HORIZON NUCLEAR POWER

WYLFA NEWYDD

ENERGY WORKING FOR BRITAIN

Wylfa Newydd Project

6.2.12 ES Volume B - Introduction to the environmental assessments B12 - Coastal processes and coastal geomorphology

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12 Coastal processes and coastal geomorphology

12.1 Introduction

12.1.1 This chapter B12 provides an introduction to the technical basis for the coastal processes and coastal geomorphology assessment for the Wylfa Newydd Project. It includes a summary of legislation, policy and guidance; key points arising in consultation that have guided the coastal and marine processes and geomorphology assessment; and assessment methodologies and criteria.

12.1.2 Specifically, this chapter introduces the background to an assessment of the potential changes to coastal and marine processes, as well as the potential effects on specific geomorphology receptors (features). The Wylfa Newydd Project has the potential to change current, wave and sedimentary coastal and marine processes both locally and over a wider area. The assessment also covers the marine Disposal Site at Holyhead North. Changes to processes have the potential to effect upon other receptors, particularly marine ecology.

12.1.3 Coastal geomorphology is the study of the evolution and development of coastal landforms under the effects of winds, currents, waves and sea-level changes. Human activities such as the introduction of breakwaters and dredging can cause effects to geomorphological receptors, through changes in beach and cliff erosion or deposition processes. Geomorphologists aim to understand the history of landforms and their dynamics and to predict those sorts of changes. Specific coastal geomorphology receptors have been identified for assessment.

12.1.4 The assessment of changes and effects for coastal and marine processes and coastal geomorphology is included in chapter D12 (Application Reference Number: 6.4.12) for the Wylfa Newydd Development Area and the Disposal Site.

12.2 Legislation, policy and guidance

12.2.1 The following legislation, policy and guidance have been used to inform the scope and content of the coastal and marine processes and coastal geomorphology assessment of changes; assist in the identification of potential effects on receptors and mitigation; and influence the design of the Wylfa Newydd Project to reduce the significance of effects.

Key legislation

12.2.2 The relevant legislation and how it relates to the coastal and marine processes and geomorphology assessment are set out in table B12-1.

Table B12-1 Summary of key legislation

Document	Description
Water Framework Directive (WFD) (2000/60/EC)	This EU Directive is European water legislation with the overarching objective of all water bodies in Europe attaining good or high ecological status or potential by 2027. The WFD is implemented in Wales by the Water Environment (Water Framework Directive) (England and Wales) Regulations 2003. The WFD establishes a framework for the prevention of deterioration and protection of surface, lake, groundwater, estuarine (transitional) and coastal water bodies. Objectives include improving the water environment to achieve good/high chemical and ecological status or potential in the context of current uses, maintaining existing good/high status and implementing mitigation to support the water environment at a catchment and water body scale. New activities are required to take into consideration the water body objectives published within the relevant River Basin Management Plan. This overarching legislation and subsequent England and Wales Regulations (see immediately below) are particularly relevant to coastal and marine processes and geomorphology because activities can potentially affect the structure or function of landforms and hydromorphological status of a water body.
The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017	The WFD (England and Wales) Regulations 2017 consolidate, revoke and replace the Water Environment (Water Framework Directive) (England Wales) Regulations 2003. The Regulations require the identification of river basin districts. They also make provision for certain protected areas and make provision for the establishment of environmental objectives for each water body and programmes of measures to meet those objectives. Changes to coastal and marine processes and geomorphology can potentially affect the structure or function of landforms and hydromorphological status of a water body.
The Water Environment (Water Framework Directive) (England and Wales) (Amendment) Regulations 2015	These amending 2015 Regulations update the first enactment, to incorporate the requirements of WFD daughter directives, Council Directive 2008/105/EC (the 'Environmental Quality Standards Directive') and Priority Substances (Amendment) Directive 2013 (Directive 2013/39/EU) into UK law. Further miscellaneous adjustments to the regulations include updated definitions, duties and

Document	Description
	terminologies. Changes to coastal and marine processes and geomorphology can potentially affect the structure or function of landforms and hydromorphological status of a water body.
Marine and Coastal Access Act 2009	This Act provides the legal mechanism to help ensure clean, healthy, safe, productive and biologically diverse oceans and seas by putting in place a system for improved management and protection of the marine and coastal environment. It established a strategic Marine Planning System which includes production of a Marine Policy Statement and streamlines the marine licensing system. This is relevant because it strives towards elimination or minimisation of effects on coastal and marine processes and geomorphology.
Water Resources Act 1991	This Act aims to prevent and minimise pollution of water. It regulates water resources, water quality and pollution and flood defence. This is relevant because of the potential for sediment pollution from land surfaces entering the sea.
The Conservation of Habitats and Species Regulations 2017	These Regulations implement the provisions of the Habitats Directive (92/43/EEC) and the Birds Directive (2009/147/EC). They provide for the designation and protection of European Designated Sites and species and the adaptation of planning and other controls for the protection of European Designated Sites. This is relevant because coastal and marine processes and geomorphology are key elements creating and sustaining certain habitats on which the Designations are made.
The Convention for the Protection of the Marine Environment of the North-East Atlantic (the 'OSPAR Convention') 1992	This Convention is key in coordinating Member States to meet their obligations under the EU Marine Strategy Framework Directive (2008/56/EC). The OSPAR Convention contains a series of Annexes which include prevention and elimination of pollution by dumping or from offshore sources and the protection and conservation of ecosystems and biological diversity. This Convention also helps underpin the provisions for disposing of dredged material at sea under the Marine and Coastal Access Act.

