl East Bathing Water). Increased SSCs are unlikely to be detectable at the monitoring points for Abergele (Pensarn) and Kinmel Bay (Sandy Cove) Bathing Waters during spring or neap tides. Within the Rhyl Bathing Water Sensitive Area, SSCs could be in the range of 250 to 500 mg/l; however, it is important to note these elevated concentrations would be highly localised to the site of works/ seabed disturbance and short lived as sediments readily disperse.

121 While elevated SSCs are predicted at the monitoring points of Rhyl, Rhyl East and Prestatyn Bathing Waters, these changes to water quality will be short-lived, localised and highly transient. The timing of the proposed works is currently unknown and, therefore, could overlap the bathing season during which monitoring is conducted. However, the potential for changes to bacterial abundance, and thus impacts to Bathing Water classifications, is considered negligible. In addition, the predicted increases in SSC at the monitoring points are relatively modest and likely to be within natural variation, or conditions experienced during storms events.

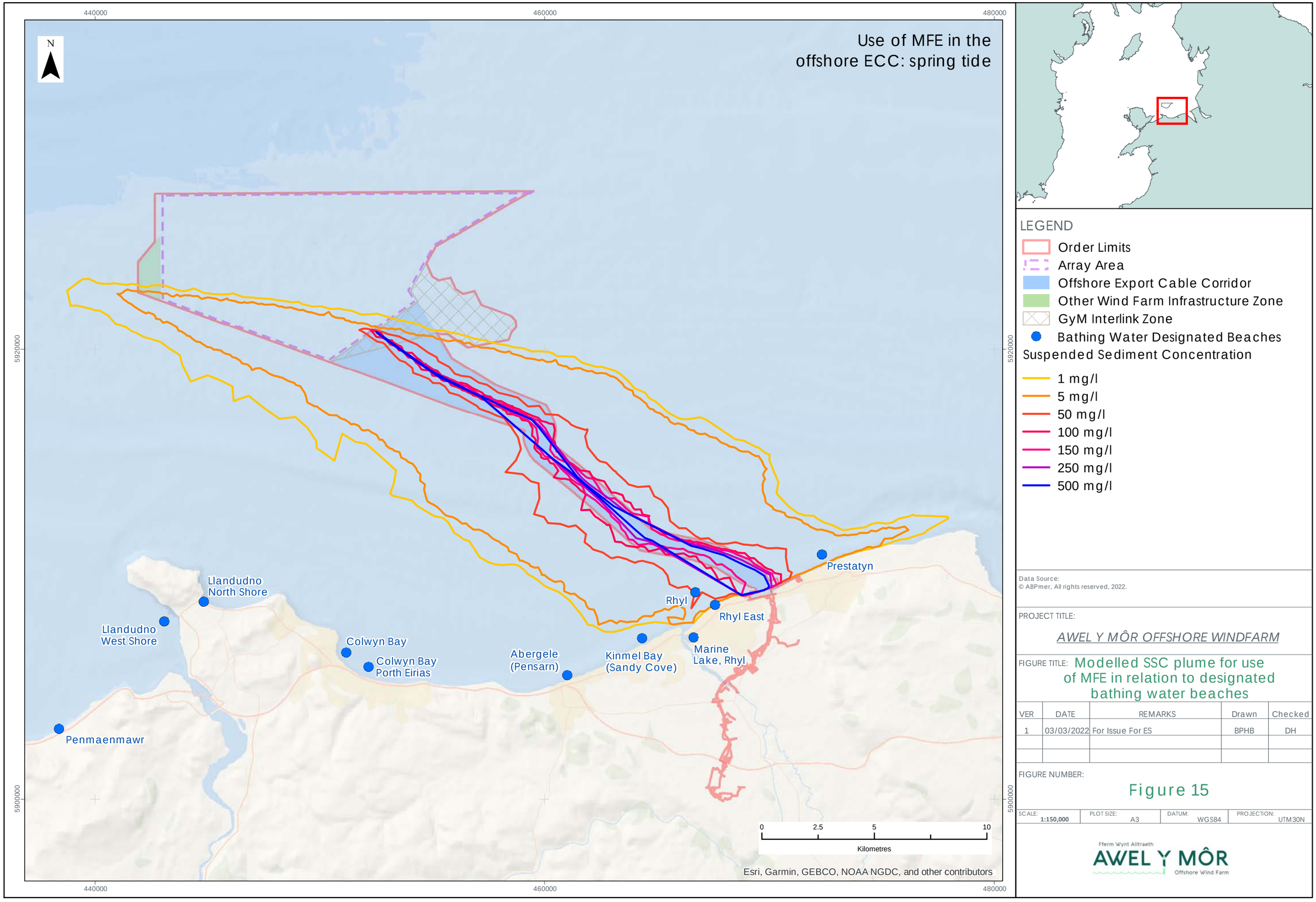
122 Marine Lake, Rhyl Bathing Water is situated adjacent to the Afon Clwyd. The Bathing Water is not directly linked to the sea but can be topped up during high tide through a sluice connected to the Afon Clwyd. As shown in Figure 15 and Figure 16, elevated SSCs are unlikely to be observed within the Afon Clwyd on either spring or neap tides; therefore, there is limited potential for suspended sediments associated with AyM activities to enter Marine Lake. Any increased SSCs are likely to be less than 5 mg/l (if observed at all) and unlikely to result in material changes to bacterial abundance. Furthermore, the site is topped up (sluice opened) at high water, at which point the plume would be transported downstream (away from the Bathing Water) with the ebb tide.

123 Separate to potential changes in bacterial abundance, and thus classifications, 'abnormal situations' can also lead to the closure of designated Bathing Waters (for as long as it takes to clean up the beach from a pollution event). There is the potential for accident spills to result in water quality deterioration, for example through the unplanned release of chemicals and/ or materials during planned project activities. An example of an occurrence of such an event would be the accidental release of grease and oils during maintenance work and from vessels associated with AyM. Bathing Water Sensitive Areas are also identified based on risks of nutrient inputs which could result in adverse conditions (e.g., eutrophication).

124 A PEMP will be produced post-consent and implemented to cover the construction and O&M phases of AyM. The PEMP will be secured as a condition in the Marine Licence. The PEMP will include a Marine Pollution Contingency Plan (MPCP) to provide protocols to cover accidental spills and potential contaminant release, and include key emergency contact details (e.g., NRW, Maritime and Coastguard Agency and the project site co-ordinator). While it is predicted that sediments will be mobilised due to activities associated with the proposed development (e.g., sandwave clearance, cable installation, HDD (or other trenchless technique) at landfill), it is unlikely that this will result in significant nutrient uplift in the surrounding waters. Therefore, it is considered unlikely that water quality at nearby Bathing Waters or the Rhyl Bathing Water Sensitive Area will be significantly impacted by the proposed development.

125 It should be noted that any activities disturbing sediment undertaken in the array area are not anticipated to impact on the designated WFD waterbodies. The project specific modelling indicates that no works undertaken in the array area will result in measurable changes in SSC within the WFD water bodies (Volume 4, Annex 2.3: Physical Processes Modelling Results (application ref: 6.4.2.3).