Document	Description
	It is relevant to this chapter because of the potential effects on coastal processes at the Disposal Site of dredged materials.
Marine Strategy Framework Directive 2008/56/EC	This EU Directive seeks to achieve good Environmental Status of the EU's marine waters by 2020 and to protect the resource base upon which marine-related economic and social activities depend. It is the first EU legislative instrument related to the protection of marine biodiversity, as it contains the explicit regulatory objective that "biodiversity is maintained by 2020" through the development of Marine Strategies by member states. This is relevant to this chapter and the coastal processes and coastal geomorphology chapter DB12 (Application Reference Number: 6.42.12) because changes to coastal and marine processes and geomorphology can potentially affect the environmental status of marine waters.
The Marine Strategy Regulations 2010	These Regulations transpose Council Directive 2008/56/EC (the Marine Strategy Framework Directive) into UK law. They provide the Competent Authorities with the necessary powers to carry out their obligations as required by the Directive. This is relevant to the coastal processes and coastal geomorphology chapter D12 (Application Reference Number: 6.4.12) because Directive 2008/56/EC requires achievement or maintenance of good environmental status by 2020 (see above).

Key policy

12.2.3 The relevant national and local plans and policies, and how these relate to the coastal processes and coastal geomorphology assessment, are described in table B12-2.

Table B12-2 Summary of key policy

Document	Description
Overarching National Policy Statement for Energy (EN-1) [RD1]	This National Policy Statement (NPS), designated by the Secretary of State (SoS) in July 2011, sets out the overarching national policy for delivery of major energy infrastructure projects. It states in paragraph 5.3.3 that: "*Where the development is subject to EIA [Environmental Impact Assessment] the applicant*

Document	Description
	should ensure that the ES [Environmental Statement] clearly sets out any effects on internationally, nationally and locally designated sites of ecological or geological conservation importance, on protected species and on habitats and other species identified as being of principal importance for the conservation of biodiversity,". EN-1, Section 5.5 requires applications to include an assessment of the effects on coastal processes and geomorphology, accounting for potential effects of climate change. Where a development potentially affects coastal processes then the applicant must demonstrate how adverse effects can be managed or minimised (see paragraph 5.5.7). EN-1 also expects the implications of a proposed project on strategies for managing the coast to be assessed. These strategies include Shoreline Management Plans (SMPs) and River Basin Management Plans (see paragraph 5.5.7). The SoS should not normally consent to new development in areas of dynamic shorelines where the proposal could inhibit sediment movement or have an adverse effect on coastal processes at other locations. Effects on coastal processes must be managed to minimise adverse effects elsewhere along the coast (paragraph 5.5.11). EN-1 states that the environmental assessment of a project should include the effects on coastal change, such as physical change to the shoreline from erosion and deposition, and on the natural environment generally (paragraph 5.5.1).
National Policy Statement for Nuclear Power Generation (EN-6) [RD2]	This NPS, designated by the SoS in July 2011, sets out national policy on new Nuclear Power Stations identified as potentially suitable for deployment by 2025. It states in paragraph 3.8.3 requirements for the applicant to take account of climate change adaptation measures and assess effects on coastal processes and intertidal deposition.
National Policy Statement for Renewable Energy Infrastructure (EN-3) [RD3]	This policy explicitly includes context for the assessment of coastal and marine processes and geomorphology. Paragraph 2.6.189 of EN-3 provides specific guidance for assessment of waves and tides, scour effects, sediment transport and suspended solids

Document	Description
	(released during construction and decommissioning). This paragraph relates to offshore wind projects, but provides the most relevant guidance for the assessment of coastal processes and coastal geomorphology for the assessments of the Wylfa Newydd Project.
Emerging Welsh National Marine Plan [RD4]	The Welsh Government is currently developing the first Welsh National Marine Plan utilising the framework and high-level objectives for Marine Planning outlined in the Marine Policy Statement. The purpose of the Plan is to manage marine activities in a sustainable way, taking into account economic, social and environmental priorities. The goals and principles of the Well-being of Future Generations (Wales) Act 2015 are a key focus in developing the Plan. In relation to the coastal and marine processes and coastal geomorphology assessments contained in chapter D12 (Application Reference Number: 6.4.12). This document is important in that it stipulates a scientific approach and defines environmental limits.
National Strategy for Flood and Coastal Erosion Risk Management in Wales [RD5]	This Strategy sets out the Welsh Government's framework for flood and coastal erosion risk management. The priorities are: • reducing the consequences of flooding; • raising awareness of the risks; • providing an effective response to flood and coastal erosion events; and • prioritising investment in the communities most at risk to flooding and coastal erosion.
Planning Policy Wales (Edition 9) [RD6]	This Document sets out the land use planning policies of the Welsh Government, forming a strategic framework to guide development. The following chapters provide context for the coastal and marine processes and geomorphology assessments. Chapter 5 sets out the Welsh Government's objectives for the conservation and improvement of the natural heritage, paragraph 5.7.1 has specific guidance on coastal developments: • "In preparing their development plans local planning authorities will be expected to take into