126 The SSC elevation and associated decrease in bacterial mortality, would be localised, within the range of natural variability and temporary. The magnitude of these elevated SSC and potential bacterial counts on water quality receptors are considered to be **low adverse**.



LEGEND

- Order Limits
- Array Area
- Offshore Export Cable Corridor
- Other Wind Farm Infrastructure Zone
- GyM Interlink Zone
- Bathing Water Designated Beaches

Suspended Sediment Concentration

- 1 mg/l
- 5 mg/l
- 50 mg/l
- 100 mg/l
- 150 mg/l
- 250 mg/l
- 500 mg/l

PROJECT TITLE:

AWEL Y MÔR OFFSHORE WINDFARM

FIGURE TITLE: Modelled SSC plume for use of MFE in relation to designated bathing water beaches

VER	DATE	REMARKS	Drawn	Checked
1	03/03/2022	For Issue For ES	BPHB	DH

FIGURE NUMBER:

Figure 15

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:150,000	A3	WGS84	UTM30N

Fferm Wynt Alltraeth
AWEL Y MÔR
Offshore Wind Farm

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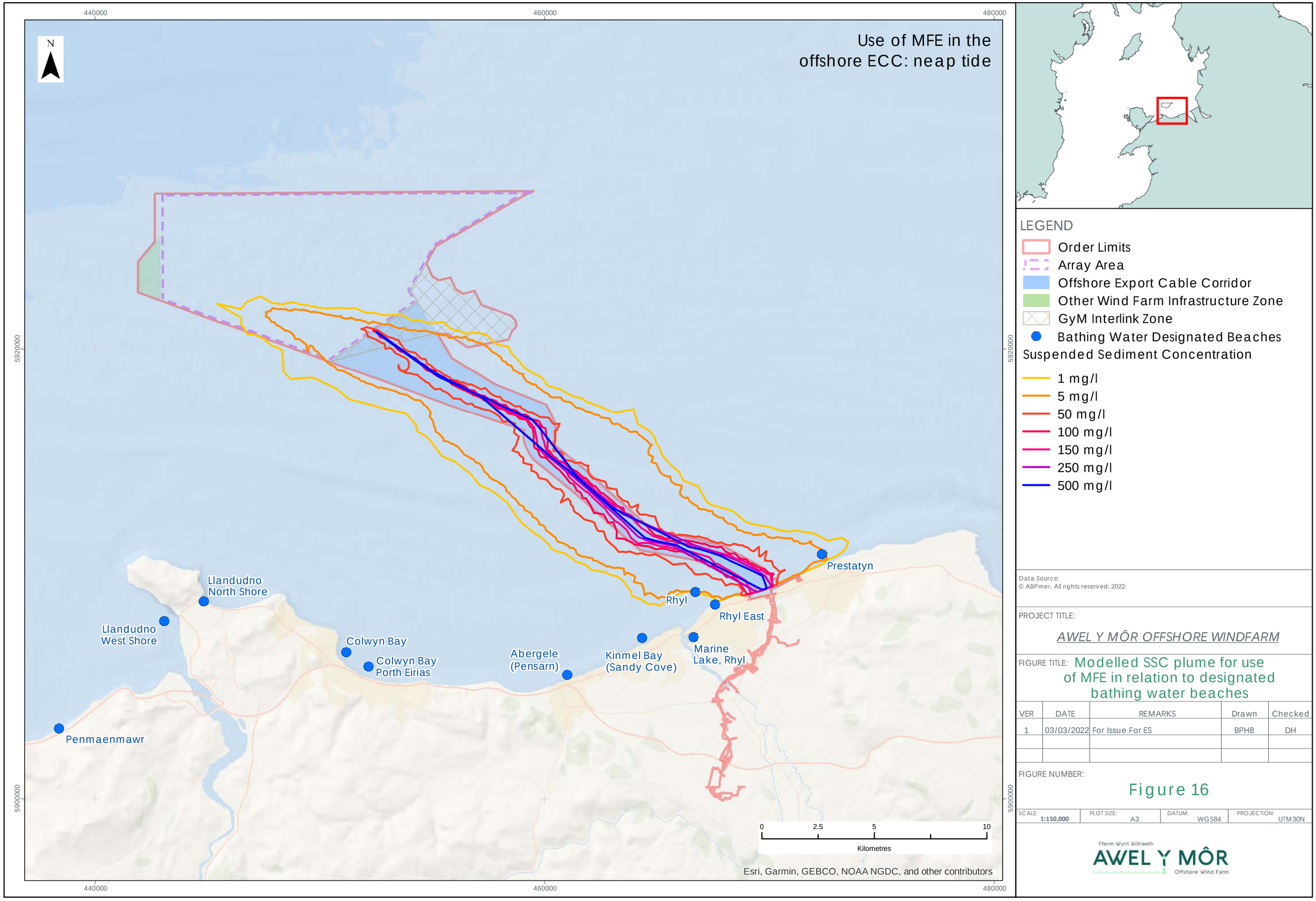

LEGEND

- Order Limits
- Array Area
- Offshore Export Cable Corridor
- Other Wind Farm Infrastructure Zone
- GyM Interlink Zone
- Bathing Water Designated Beaches

Suspended Sediment Concentration

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FIGURE TITLE: Modelled SSC plume for use of MFE in relation to designated bathing water beaches

VER	DATE	REMARKS	Drawn	Checked
1	03/03/2022	For Issue For ES	BPHB	DH

FIGURE NUMBER:

Figure 16

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:150,000	A3	WGS84	UTM30N

Fferm Wynt Alltraeth
AWEL Y MÔR
Offshore Wind Farm

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Sensitivity of receptors

127 Descriptions of sensitivity for water quality receptors (high, medium, low and negligible) are provided in Table 7.

128 The sensitivity of the identified Bathing Waters, to the potential for increased bacterial counts is **medium** with a moderate capacity to accommodate the proposed change. The potential for elevated counts resulting from decreased turbidity are within the natural variation.

129 The sensitivity of the North Wales coastal waterbody and the Clwyd transitional waterbody to the reduction in water clarity are judged to be **low.**

130 The sensitivity of non-designated waters, such as those within the array area, are judged to be insensitive to short-term and discrete reductions in water clarity, arising from the proposed construction activities. There is no applicable quality status which may be affected by these works. The sensitivity of non-designated waters is judged to be **negligible**.

Significance of effect

131 The magnitude of the increases to SSC and associated decrease in bacterial mortality has been assessed as low adverse. The sensitivity of the identified Bathing Waters was assessed as medium. The significance of the effect on the identified Bathing Waters is therefore concluded to be ***minor adverse***, which is not significant in terms of the EIA Regulations.

132 The magnitude of the increases to SSC has been assessed as low adverse. The significance of the effect on the WFD waterbodies is concluded to be ***minor adverse***, which is not significant in terms of the EIA Regulations. The significance of the effect on the non-designated waters are concluded to be ***negligible***, which is not significant in terms of the EIA Regulations.

133 No additional mitigation to that already identified in Table 16 is considered necessary. Therefore, no significant adverse residual effects have been predicted in respect of MW&SQ receptors.

3.10.3 Release of sediment-bound contaminants from disturbed sediments

134 As described in Table 15, the construction of AyM has the potential to increase SSC in the marine environment through the generation of sediment plumes. Whilst in suspension, there is the potential for sediment-bound contaminants, such as metals, hydrocarbons and organic pollutants, to be released into the water column and lead to an adverse effect on water quality receptors. Details of the potential disturbance to sediments during construction is presented in Section 3.10.2.

Magnitude of impact

135 As presented in Section 3.7 above, the contamination at AyM is considered to be very low within both the array and offshore ECC areas. No samples within the Order Limits, and so the area of sediment which may be directly disturbed, exceeded the TEL threshold for PAHs (Table 9 and Table 11) and there were no breaches of Cefas Guideline Action Level 1 in any of the samples analysed (Table 10 and Table 12).

136 The release of contaminants such as metals and PAHs is likely to be rapidly dispersed with the tidal currents; and therefore increased bioavailability resulting in adverse eco-toxicological effects is not expected. This rapid dispersion and dilution is demonstrated through the sediment plume modelling undertaken – see Section 3.10.1 and Volume 4, Annex 2.3: Physical Processes Modelling Results (application ref: 6.4.2.3).

137 Furthermore, under normal circumstances, very small concentrations of contaminants enter to the dissolved phase, with the vast majority adhering to the sediment particles when temporarily entering suspension in the water column. Partition coefficients may be applied to estimate the concentration of the contaminants entering the dissolved phase which typically result in a reduction of several orders of magnitude than the concentrations associated with suspended sediments. As such, it is considered highly unlikely that the Maximum Allowable Concentration (MAC) Environmental Quality Standards (EQS) threshold will be exceeded for any of the substances as a result of disturbing sediment from the proposed activities, given the fates of the plumes.

138 Moreover, given the short-term nature of the works and presence of the sediment plumes, any small uplift in the water concentrations of EQS substances would be anticipated to return to background levels very quickly.

139 It should be noted that any activities disturbing sediment undertaken in the array are not anticipated to impact on the designated WFD waterbodies. The project specific modelling indicates that no works undertaken in the array have measurable changes in SSC within the WFD water bodies (Volume 4, Annex 2.3: Physical Processes Modelling Results (application ref: 6.4.2.3)).

140 The magnitude of this potential impact is considered to be **low adverse** as a result of the short-term nature of the impact. Furthermore, it is not anticipated that disturbance of sediment-bound contaminants would affect the waterbody's performance against respective EQSs as the potential impacts will be temporary in nature.

Sensitivity of receptors

141 Descriptions of sensitivity for water quality receptors (high, medium, low and negligible) are provided in Table 7.

142 The sensitivity of the North Wales coastal waterbody and the Clwyd transitional waterbody to the release of sediment-bound contaminants is judged to be **low.**

143 The sensitivity of non-designated waters, such as those within the array, are judged to be insensitive to short-term and discrete disturbances of the sediments present which may release sediment-bound contaminants. There is no applicable quality status which may be affected by these works. The sensitivity of non-designated waters is judged to be **negligible**.

Significance of effect

144 The impacts to water quality receptors as a result of the release of sediment-bound contaminants are considered to be of low adverse magnitude. The sensitivity of the WFD waterbodies and non-designated waters is deemed to be low and negligible respectively. The significance of the effect on the WFD waterbodies, and receiving environment more broadly, is therefore concluded to be ***minor adverse*** *to* ***negligible***, which are not significant in terms of the EIA Regulations.

145 No additional mitigation to that already identified in Table 16 is considered necessary. Therefore, no significant adverse residual effects have been predicted in respect of MW&SQ receptors.

3.10.4 Deterioration in water clarity due to the release of drilling mud

146 There is a requirement to use drilling mud, such as bentonite (or another inert mud), in order to undertake HDD (or other trenchless technique) and make landfall. This in turn will result in the release of drilling mud within the intertidal area at the punch out point under the maximum adverse scenario assessed (Table 15).

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

[xiii] Offshore Chemical Notification Scheme operated by Cefas – [redacted]

[xiv] OSPAR (2019) 'OSPAR List of Substances Used and Discharged Offshore which Are Considered to Pose Little or No Risk to the Environment' Available from: [redacted]

148 As presented in Table 15, this assessment has been based on the maximum bentonite volume which could be released into the environment. The principal issue, for MW&SQ receptors, relating to bentonite release to the water column comprise the potential for an increase in SSC (and so turbidity) within the water column and potential reduction in bacterial mortality, as detailed in Section 3.10.2. With the exception of the potential for increased turbidity from the release of bentonite, no other potential deterioration in MW&SQ, such as the introduction of contaminants or nutrients, has been identified as agreed through the AyM Evidence Plan (see Table 2).

Magnitude of impact

149 Bentonite is a clay-based substance and as such may persist in suspension for hours to days following release, becoming diluted to very low concentrations (indistinguishable from natural background levels and variability). As presented in Volume 2, Chapter 2: Marine Geology, Oceanography and Physical Processes (application ref: 6.2.2), the majority of the plume will be advected in the direction of the ambient tidal currents, which are broadly aligned to the coast. The direction of transport (either to the northeast or southwest) will depend on the state of the tide (flood or ebb) at the time of the release. It is expected that the plume would be dispersed to relatively low concentrations within hours of release and to background concentrations within a few tidal cycles.

150 As described in Section 3.10.2, there is a relationship between increased turbidity and decreased bacterial mortality within the water column. However, given the predicted levels of dilution, the temporary nature of the activities, and dispersion from tidal currents of the SSC, it is expected that any increases in bacteria in the water column would be in the order of days. Following the dispersion of the bentonite plumes, and subsequent increases in UV light, the bacterial counts in the water column will return to "do-nothing" baseline conditions. The resultant decrease in water clarity would be analogous to storm events (see Section 3.7) and, therefore, these potential changes are considered to remain within the natural variation of the marine environment in the study area.

151 In terms of Bathing Waters identified within the ZoI, it is anticipated that concentrations of bentonite observed at the Rhyl and Rhyl East Bathing Water monitoring points, approximately 1 to 1.5 km to the west of the Order Limits, and Prestatyn Bathing Water, approximately 2.5 km to the east of the Order Limits, would be minimal and highly transient. It is considered unlikely that the short-term increased turbidity from the bentonite plume would result in notable changes in bacterial abundance, and therefore would not influence Bathing Water classifications. The risk is further reduced at the more distant Bathing Waters identified within the ZoI, namely Kinmel Bay (Sandy Cove), Abergale (Pensarn) and Marine Lake, Rhyl.

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

Sensitivity of receptors

153 Descriptions of sensitivity for water quality receptors (high, medium, low and negligible) are provided in Table 7.

154 The sensitivity of the identified Bathing Waters, to the potential for increased bacterial counts is **medium** with a moderate capacity to accommodate the proposed change which are within the natural variation.

155 The sensitivity of the North Wales coastal waterbody and the Clwyd transitional waterbody to the release of bentonite are judged to be **low**; as these elevated concentrations would occur in the order of days and within natural variation of the waterbodies.