Document	Description
	account other plans and policies with implications for the coastal area. They will need to consider landward and seaward pressures – and the impacts of these pressures – on coastal systems." "Seaward pressures may include waste disposal, sea fishing, increased leisure sailing, dredging of navigable channels, water sports and bathing, marine aggregates extraction or tidal and wave power generation." Chapter 13 (minimising and managing environmental risks and pollution) sets out the Welsh Government's objectives for avoiding or minimising the adverse effects of any environmental risks on present or future land use. The Welsh Government's objectives are stated to be to: • maximise environmental protection for people, natural and cultural resources, property and infrastructure; and • prevent or manage pollution and promote good environmental practice."
Technical Advice Note (TAN) *14: Coastal Planning* [RD7]	TAN 14 provides guidance on key issues for planning for the coastal zone. It provides technical guidance to supplement national planning policy (in the preparation of development plans and may be material to decisions on individual planning applications). It emphasises the need to take into account the significance of coastal processes. In particular, that on-shore development can often have an impact off-shore. It recommends that a maritime zone be established which takes account of this dynamic environment. The TAN also emphasises the interlinkage between physical and biological processes in creating, maintaining and altering features of nature and landscape conservation value. TAN 14 is particularly relevant to understanding the context for the study areas selected in terms of major sediment cells and sub-cells.
TAN 5: Nature Conservation and Planning [RD8]	TAN 5 provides advice relevant to local planning authorities. Changes to coastal and marine processes and geomorphology can affect the following aspects listed in the policy guidance: • the key principles of positive planning for nature conservation;

Document	Description
	• nature conservation in development management procedures; • development affecting protected internationally and nationally designated sites and habitats; and • development affecting protected and priority habitats and species.
Anglesey and Gwynedd Joint Local Development Plan 2011 - 2026 - Written Statement [RD9]	The Joint Local Development Plan (JLDP) covers the local authorities of the Isle of Anglesey County Council (IACC) and Gwynedd Council and forms the basis for land use planning in these areas. The JLDP covers the period 2011 to 2026. It aims to achieve (amongst other issues) protection of areas to ensure the maintenance and enrichment of the natural and built environment. Of particular relevance to this chapter is Strategic Objective SO14 of the plan which is concerned with managing, protecting and enhancing the quality and quantity of the water environment; and Strategic Policy PS14 which is concerned with the protection and enhancement of sites of conservation importance and restoration of natural habitat networks.
New Nuclear Build at Wylfa: Supplementary Planning Guidance [RD10]	This Supplementary Planning Guidance identifies a clear and ambitious vision for the Wylfa Newydd Project, which aligns with the IACC's wider socio-economic and legacy aspirations in relation to all major development on the island. The vision is that, "The New Nuclear Build at Wylfa is a positive driver for the transformation of the economy and communities on Anglesey, providing sustainable employment opportunities, improving the quality of life for existing and future generations and enhancing local identity and distinctiveness." It states that as an objective the IACC expects the Wylfa Newydd Project to conserve and enhance Anglesey's distinctive environment, taking into account climate change. It is anticipated that this will be achieved for the water environment by: • conserving the integrity of sites on or near Anglesey Island designated at a European, national or local level for their nature conservation value; • minimising the release of potentially polluting substances to water; and • implementing measures to mitigate potential adverse impacts.

Document	Description
	This policy is directly relevant to coastal and marine processes and geomorphology.
Water Strategy for Wales [RD11]	The Strategy covers all inland waters, estuaries and coastal waters, including groundwater. It sets out the Welsh Government's direction for water policy over the next 20 years and beyond. The strategy highlights the Welsh Government's vision to have a thriving water environment which is sustainably managed to support healthy communities, flourishing businesses and the environment. It covers a broad range of matters relating to the management of water systems, including all inland waters, estuaries and coastal waters. Changes to coastal and marine processes and geomorphology can have effects on a thriving water environment and therefore this policy is directly relevant to this chapter and chapter D12 (Application Reference Number: 6.4.12).
West of Wales Shoreline Management Plan 2 Cardigan Bay and Ynys Enlli to the Great Orme Coastal Groups [RD12]	Developed in partnership by local authorities, regulators and other stakeholders, a SMP is a high-level non-statutory policy document designed to assist coastal flood and erosion risk management planning. It provides a large-scale assessment of the risks (to people, property, the natural and historic environment) associated with coastal erosion and flooding at the coast. It proposes policies to help manage these risks sustainably over the short (0–20 years), medium (20–50 years) and long term (50–100 years). SMP policies are considered by Natural Resource Wales (NRW) in their determination of Marine Licences. An SMP provides a large-scale assessment of the risks associated with coastal evolution. It presents a policy framework to address these risks to people and the developed, historical and natural environment in a sustainable manner. The relevant current plan covering Anglesey is SMP2 and has been fully referred to in this chapter and chapter D12 (Application Reference Number: 6.4.12).
UK Marine Policy Statement [RD13]	The Policy Statement was adopted in 2011 for the purpose of section 44 of the Marine and Coastal Access Act 2009. The Marine Policy Statement is the framework for preparing marine plans and taking decisions affecting the marine environment. The

Document	Description
	Marine Policy Statement aims to facilitate and support the formulation of marine plans, ensuring that marine resources are used in a sustainable way in line with a number of high-level marine objectives with the view to: • promote sustainable economic development; • enable the UK's move towards a low carbon economy, in order to mitigate the causes of climate change and ocean acidification and adapt to their effects; • ensure a sustainable marine environment which promotes healthy, functioning marine ecosystems and protects marine habitats, species and the UK's heritage assets; and • contribute to the societal benefits of the marine area, including the sustainable use of marine resources to address local social and economic issues.
Western Wales River Basin Management Plan (RBMP) *2015–2021* Summary [RD14]	The purpose of the Western Wales RBMP is to achieve the objectives of the WFD which are to protect and improve the water environment for the wider benefit of people and wildlife. To achieve this, the RBMP includes a summary of the Programme of Measures needed, together with the predicted environmental outcomes over the next six years. The actions set out in this plan will have an effect on all types of water body across the catchments covered by the RBMP. This includes rivers, lakes, canals, groundwater, wetlands, estuaries and coastal waters. The RBMP aims to be integrated at the catchment scale ensuring a connection across the wider environment for people and wildlife, from catchment to coast.