156 The sensitivity of non-designated waters, such as those within the array, are judged to be insensitive to short-term and discrete reductions in water clarity, arising from the proposed construction activities. There is no applicable quality status which may be affected by these works. The sensitivity of non-designated waters is judged to be **negligible**.

Significance of effect

157 The magnitude of the increases to SSC and associated decrease in bacterial mortality, associated with the release of drilling mud, has been assessed as low adverse. The sensitivity of the Bathing Waters was assessed as medium. The significance of the effect on the Bathing Waters is therefore concluded to be ***minor adverse***, which is not significant in terms of the EIA Regulations.

158 The magnitude of the increases to SSC from the release of drilling mud has been assessed as low adverse. The significance of the effect on the WFD waterbodies is concluded to be ***minor adverse***, which is not significant in terms of the EIA Regulations. The significance of the effect on the non-designated waters are concluded to be ***negligible***, which is not significant in terms of the EIA Regulations.

159 In addition to the embedded mitigation measures to that already identified in Table 16, if the drilling fluid were captured within a cofferdam(s) (where HDD or other trenchless technique exit pits are located within the intertidal zone, temporary cofferdams may be installed to preclude water intrusion), the magnitude of the impact would be reduced to **negligible adverse**. The significance of the effect on the Bathing Waters, WFD waterbodies, and receiving environment more broadly is therefore concluded to be ***minor*** *to* ***negligible adverse***, which are not significant in terms of the EIA Regulations. Therefore, no significant adverse residual effects have been predicted in respect of MW&SQ receptors.

3.10.5 Accidental releases or spills of materials or chemicals

160 Substances such as grease, oil, fuel, anti-fouling paints and grouting materials may be accidentally released or spilt into the marine environment. AyM is committed to the use of best practice, due diligence and pollution prevention guidelines at all times. As outlined in Table 16, a MPCP (to be included within the PEMP) would be in place and agreed with NRW (through conditions in the Marine Licence) in line with the Integrated Pollution Prevention and Control (IPPC) Directive (Directive 2008/1/EC or equivalent at that time) such that any potential risk is minimised. Any planned discharges would be permitted small volumes, intermittent and dilute and disperse quickly.

161 This commitment ensures the use of appropriate preventative measures and serves as an embedded mitigation against this type of pollution incidence (see Table 16). If an accidental spill occurs, NRW (and other relevant parties) would be informed as required in the MPCP (Table 16).

Magnitude of impact

162 No discharges (continuous or intermittent) are proposed during the construction phase of AyM, with the exception of drilling mud (see previous section). The MDS for the volumes of chemicals and materials used in the construction/ infrastructure associated with AyM are presented in Table 15.

163 Any quantities of accidentally released materials are likely to be small. Associated lateral and vertical dispersion rates are expected to be high. The potential impacts will be temporary in nature and controls will be in place. The magnitude of this potential impact is considered to be **negligible adverse**, as it is not anticipated to affect the waterbodies performance against their EQSs.

Sensitivity of receptors

164 Descriptions of sensitivity for water quality receptors (high, medium, low and negligible) are provided in Table 7.

165 It is noted that Bathing Waters are monitored for visible pollution such as oil and tar residues. Of the six Bathing Waters identified within the ZoI, oil and tar residues were only observed once at Rhyl East Bathing Water in August 2017 (NRW, 2021b). The classification of these Bathing Waters, as defined under the Bathing Water Regulations 2013 (as amended), is dependent on the monitoring of the bacterial counts during the bathing season. Separately, while the presence of oil/ grease (or other accidental spillages) will not result in deterioration of the Bathing Water classification, it could lead to the declaration of an 'Abnormal Situation' which would close the beach for as long as it takes to clear up the pollution event. The sensitivity of the Bathing Waters to the potential change is deemed to be **medium**.

166 The North Wales coastal waterbody is currently at overall moderate status based on moderate ecological potential and failing chemical status. The Clwyd transitional waterbody is currently at overall moderate status based on moderate ecological potential and good chemical status. The overall aim of the WFD is to achieve good overall status (thus good ecological status/potential and good chemical status) in all waterbodies. It is judged that both waterbodies have a high ability to accommodate a small accidental spill (if it were to occur), which is unlikely to result in a deterioration in status or prevent future objectives under the WFD. The sensitivity of the waterbodies to the proposed change is deemed to be **low**. Further consideration of potential impacts to these waterbodies is provided in Volume 4, Annex 3.1: Water Framework Directive Assessment (application ref: 6.4.3.1).

167 The sensitivity of non-designated waters is judged to be **negligible.** There is no applicable quality status which may be affected by a small spill event.

Significance of effect

168 The magnitude of the impact resulting from accidental spills and releases is considered to be negligible adverse. The sensitivity of the Bathing Waters, WFD waterbodies and non-designated waters is deemed to be medium, low and negligible respectively. The significance of the effect on the Bathing Waters, WFD waterbodies and receiving environment more broadly is therefore concluded to be ***minor*** *to* ***negligible***, which are not significant in terms of the EIA Regulations.

169 No additional mitigation to that already identified in Table 16 is considered necessary. Therefore, no significant adverse residual effects have been predicted in respect of MW&SQ receptors.

3.11 Environmental assessment: operational phase

3.11.1 Deterioration in water quality due to suspension of sediments from scour

170 The term scour refers here to the development of pits, troughs or other depressions in the seabed sediments around the base of project infrastructure. Scour is the result of net sediment removal over time due to the complex three-dimensional interaction between the foundation and ambient flows (currents and/ or waves).

171 A full assessment of scour associated with the presence of foundations and cable protection measures is presented in Volume 2, Chapter 2: Marine Geology, Oceanography and Physical Processes (application ref: 6.2.2). The scour of the seabed will lead to re-suspension of sediments before an equilibrium of scour pit development is reached. It is noted that sediment contaminant concentrations are low (see Section 3.7) and thus re-suspension/ re-distribution of material from scour is unlikely to result in changes in chemical water quality. These impacts are considered as part of the O&M phase of the proposed development and primarily within the array.

Magnitude of impact

172 The magnitude of any change to the seabed topography will vary depending upon the infrastructure type (including different foundation types), the local baseline oceanographic and sedimentary environments and the type of scour protection implemented (if needed). In some cases, the modified sediment character within a scour pit may not be so different from the surrounding seabed; however, changes relating to bed slope and elevated flow speed and turbulence close to the foundation are still likely to apply.

173 Any elevation in SSC as a consequence of scour will be short-lived, localised and within the range of natural variability; see Section 2.11.1 of Volume 2, Chapter 2: Marine Geology, Oceanography and Physical Processes (application ref: 6.2.2). Therefore, magnitude of the potential to release sediment-bound contaminants (concentrations in sediment samples were observed to be at low levels; see Section 3.7.1 and 3.7.2) as a result of seabed scour is considered to be **negligible**.

Sensitivity of receptors

174 Descriptions of sensitivity for water quality receptors (high, medium, low and negligible) are provided in Table 7.

175 The sensitivity of the North Wales coastal waterbody and the Clwyd transitional waterbody to increases in SSC and the release of sediment-bound contaminants resulting from scour in the offshore ECC are judged to be **low.**

176 The sensitivity of non-designated waters, such as those within the array, are judged to be insensitive to the effects from scour on water quality. There is no applicable quality status which may be affected by these works. The sensitivity of non-designated waters is judged to be **negligible**.