Key guidance

12.2.4 The coastal and marine processes and geomorphology assessment has been undertaken in line with a number of key technical guidance documents. These guidance documents are widely used across the UK and represent standard good practice for the assessment for the various consenting regimes. These are summarised in table B12-3.

Table B12-3 Summary of key guidance

Guidance	Description
UK Technical Advisory Group on the Water	A partnership of the UK environment and conservation agencies, providing a series of

Guidance	Description
Framework Directive: Application of Groundwater Standards to regulation [RD15]	documents giving guidance on the WFD and the assessment process. This has direct relevance to the three coastal water bodies within the study area. Changes to the hydromorphology can affect the ecological status of each.
Environmental handbook for building and civil engineering projects. Part 1: Design and Specification [RD16]	The guidance relates to implementing good construction practices and design. This is relevant to this chapter and chapter D12 (Application Reference Number: 6.4.12) as it contains guiding principles on how to minimise or mitigate adverse effects on coastal and marine processes and geomorphology.
Coastal and marine environmental site guide [RD17]	The guidance relates to implementing good construction practices and design for coastal and marine sites. This is relevant to this chapter and chapter D12 (Application Reference Number: 6.4.12) as it contains guiding principles on how to minimise or mitigate adverse impacts on coastal and marine processes and geomorphology.
Guidelines for Ecological Impact Assessment in UK and Ireland, Terrestrial, Freshwater and Coastal. [RD18]	This guidance provides guidelines on the approach to take for EIA within the coastal environment and provides guidance on the assessment of value, magnitude and significance and is therefore directly relevant to this chapter and chapter D12 (Application Reference Number: 6.4.12).
The Marine Monitoring Handbook [RD19]	The Marine Monitoring Handbook is used as guidance by the UK government's statutory nature conservation agencies and their key partners in drawing up monitoring schemes for marine Special Area of Conservations (SACs). The Handbook provides guidance on the different options and their relative costs and benefits and describes best practice through a series of procedural guidelines for the common survey/monitoring techniques. It draws on the information gathered from extensive trials of different techniques and their deployment undertaken during the UK Marine SACs project to ensure all advice has a sound practical basis. It includes guidance (for example) on sediment sampling that has relevance to the survey work

Guidance	Description
	presented in this chapter and chapter D12 (Application Reference Number: 6.4.12).
Regionally Important Geological Sites (RIGS) [RD20]	This Handbook provides an overview of the information, resources, techniques and best practice associated with RIGS; it is intended for RIGS groups and associated members. It is relevant as coastal and marine processes may inform impacts on geology receptors.
Offshore Wind Farms: Guidance Note for EIA in Respect to FEPA and CPA Requirements [RD21]	Guidance on Offshore Wind Farms for EIA prepared by the Centre for Environment Fisheries and Aquaculture (Cefas) on behalf of the Marine Consents and Environment Unit (MCEU). This guidance details requirements that must be satisfied before any substance or article can be deposited in the sea or under the sea bed in UK waters, or in UK controlled waters, or from British Vessels. This guidance relates to offshore wind farms but provides the most relevant guidance on requirements that must be satisfied when undertaking Marine Works similar to those that will take place in the Wylfa Newydd Project.
EIA: a Handbook for Scoping Projects [RD22]	Handbook scoping the types of effects and mitigation for a wide range of development types including marine activities. This is relevant beyond scoping as it contains detailed guidance on the effects and possible mitigation of marine activities (such as the construction of breakwaters).
Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities [RD23]	The purpose of this document is to ensure that an economically credible appraisal, taking account of the uncertainties associated with climate change, can be made to support Government investment decisions. In addition, the document provides important information on baseline evolution, which is relevant to this chapter and chapter D12 (Application Reference Number: 6.4.12).
Water Framework Directive assessment: estuarine and coastal waters 2016 [RD24]	This guidance document updates and replaces a previous document ‘clearing the waters’. It is concerned with how to undertake and submit a WFD assessment. It covers screening, scoping and impact assessment (including dredging activities).

Guidance	Description
UK Climate Impact Programme [RD25]	The UK Climate Projections (UKCP09) website provides information on the observed and projected climate. It is also concerned with marine and coastal projections, future projections for sea level rise, storm surge, sea temperature, salinity, current and waves. UKCP09 provides climate projections for the UK for three different future greenhouse gas emissions scenarios: a low emissions scenario; a medium emissions scenario; and a high emissions scenario. This guidance is relevant to understand the evolution of baseline conditions due to climate change.
CL03-16 Climate change allowance for Planning purposes [RD26]	This guidance produced by Welsh Government provides more up to date climate change figures including projected increases to sea levels that should be used for planning applications (from December 1, 2016). This guidance has been used to inform the assessment contained in chapter D12 (Application Reference Number: 6.4.12)
Hinkley Point Physical Science Report (BEEMS) [RD27]	Studies undertaken for Hinkley Point which evaluate potential effects of new nuclear build at the coast. This study specifically assimilated knowledge of hydrodynamics, climatology, sedimentology and coastal geomorphology relevant to Hinkley Point power station development. This is relevant as a benchmark for chapter D12 (Application Reference Number: 6.4.12) as it has also been through a Development Consent Order (DCO) process.
Hinkley Oceanographic Survey (BEEMS) [RD28]	Studies undertaken for Hinkley Point which evaluate potential effects of new nuclear build at the coast. This study assimilated oceanographic information and data relevant to Hinkley Point power station development. This is relevant as benchmark for chapter D12 (Application Reference Number: 6.4.12).