Significance of effect

177 The magnitude of the impact resulting from the seabed scouring is considered to be negligible adverse. The sensitivity of the WFD water bodies and non-designated waters is deemed to be low and negligible respectively. The significance of the effect on the WFD waterbodies, and receiving environment more broadly, is therefore concluded to be ***negligible***, which are not significant in terms of the EIA Regulations.

178 No additional mitigation to that already identified in Table 16 is considered necessary. Therefore, no significant adverse residual effects have been predicted in respect of MW&SQ receptors.

3.11.2 Deterioration in water quality due to suspension of sediments from O&M activities

179 As presented in Table 15, if a section of the cable became exposed or damaged it would require reburial and/ or replacement. Reburial (and/ or replacement) would be undertaken using similar techniques to that set out in the assessment of SSC and bed level changes associated with cable installation activities (see Volume 2, Chapter 2: Marine Geology, Oceanography and Physical Processes (application ref: 6.2.2)). The lengths of exposed/ damaged cable would be shorter and the potential impacts would likely be more localised and occur over a shorter duration than those considered during the construction phase.

180 It should be noted that any O&M activities which are undertaken in the array are not anticipated to impact on the designated WFD waterbodies. The project specific modelling indicates that no works undertaken in the array would have measurable changes in SSC within the WFD waterbodies (Volume 4, Annex 2.3: Physical Processes Modelling Results (application ref: 6.4.2.3)).

Magnitude of impact

181 The magnitude (and so significance) of the effects on water quality resulting from O&M activities would be no greater than those assessed in Sections 3.10.2 and 3.10.3. Therefore, the magnitude of the impact is considered to be **low adverse** for the potential changes in water clarity, microbiology and release of sediment-bound contaminants.

Sensitivity of receptors

182 Descriptions of sensitivity for water quality receptors (high, medium, low and negligible) are provided in Table 7.

183 The sensitivity of the identified Bathing Waters to the potential for increased bacterial counts is **medium** with a moderate capacity to accommodate the proposed change within the natural variation.

184 The sensitivity of the North Wales coastal waterbody and the Clwyd transitional waterbody to the reduction in water clarity and release of sediment-bound contaminants are judged to be **low**.

185 The sensitivity of non-designated waters, such as those within the array, are judged to be insensitive to short-term and discrete reductions in water clarity and release of sediment-bound contaminants, arising from the proposed construction activities. There is no applicable quality status which may be affected by these works. The sensitivity of non-designated waters is judged to be **negligible**.

Significance of effect

186 The magnitude of the increases to SSC and associated decrease in bacterial mortality has been assessed as low adverse. The sensitivity of the identified Bathing Waters was assessed as medium. The significance of the effect on the Bathing Waters is therefore concluded to be ***minor adverse***, which is not significant in terms of the EIA Regulations.

187 The magnitude of the increases to SSC has been assessed as low adverse. The significance of the effect on the WFD waterbodies is concluded to be ***minor adverse***, which is not significant in terms of the EIA Regulations. The significance of the effect on the non-designated waters are concluded to be ***negligible***, which is not significant in terms of the EIA Regulations.

188 No additional mitigation to that already identified in Table 16 is considered necessary. Therefore, no significant adverse residual effects have been predicted in respect of MW&SQ receptors.

3.11.3 Accidental releases or spills of materials or chemicals during operation

189 There is a potential risk of the accidental spillage or release of materials such as grease and oils during maintenance work and from vessels associated with the windfarm. As noted above, AyM is committed to the use of best practice and pollution prevention guidelines at all times. These commitments will be secured through conditions in the Marine Licence. Any permitted discharges would be small volumes, intermittent and dilute and disperse quickly.

190 The magnitude of this potential impact is considered to be **negligible adverse** as a result of the controls and best practice measures that will be captured within the PEMP, to be submitted for approval post-consent as a condition in the Marine Licence. Furthermore, it is not anticipated that any accidental release or spill would affect the waterbody's performance against respective EQSs as the potential impacts will be temporary in nature.

191 As defined above, the sensitivity of the Bathing Waters, WFD waterbodies and non-designated waters is deemed to be **medium**, **low** and **negligible** respectively. The significance of the effect on the Bathing Waters, WFD waterbodies, and receiving environment more broadly, is therefore concluded to be ***minor*** *to* ***negligible adverse***, which are not significant in terms of the EIA Regulations.

192 No additional mitigation to that already identified in Table 16 is considered necessary. Therefore, no significant adverse residual effects have been predicted in respect of MW&SQ receptors.

3.12 Environmental assessment: decommissioning phase

3.12.1 Deterioration in water quality due to suspension of sediments

193 As outlined in Table 16, the project infrastructure will be decommissioned in line with the decommissioning plan, and the prevailing best environmental practice/ option at the time, which may indicate infrastructure such as cables should be retained *in situ*. For the purposes of undertaking a MDS assessment, it is assumed that the decommissioning would be a reversal of the construction process if infrastructure were removed.

Magnitude of impact

194 The impacts during decommissioning are considered to be similar or less than during construction. Therefore, the magnitude of the impact is considered to be **low adverse** for the potential changes in water clarity, microbiology and release of sediment-bound contaminants.

Sensitivity of receptors

195 Descriptions of sensitivity for water quality receptors (high, medium, low and negligible) are provided in Table 7.

196 The sensitivity of the identified Bathing Waters, to the potential for increased bacterial counts is **medium** with a moderate capacity to accommodate the proposed change within the natural variation.

197 The sensitivity of the North Wales coastal waterbody and the Clwyd transitional waterbody to the reduction in water clarity and release of sediment-bound contaminants are judged to be **low**.

198 The sensitivity of non-designated waters, such as those within the array, are judged to be insensitive to short-term and discrete reductions in water clarity and release of sediment-bound contaminants, arising from the proposed construction activities. There is no applicable quality status which may be affected by these works. The sensitivity of non-designated waters is judged to be **negligible**.

Significance of effect

199 The magnitude of the increases to SSC and associated decrease in bacterial mortality has been assessed as low adverse. The sensitivity of the Bathing Waters is assessed as medium. The significance of the effect on the Bathing Waters is therefore concluded to be ***minor adverse***, which is not significant in terms of the EIA Regulations.

200 The magnitude of the increases to SSC and release of sediment-bound contaminants has been assessed as low adverse. The significance of the effect on the WFD waterbodies is concluded to be ***minor adverse***, which is not significant in terms of the EIA Regulations. The significance of the effect on the non-designated waters are concluded to be ***negligible***, which is not significant in terms of the EIA Regulations.

201 No additional mitigation to that already identified in Table 16 is considered necessary. Therefore, no significant adverse residual effects have been predicted in respect of MW&SQ receptors.

3.12.2 Accidental releases or spills of materials or chemicals

202 The potential impacts during decommissioning are considered to be similar or less than during construction for accidental spills and releases. As noted above, AyM is committed to the use of best practice and pollution prevention guidelines at all times.