Guidance	Description
Scour Assessment at Hinkley Point Structures (BEEMS) [RD29]	Studies undertaken for Hinkley Point which evaluate potential effects of new nuclear build at the coast. This study assessed the level of sea floor sediment that had been removed from marine structures within the Hinkley Point B Development as a result of hydrodynamic forces. The study also provides recommendations for mitigating the effects of sediment removal. This is relevant as a benchmark for chapter D12 (Application Reference Number: 6.4.12)
Good practice guidelines for ports and harbours operating within or near UK European marine sites [RD30]	Good practice guidelines for ports and harbours operating within or near UK marine sites. Guidelines aim to avoid, minimise and address potential environmental impacts arising from their operations. This is based on work undertaken by Associated British Ports in 1999. The potential is for processes in the dredge and disposal areas to cause alteration of erosion and sedimentation patterns in adjacent areas, potentially resulting in erosion, or the creation of an intertidal and subtidal habitat. There could also be changes in hydrodynamics and geomorphology at the dredge and disposal sites. Guidance recommends that the effects of suspended sediments and turbidity are generally short term (<1 week after activity) and near-field (<1km from activity). The guidance recommends ensuring that dredging is undertaken in a manner that limits, as far as practicably possible, the disturbance and dispersion of sediments from the dredger and barges during dredging operations. It also advises that consideration should be given to timing of operation to avoid or minimise environmental effects.
Final Report of WFD21c project [RD31]	The guidance provides an assessment of the Transitional and Coastal Waters Morphological Impact Assessment System tool for (a) screening proposed new or altered activities / structures for compliance with WFD water body status and (b) classifying Transitional and Coastal waters under the WFD.

Guidance	Description
Final Report of the Dredging and Dredged Material Disposal Monitoring Task Team [RD32]	The Dredged Material Monitoring Task Team draws on expertise from Government Agency, industry and academia to provide a comprehensive manual of protocols for monitoring dredging and disposal sites to ensure that impact on the environment by dredging requirements is minimised. It has relevance to coastal and marine processes and geomorphology at the Wylfa Newydd Development Area (dredging) and the Disposal Site.

12.3 Consultation

12.3.1 This section provides an account of the topic-specific consultation undertaken to support the assessment. For a full overview of the environmental consultation activities undertaken for the Wylfa Newydd Project, please refer to chapter A6 (EIA Scoping Report and Addendum) (Application Reference Number: 6.1.6) and chapter A7 (Consultation with environmental stakeholders) (Application Reference Number: 6.1.7).

Planning Inspectorate Scoping Opinion

12.3.2 In March 2016, Horizon submitted an updated Wylfa Newydd Project EIA Scoping Report to the Planning Inspectorate. In May 2017, Horizon submitted an Addendum to the March 2016 Wylfa Newydd Project EIA Scoping Report to the Planning Inspectorate (and to NRW). Following a period of consultation with stakeholders, a further Scoping Opinion was received from the SoS (via the Planning Inspectorate) on 14 June 2017.

12.3.3 The Wylfa Newydd Project EIA Scoping Report, Addendum and the subsequent Scoping Opinions inform the approach to the assessment. Table B12-4 provides an account of how comments raised by stakeholders in the Scoping Opinion have been considered in the coastal processes and coastal geomorphology assessment.

Table B12-4 Key issues raised through Scoping

Key issue raised	Action taken
"The Applicant has defined a study area within a 5km radius of the Power Station Site. Although a degree of knowledge, modelling and professional judgement has been cited as the reason for definition of the 5km zone, the Secretary of State would expect the ES [Environmental Statement] to include further reasoned justification as to why this is	The rationale for choice of study areas for coastal and marine processes and coastal geomorphology is included in this chapter, section 12.4. Actual study areas are more clearly defined within chapter D12 (Application Reference Number: 6.4.12) and illustrated on accompanying figures D12-1 and

Key issue raised	Action taken
appropriate as well as documented agreement with statutory consultees to this effect. The Applicant's attention is also drawn to the comments of NRW (see appendix 3 of this Opinion) in relation to study areas." (Planning Inspectorate)	D12-2 (Application Reference Number: 6.4.101). Horizon and its consultants have attended several meetings with NRW in 2016 and 2017 at which the study areas were displayed. No further comments were raised.
"The Secretary of State expects that criteria for determining receptor value and magnitude of effect are clearly expressed within the ES and that the application of professional judgement is clearly justified in this respect. The Secretary of State also recommends early agreement with statutory consultees as to the prescription of values to individual receptors". (Planning Inspectorate)	The criteria for determining geomorphology receptor value and magnitude of effect have been clearly presented within this chapter. Wave, current and plume dispersion modelling has been completed and used to inform professional judgement (see appendix D12-3, Application Reference Number: 6.4.82; appendix D13-8, Application Reference Number: 6.4.90; and appendix D13-12, Application Reference Number: 6.4.94). NRW has been present at numerous meetings in 2016 and 2017 where the values attached to specific geomorphology receptors have been presented. No further comments were raised.
"The Secretary of State draws the Applicant's attention to TAN 14 Coastal Planning (1998), which is omitted from the list of TANs considered relevant to the potential environmental impacts of the proposed development in Section 2.1.2. The Applicant is expected to refer to the guidance within TAN14 during the EIA process and within the ES." (Planning Inspectorate)	TAN 14 [RD7] is now explicitly referred to in the Environmental Statement and has been considered/referred to as appropriate during the assessment process which is recorded in chapter D12 (Application Reference Number: 6.4.12).
"The FCA [Flood Consequence Assessment] will need to overlap and cross refer to both the surface water and coastal processes chapter so as to consider the impacts of the Proposed Development in terms of flooding." (Planning Inspectorate)	The FCA is dealt with in the surface water and groundwater chapter B8 (Application Reference Number: 6.2.8) of this Environmental Statement, but cross-reference is made to the coastal processes and coastal geomorphology chapter where needed.

Key issue raised	Action taken
“The Secretary of State would expect the potential impacts of dredging during construction and operation to be assessed as part of the EIA, with mitigation measures proposed where appropriate.” (Planning Inspectorate)	The potential effects of dredging have been considered including the effects of sediment dispersion on geomorphology receptors.
"NRW consider it essential the study area is based on current design detail and scope in all projects with N2K status in the sediment sub cell area until evidence is presented to scope them out. Section 15.4.1 and section 16.4.1 both state the study area being 5km and tidal influence being 20–25km. NRW would expect to see studies out to the tidal excursion area with asymmetry being taken into account to understand the baseline conditions and future forecasts with structures in place. The sediment sub cell will encompass the tidal excursion boundary and NRW advise that this is the starting point for an impact assessment." (NRW)	Modelling results and interpretation have now been used to assess potential effects of the offshore structures on coastal forms and coastal processes. These results have been used to define the study areas in relation to tidal excursions. This has been discussed with NRW. The method, including the study area, has been presented and discussed at several meetings with NRW, most recently in July 2017. No further comments were raised. These models are included in Appendix D12.03 (Application Reference Number: 6.4.82); Appendix D12.08 (Application Reference Number: 6.4.90); D13.08 (Application Reference Number: 6.4.90) and D13.12 (Application Reference Number: 6.4.94). Sediment regime is included at Appendix D12.02 (Application Reference Number: 6.4.81)
“The ES should fully assess the effects of the marine works (during both construction and operational phase) on sediment processes and the likely effects on the shingle ridge which is critical to the functioning of the Cemlyn Bay SSSI [Site of Special Scientific Interest]/SAC and is also critical to the functioning of the SPA [Special Protection Area] as the nesting site. These assessments will also be required to inform the HRA [Habitats Regulations Assessment] that the SoS will need to undertake.” (NRW)	Sediment process effects on the shingle ridge (Esgair Gemlyn) and lagoon have been assessed and are reported in chapter D12 (Application Reference Number: 6.4.12). Wave modelling and bed shear stress calculations have been used to support the assessment.

Key issue raised	Action taken
"The Scoping report states that a Rochdale envelope approach will be used. NRW advise that clarity is required as to how this is to be implemented in the marine environment." (NRW)	The use of the Rochdale envelope general approach is fully explained in chapter B1 (introduction to the assessment process) (Application Reference Number: 6.2.1). Design-based assumptions specific to marine activities and potential effects on coastal processes and coastal geomorphology are fully explained in chapter D12 (Application Reference Number: 6.4.12).
"NRW advise a high-resolution study (modelling and field campaign) is conducted around Cemlyn Lagoon / Bay. NRW are unable to concur with the minor adverse assessment based on the current level of information. The Scoping report states that the applicant will model the expected changes to sediment transport depending on the final design chosen for the intake and any breakwaters. The further studies listed in section 15.4.2 (Tidal flow modelling, sand transport modelling (including bed shear stress) and sediment plume dispersion modelling) are welcomed and will aid assessment. As mentioned, NRW cannot concur with any impact assessment until further studies have been completed. NRW advise that the applicant models changes in hydrodynamics, such as incident wave reflection, current speed and direction off the breakwaters, MOLF [Marine Off-loading Facility] and CWS [Cooling Water System], not just sediment transport. We advise that a model run with the chosen configuration of offshore structures is run at the earliest convenience to understand the potential impacts and distance that changes may occur, thus possibly needing to follow an iterative approach and change model size and	At the scoping stage reliance was placed on professional judgement to arrive at 'minor adverse' significance, informed by previous studies and up to date literature. Wave, current and sediment plume modelling and a field campaign have since been undertaken to inform the detailed assessment (see appendix D12-3, Application Reference Number: 6.4.82; appendix D13-8, Application Reference Number: 6.4.90; and appendix D13-12, Application Reference Number: 6.4.94). There has been a series of meetings in 2016 and 2017 with NRW to take advice on the approach undertaken. Specifically, nine modelling scenarios were discussed with NRW before being adopted for the purpose of assessment. An approach to determining the significance of bed shear stress versus bed sediment characterisation has been agreed as an approach. All marine activities have been included in the hydrodynamic modelling (see appendix D13-8, Application Reference Number: 6.4.90).