203 The magnitude of this potential impact is considered to be **negligible** as a result of the controls and best practice measures that will be captured within the PEMP, to be submitted for approval post-consent as a condition in the Marine Licence. Furthermore, it is not anticipated that any accidental release or spill would affect the waterbody's performance against respective EQSs as the potential impacts will be temporary in nature.

204 As defined above, the sensitivity of the Bathing Waters, WFD waterbodies and non-designated waters is deemed to be **medium**, **low** and **negligible** respectively; to accidental spills and releases. The significance of the effect on the Bathing Waters, WFD waterbodies, and receiving environment more broadly, is therefore concluded to be ***minor*** *to* ***negligible adverse***, which are not significant in terms of the EIA Regulations.

205 No additional mitigation to that already identified in Table 16 is considered necessary. Therefore, no significant adverse residual effects have been predicted in respect of MW&SQ receptors.

3.13 Environmental assessment: cumulative effects

3.13.1 Identification of plans and projects

206 The Cumulative effects assessment methodology and longlist are described in Volume 1, Annex 3.1: Cumulative Effects Assessment (application ref: 6.1.3.1). The longlist has been reduced to a shortlist for assessment in this chapter based on a consideration of:

- Stage 1: Identification of whether a spatial overlap between the plans and projects and the AyM ZoI which could potentially result in significant effects;
- Stage 2: This list was then further refined to whether there may be a temporal overlap between the potential effects of the projects. A potential temporal overlap is defined as:
  - Proposed but not yet under construction (either pre- or post-consent);
  - Only partially constructed at the time that baseline characterisation was undertaken;
  - Recently completed, during the development of the baseline characterisation, and the full extent of the impacts arising from the development(s) may not be reflected in the baseline; and/ or
  - May have consent or licences to undertake further work, such as maintenance dredging or notable maintenance works which may arise in additional effects.

- Stage 3: Defining the degree of certainty and data confidence was then considered to identify an appropriate tier for each of the projects.

207 The projects identified for the cumulative assessment on MW&SQ receptors are presented in Table 17 and Figure 17. No licensed marine disposal sites were identified within the ZoI.

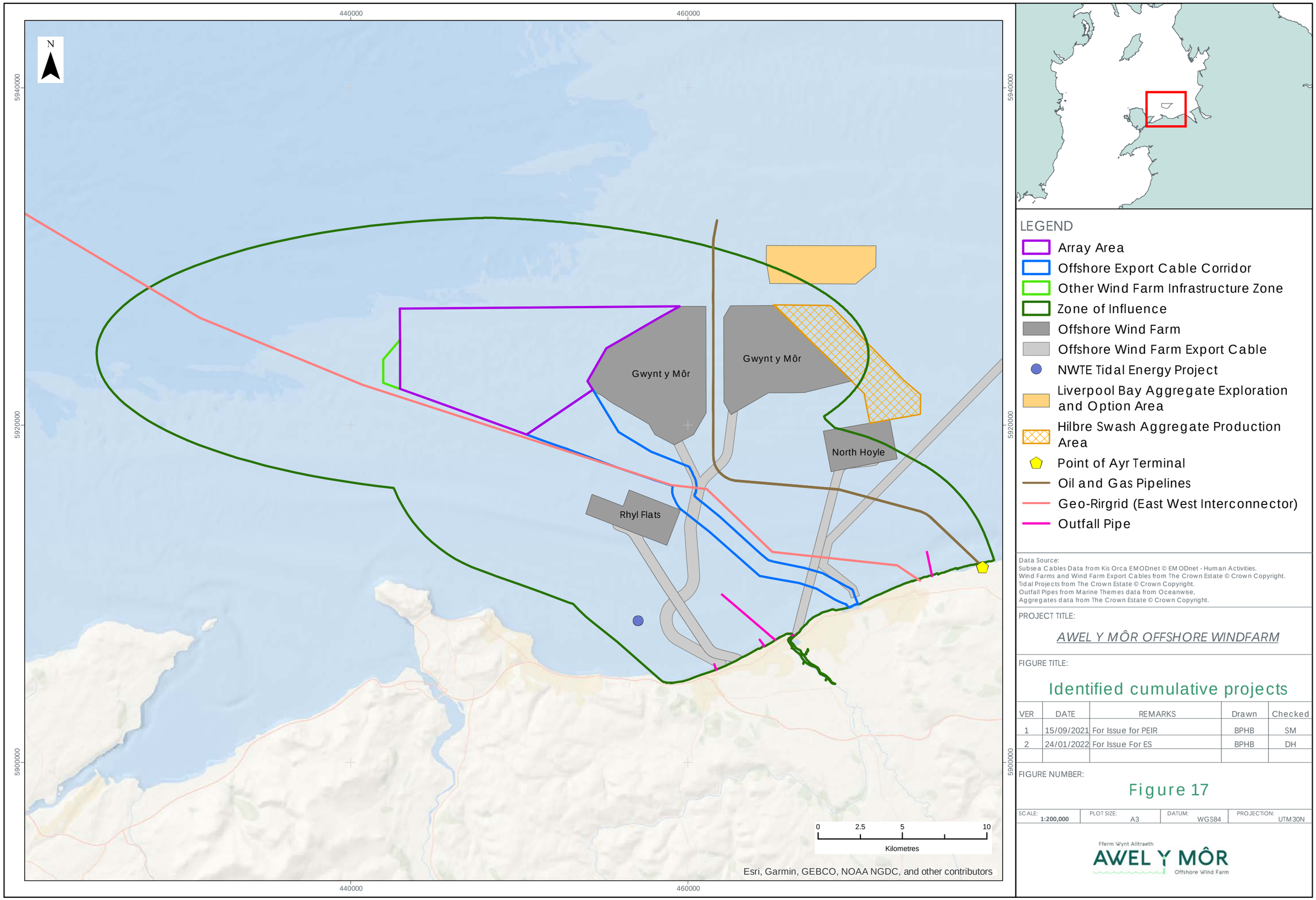
Table 17: Projects considered within the MW&SQ cumulative effect assessment.

DEVELOPMENT TYPE	PROJECT	STATUS	DATA CONFIDENCE ASSESSMENT/ PHASE	TIER
Energy				
Offshore Wind Farm (generation and transmission assets)	Gwynt y Môr	Operational	High - Third party project details published in the public domain and confirmed as being 'accurate' by The Crown Estate	Tier 1
Offshore Wind Farm (generation and transmission assets)	Rhyl Flats	Operational	High - Third party project details published in the public domain and confirmed as being 'accurate' by The Crown Estate	Tier 1
Offshore Wind Farm (generation and transmission assets)	North Hoyle	Operational	High - Third party project details published in the public domain and confirmed as being 'accurate' by The Crown Estate	Tier 1
Offshore Wind Farm (transmission assets only)	Burbo Bank Extension	Operational	High - Third party project details published in the public domain and confirmed as being 'accurate' by The Crown Estate	Tier 1
Interconnector	Geo-Eirgrid (East West Interconnector)	Active	Medium - Third party project details published in the public domain but not confirmed as being 'accurate'	Tier 1
Tidal Energy	North Wales Tidal Energy Project between	In development	Medium - Third party project details published in the public domain but not confirmed as being 'accurate'	Tier 3 – no application has been submitted