Key issue raised	Action taken
resolution depending on model outputs. NRW has provided advice and guidance to the applicant with regard to marine modelling methodology; however, we advise that further discussions are required to confirm that the modelling methodology is adequate before completing the associated assessments and ES/HRA." (NRW)	
"The applicant should ensure that baseline data is up to date and in this regard is drawn to the comments of NRW regarding the currency of data for Esgair Gemlyn" (SoS)	A Light Detection And Ranging (LiDAR) investigation was undertaken in 2017, specifically focused on Esgair Gemlyn.
"The key changes identified in Section 15.1 3.80 relevant to this topic do not explicitly refer to the proposed changes to the cooling water intake, as identified in Table 3.1 of the Scoping Report addendum. The SoS expects that potential impacts as a result of such changes are fully assessed in the ES. This comment applies equally to the marine environment ES chapter". (SoS)	The potential effects arising from excavation for the cooling water intake on geomorphological receptors is assessed in chapter D12 (Application Reference Number: 6.4.12).
"The SoS welcomes that the Applicant is in discussion with NRW about this assessment, including agreeing the key waves and currents scenarios that will be modelled in order to inform the assessment. The ES should detail the models that have been used and the input parameters applied. The SoS notes that NRW has concerns regarding the proposed 5km study area and advises that this is discussed and resolved between the two parties." (SoS)	The models and input parameters are summarised in this chapter and chapter D12 (Application Reference Number: 6.4.12). The hydrodynamic model outputs are included in appendix D13-8 (Application Reference Number: 6.4.90), and appendix D13-12 (Application Reference Number: 6.4.94). A wave modelling report is provided as appendix D12-3 (Application Reference Number: 6.4.82). Study areas (and their selection) are described in this chapter and chapter D12 (Application Reference Number: 6.4.12). The method, including study areas, has been presented and discussed at several

Key issue raised	Action taken
	meetings with NRW, most recently in July 2017. No further comments were raised.
"It is welcomed that the thermal characteristics of the hydrodynamic modelling will be covered in the marine environment chapter of the ES. This should be cross-referenced from the coastal processes ES topic chapter." (SoS)	Reference is made in chapter D12 (Application Reference Number: 6.4.12) to thermal characteristics which are assessed in chapter D13 (Application Reference Number: 6.4.13).
"Although table A1 acknowledges that TAN 14 will be taken into account in the coastal process and coastal geomorphology chapter of the ES, it is still absent from the Addendum chapter of the list of relevant policies and references used." (NRW)	TAN 14 is referred to at appropriate junctures and appears in the reference list.
"No information on maintenance dredging has been provided to date. Impacts from maintenance dredging will need to be assessed in the ES, Statement to Inform HRA and WFD Compliance Assessment." (NRW)	Maintenance dredging is assessed in chapter D12 (Application Reference Number: 6.4.12); D13 (Application Reference Number: 6.4.13); the Shadow HRA Report (Application Reference Number: 5.2); and the WFD Compliance Assessment (Application Reference Number: 8.26).
"As stated in NRW's 2016 Scoping Advice (comment no. 85), based on current information provided NRW is unable to agree with the 5km study area proposed and advise that all sensitive receptors within the sediment sub cell be scoped in at this stage until evidence proves otherwise." (NRW)	The method for selection of study area is now referred to and justified in this chapter and chapter D12 (Application Reference Number: 6.4.12) of the Environmental Statement. The 5km study area, nested within the much larger modelling grids, has only recently been affirmed following receipt of modelling results. The method, including the study area, has been presented and discussed at several meetings with NRW, most recently in July 2017. No further comments were raised.
"Paragraph 7 (section 15.1) states that an assessment is proposed using one or two tidal excursions. This has	For the purposes of study, the area of investigation reflects boundaries implemented within the

Key issue raised	Action taken
not been agreed with NRW. NRW advise that further discussion is required regarding this point." (NRW)	hydrodynamic and wave models used to support this assessment - see chapter D12 (Application Reference Number: 6.4.12) and chapter D13 (Application Reference Number: 6.4.13).
"NRW is concerned on the date of the baseline data associated with the understanding of Esgair Gemlyn as it is considered that data pre-2014 storms have been used. Further 2015 LiDAR is available free of charge from the Lle government portal (http://lle.gov.wales)." (NRW)	More recent data/ information has been used in the assessment, including a specific LiDAR survey in 2017 undertaken by Horizon. We have also used more historic data.
"The modelling of the final design envelope for the Marine Off-Loading Facility and breakwaters has not been shared with NRW and therefore any modelling relating to coastal process and geomorphology cannot be agreed or confirmed at this stage." (NRW)	The hydrodynamic and wave modelling, described in chapter D12 (Application Reference Number: 6.4.12) and chapter D13 (Application Reference Number: 6.4.13) has been based on design parameters and assumptions with a worst case scenario being assessed (see chapter D1 (proposed development) (Application Reference Number: 6.4.1)).
"In the absence of detailed design of the breakwaters, the range of potential options being taken forward must be adequately assessed, and whilst it is stated that a Rochdale Envelope approach based on worst case scenario is proposed, it may be that different breakwater designs have different potential impacts as opposed to one being a worst case; in which case a Rochdale Envelope approach may not suffice. NRW has advised the applicant that, in order to understand what the reasonable worst case would be, different scenarios would need to be modelled. Modelling and assessment of the project changes affecting the marine environment will be needed to inform both the ES as well as the	The hydrodynamic and wave modelling have been based on design parameters and assumptions with a worst case scenario being assessed (see chapter D1 (Application Reference Number: 6.4.1)). Chapter D12 (Application Reference Number: 6.4.12) assesses the effects on coastal processes and coastal geomorphology and this assessment has been used to inform the Shadow HRA Report (Application Reference Number: 5.2) and the WFD Compliance Assessment (Application Reference Number: 8.26).