DEVELOPMENT TYPE	PROJECT	STATUS	DATA CONFIDENCE ASSESSMENT/ PHASE	TIER
	Prestatyn and Llandudno.			
Aggregates				
Aggregate Exploration and Option Area	Liverpool Bay (1808)	Active	Medium - Third party project details published in the public domain and confirmed as being 'accurate'	Tier 1
Aggregate Production Area	Hilbre Swash (392)	Active	Medium - Third party project details published in the public domain and confirmed as being 'accurate'	Tier 1
Aggregate Production Area	Hilbre Swash (393)	Active	Medium - Third party project details published in the public domain and confirmed as being 'accurate'	Tier 1
Oil and Gas				
Terminal	Point of Ayr Terminal	Active	Medium - Third party project details published in the public domain and confirmed as being 'accurate'	Tier 1
Gas pipeline	Pipeline Eni (Gas)	Active	Medium - Third party project details published in the public domain and confirmed as being 'accurate'	Tier 1

DEVELOPMENT TYPE	PROJECT	STATUS	DATA CONFIDENCE ASSESSMENT/ PHASE	TIER
Methanol pipeline	Pipeline Eni (Methanol)	Active	Medium - Third party project details published in the public domain and confirmed as being 'accurate'	Tier 1
Condensate pipeline	Pipeline Eni (Condensate)	Active	Medium - Third party project details published in the public domain and confirmed as being 'accurate'	Tier 1
Outfalls				
Wastewater outfall	MTF_INDUSTRIAL. 28229	Active	High - Third party project details published in the public domain and confirmed as being ‘accurate’ by the Crown Estate	Tier 1
Wastewater outfall	MTF_INDUSTRIAL. 28227	Active	High - Third party project details published in the public domain and confirmed as being ‘accurate’ by the Crown Estate	Tier 1
Wastewater outfall	MTF_INDUSTRIAL. 28225	Active	High - Third party project details published in the public domain and confirmed as being ‘accurate’ by the Crown Estate	Tier 1
Wastewater outfall	MTF_INDUSTRIAL. 28226	Active	High - Third party project details published in the public domain and confirmed as being ‘accurate’ by the Crown Estate	Tier 1

DEVELOPMENT TYPE	PROJECT	STATUS	DATA CONFIDENCE ASSESSMENT/ PHASE	TIER
Wastewater outfall	MTF_INDUSTRIAL.98652	Active	High - Third party project details published in the public domain and confirmed as being 'accurate' by the Crown Estate	Tier 1



LEGEND

- Array Area
- Offshore Export Cable Corridor
- Other Wind Farm Infrastructure Zone
- Zone of Influence
- Offshore Wind Farm
- Offshore Wind Farm Export Cable
- NWTE Tidal Energy Project
- Liverpool Bay Aggregate Exploration and Option Area
- Hilbre Swash Aggregate Production Area
- Point of Ayr Terminal
- Oil and Gas Pipelines
- Geo-Rirgrid (East West Interconnector)
- Outfall Pipe

Data Source:
Subsea Cables Data from Kis Orca EMODnet © EMODnet - Human Activities.
Wind Farms and Wind Farm Export Cables from The Crown Estate © Crown Copyright.
Tidal Projects from The Crown Estate © Crown Copyright.
Outfall Pipes from Marine Themes data from Oceanwise.
Aggregates data from The Crown Estate © Crown Copyright.

PROJECT TITLE:

AWEL Y MÔR OFFSHORE WINDFARM

FIGURE TITLE:

Identified cumulative projects

VER	DATE	REMARKS	Drawn	Checked
1	15/09/2021	For Issue for PEIR	BPHB	SM
2	24/01/2022	For Issue For ES	BPHB	DH

FIGURE NUMBER:

Figure 17

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:200,000	A3	WGS84	UTM30N

Fferm Wynt Alltraeth
AWEL Y MÔR
Offshore Wind Farm

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208 The cumulative MDS is described in Table 18 for each of the identified potential cumulative effects for this assessment. A description of the significance of cumulative effects upon MW&SQ receptors arising from each identified impact is provided in the sub-sections below. No additional potential water quality impacts or receptors are identified than when considering AyM cumulatively with the identified projects (Table 18) under the MDS.

Table 18: Cumulative MDS.

POTENTIAL EFFECT	SCENARIO	JUSTIFICATION
Deterioration in water quality due to suspension of sediments	Tier 1: • Aggregate production/ exploration (Liverpool Bay (1808), Hilbre Swash (392) and Hilbre Swash (393)). Tier 2: No Tier 2 projects identified. Tier 3: • The construction and operation of the North Wales Tidal Energy project; • Operation and maintenance of offshore windfarms including cables (GyM, Rhyl Flats, North Hoyle and Burbo Bank Extension).	If these intermittent activities overlap temporally with either the construction or maintenance of AyM, there is potential for cumulative SSC and sediment deposition to occur within the modelled plume footprints.

POTENTIAL EFFECT	SCENARIO	JUSTIFICATION
Release of sediment-bound contaminants from disturbed sediments	• Maintenance of operational cables, pipelines and outfalls (e.g. Pipeline Eni, Geo-Eirgrid (East West Interconnector); • The maintenance and potential repairs of wastewater outfalls[xv] may disturb seabed sediments resulting in sediment plumes and/ or elevated concentrations of remobilised contaminants; and • Maintenance of Point of Ayr Terminal.	If these intermittent activities overlap temporally with either the construction or maintenance of AyM, there is potential for cumulative release of sediment-bound contaminants to occur within the modelled plume footprints.

3.13.2 Cumulative deterioration in water quality due to suspension of sediments

209 Due to the current planning stage of the relevant projects, there is no available data on either project scale or timings on which to undertake a quantitative or semi-quantitative assessment; as such the discussion herein is qualitative. It is considered highly unlikely that each of the identified projects would be undertaking maintenance work, in particular asset reburial or repairs, as these are infrequent occurrences during the lifetime of developments.

[xv] Note: any bacterial or contaminants contributions from operational wastewater assets are inherently considered within the baseline environment and the current status of the receiving waters. Therefore, these are not considered within this cumulative asset.

210 Volume 2, Chapter 2: Marine Geology, Oceanography and Physical Processes (application ref: 6.2.2) presents a detailed cumulative assessment for the temporary increase in SSC (and associated deposition) resulting from AyM and other projects within the study area. Given the high levels of dispersion of the sediment as demonstrated by the project specific modelling, there is not anticipated to be a notable overlap with concentrated sediment plumes created from other maintenance and construction activities.

211 This is primarily owing to the predicted low concentrations at the extremities resulting from the rapid dispersion of the entrained SSC from the source of disturbance and the short-term nature of the AyM plumes. Sediment plumes generated by other projects, are anticipated to behave in a similar pattern as the sediments being disturbed and the types of disturbance are equivalent to those for AyM. The potential increases in SSC, when considered cumulatively, are still anticipated to be within natural variation within the ZoI. Therefore, the potential cumulative effects on water clarity and microbial growth are deemed to be equivalent to AyM alone and not significant in terms of the EIA Regulations. No additional mitigation to that already identified in Table 16 is considered necessary. Therefore, no significant adverse residual effects have been predicted in respect of MW&SQ receptors.

3.13.3 Cumulative release of sediment-bound contaminants from disturbed sediments

212 For the same rationale as provided in Section 3.13.2, it is anticipated that any contaminants will be rapidly dispersed from the point of disturbance with high levels of dilution achieved. Therefore, the potential cumulative effects on contaminants released into the water column are deemed to be equivalent to AyM alone and not significant in terms of the EIA Regulations. No additional mitigation to that already identified in Table 16 is considered necessary. Therefore, no significant adverse residual effects have been predicted in respect of MW&SQ receptors.

3.14 Inter-relationships

213 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 project (construction, O&M and decommissioning); to interact to potentially create a more significant effect on a receptor than if just assessed in isolation in these three key project stages (e.g. subsea noise effects from piling, operational WTGs, vessels and decommissioning); and
- 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 benthic ecology such as direct habitat loss or disturbance, sediment plumes, scour, JUVs use etc., may interact to produce a different, or greater effect on this receptor than when the effects are considered in isolation. Receptor-led effects might be short-term, temporary or transient effects, or incorporate longer term effects.

214 A description of the likely inter-related effects arising from AyM on MW&SQ is provided in Volume 2, Chapter 14: Inter-relationships (application ref: 6.2.14), with a summary of assessed inter-relationships provided below.

215 Potential inter-relationships exist between MW&SQ and:

- Fish and Shellfish - impacts to shellfish and fish ecology as a result of increased contaminant concentrations;
- Benthic Subtidal and Intertidal Ecology - impacts benthic, subtidal and intertidal ecology as a result of increased contaminant concentrations;
- Marine Geology, Oceanography and Physical Processes - the physical processes controlling SSC, SPM and scour are directly related to the resuspension of contaminated sediments; and
- Impacts on socio-economics and tourism from changes to Bathing Water Quality.

3.15 Transboundary effects

216 No transboundary impacts are predicted to result from the construction, O&M and decommissioning phases of AyM in terms of MW&SQ receptors. In line with the transboundary screening (Volume 1, Annex 3.2; application ref: 6.1.3.2), no potentially significant transboundary effects are predicted for MW&SQ and, therefore, a transboundary effects assessment is not considered necessary in this chapter.

3.16 Summary of effects

217 This ES chapter has investigated the potential effects on MW&SQ receptors arising from AyM. The range of potential impacts and associated effects has been informed by Scoping responses and consultation responses (including those submitted during the Evidence Plan Process and PEIR) from stakeholders, alongside reference to existing legislation and guidance.

218 The potential for AyM to interact directly and indirectly with MW&SQ receptors is presented for the proposed development alone and cumulatively with other projects within the ZoI. These potential impacts have been investigated using a combination of methods including analytical techniques, the existing evidence base and project specific sediment plume modelling. In accordance with the requirements of the MDS approach to EIA, the worst-case potential effects of AyM have been considered thereby providing a highly conservative assessment.

219 A summary of the effects of the proposed development during construction, O&M and decommissioning phases on marine water and sediment quality are presented in Table 19.

Table 19: Summary of effects.

IMPACT	MAGNITUDE	SENSITIVITY OF RECEPTOR(S)	MITIGATION MEASURES	RESIDUAL EFFECT
CONSTRUCTION				
Deterioration in water quality due to suspension of sediments	Low	Bathing Waters – Medium	No additional mitigation measures identified.	Minor adverse (not significant)
		WFD waterbodies - Low		Minor adverse (not significant)
		Non-designated waters – negligible		Negligible (not significant)
Release of sediment-bound contaminants from disturbed sediments	Low	Bathing Waters – N/A	No additional mitigation measures identified.	N/A
		WFD waterbodies - Low		Minor adverse (not significant)
		Non-designated waters – negligible		Negligible (not significant)

IMPACT	MAGNITUDE	SENSITIVITY OF RECEPTOR(S)	MITIGATION MEASURES	RESIDUAL EFFECT
Deterioration in water clarity due to the release of drilling mud	Low	Bathing Waters – Medium	No additional mitigation measures identified.	Minor adverse (not significant)
		WFD waterbodies - Low		Negligible (not significant)
		Non-designated waters - Negligible		Negligible (not significant)
Accidental releases or spills of materials or chemicals during construction	Negligible	Bathing Waters – Medium	No additional mitigation measures identified.	Minor adverse (not significant)
		WFD waterbodies - Low		Minor adverse (not significant)
		Non-designated waters – Negligible		Negligible (not significant)

IMPACT	MAGNITUDE	SENSITIVITY OF RECEPTOR(S)	MITIGATION MEASURES	RESIDUAL EFFECT
OPERATION				
Deterioration in water quality due to suspension of sediments from scour	Negligible	Bathing Waters – N/A	No additional mitigation measures identified.	N/A
		WFD waterbodies - Low		Negligible (not significant)
		Non-designated waters - Negligible		Negligible (not significant)
Deterioration in water quality due to suspension of sediments from O&M activities	Low	Bathing Waters – Medium	No additional mitigation measures identified.	Minor adverse (not significant)
		WFD waterbodies - Low		Minor adverse (not significant)
		Non-designated waters - Negligible		Negligible (not significant)

IMPACT	MAGNITUDE	SENSITIVITY OF RECEPTOR(S)	MITIGATION MEASURES	RESIDUAL EFFECT
Accidental releases or spills of materials or chemicals during operation	Negligible	Bathing Waters – Medium	No additional mitigation measures identified.	Minor adverse (not significant)
		WFD waterbodies - Low		Negligible (not significant)
		Non-designated waters - Negligible		Negligible (not significant)
DECOMMISSIONING				
Deterioration in water quality due to suspension of sediments	Low	Bathing Waters – Medium	No additional mitigation measures identified.	Minor adverse (not significant)
		North Wales coastal waterbody - Low		Minor adverse (not significant)
		Non-designated waters - Negligible		Negligible (not significant)

IMPACT	MAGNITUDE	SENSITIVITY OF RECEPTOR(S)	MITIGATION MEASURES	RESIDUAL EFFECT
Accidental releases or spills of materials or chemicals during decommissioning	Negligible	Bathing Waters – Medium	No additional mitigation measures identified.	Minor adverse (not significant)
		WFD waterbodies - Low		Negligible (not significant)
		Non-designated waters - Negligible		Negligible (not significant)
CUMULATIVE EFFECTS				
Cumulative deterioration in water quality due to suspension of sediments	Low	Bathing Waters – Medium	No additional mitigation measures identified.	Minor adverse (not significant)
		WFD waterbodies - Low		Minor adverse (not significant)
		Non-designated waters - Negligible		Negligible (not significant)

IMPACT	MAGNITUDE	SENSITIVITY OF RECEPTOR(S)	MITIGATION MEASURES	RESIDUAL EFFECT
Cumulative release of sediment-bound contaminants from disturbed sediments	Low	Bathing Waters – N/A	No additional mitigation measures identified.	N/A
		WFD waterbodies - Low		Minor adverse (not significant)
		Non-designated waters - Negligible		Negligible (not significant)

3.17 References

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