Key issue raised	Action taken
Statement to Inform HRA and WFD Compliance Assessment." (NRW)	
Paragraph 4 (section 16.1) states: "These structures and activities were considered as part of the 2016 Scoping Report. The study area and methodologies defined in the 2016 scoping report identified a 5km radius from the Power Station Site based on consideration of mixing zones and modelling information. The changes proposed do not substantially move or change the structures to the extent that a change to the study area would be required. The assessment methodology has already accounted for the design and operation of these structures. The scope of the assessment therefore remains as described in the 2016 Scoping Report". Evidence from modelled runs of sediment transport is required to determine if the 5km radius is an acceptable study zone for the coastal processes assessment. This was reiterated in comment no. 85 of NRW's 2016 Scoping advice. NRW's advice has been noted in section 15.1.7 (5th bullet point) of the Addendum. However, HNP have not considered it in Chapter 16 Marine Environment" (NRW).	Hydrodynamic and wave modelling has now been completed, allowing affirmation of a suitable study area. Thermal mixing zones are dealt with specifically in chapter B13 (Application Reference Number: 6.2.13) and chapter D13 (Application Reference Number: 6.4.13).

Statutory consultation

Pre-Application Consultation Stage One

12.3.4 The aim of Pre-Application Consultation Stage One, undertaken in late 2014, was to share information available at the time with Horizon's key consultees and stakeholders, in order to consider feedback in ongoing design development. Table B12-5 outlines how key issues raised during Pre-Application Consultation Stage One have been considered in the assessment.

Table B12-5 Key issues raised during Pre-Application Consultation Stage One

Key issue raised	Action taken
NRW noted that the Preliminary Environmental Impact report did not	Modelling of a previous design showed there to be little or no impact

Key issue raised	Action taken
give sufficient information about modelling, scenarios and survey methods, or the results from these assessments. NRW noted that additional information and clarification on a large number of issues would be needed before they would be able to provide further advice.	on coastal processes or coastal geomorphology. This was used in part for informing professional judgment during Pre-Application Consultation Stage One. The EIA has now been informed by further data and information collection and by wave/climate and sediment plume modelling described in chapter D12 (Application Reference Number: 6.4.12).
Similarly, the National Trust requested additional information about the level of baseline modelling that had been completed, noting that additional information would be needed from the ongoing modelling. The National Trust also requested modelling for the construction of the MOLF and in relation to coastal hydrodynamics and geomorphology.	This chapter and chapter D12 (Application Reference Number: 6.4.12) of this Environmental Statement have now been fully informed by further data and information collection and by wave/climate and sediment plume modelling.
At a high level, the North Wales Wildlife Trust commented that potential impacts of the Wylfa Newydd Project on the wildlife and coastal processes at Cemlyn were not sufficiently addressed, undermining the importance of Cemlyn, which they believed to be the most important ecological receptor in the area. (The North Wales Wildlife Trust).	It is accepted that potential effects on coastal processes at Cemlyn (including the shingle ridge and lagoon) needed to be assessed in detail. Coastal process studies have been fundamental to informing potential geomorphological as well as ecological effects. Modelling and further studies have now been completed as part of the assessment.

Pre-Application Consultation Stage Two

12.3.5 In September 2016, Horizon shared a Preliminary Environmental Information Report as part of Pre-Application Consultation Stage Two. This presented preliminary details of the predicted environmental effects and mitigation measures for any adverse effects identified. Table B12-6 outlines how key issues raised during Pre-Application Consultation Stage Two have been considered in the assessment.

Table B12-6 Key issues raised during Pre-Application Consultation Stage Two

Key issue raised	Action taken
“Various study area extents would benefit from being supported by a	Study area extents have been refined following modelling results

Key issue raised	Action taken
figure. Baseline study / survey reports should be referenced as Technical Appendices and provided elsewhere e.g. coastal walkover survey, wind buoy monitoring, other site specific studies." (NRW)	and a figure showing these extents is provided, see figures D12-1 and D12-2 (Application Reference Number: 6.4.101). Baseline study/ survey reports (containing information about the buoys [RD33] are now also referred to in chapter D13 (Application Reference Number: 6.4.13). Geomorphology baseline and sediment regime baseline reports are appended to chapter D12 (Application Reference Number: 6.4.12).
"Please clarify '..then up to two tidal excursions distance from the Power Station Development has been chosen as a suitable study area, including (if necessary) Carmel Head to the west and Torllwyn to the east.' Have two tidal excursions been used? Are Carmel Head and Torllwyn included in this area? or has less than two tidal excursions been used? As per comment above, supporting figure showing the extent of the two tidal excursions would be beneficial." (NRW)	Two tidal excursions were chosen following discussion with NRW as a possible extent for fine sediment plume dispersion. However, this initial boundary was revisited once the hydrodynamic results were known. The rationale for selection of study areas is provided in this chapter and chapter D12 (Application Reference Number: 6.4.12).
"Need to provide information on the numerical wave transformation modelling methodology that has been completed and the parameters that have been used for modelling and their source." (NRW)	Numerical wave transformation modelling methodology is explained in chapter D12 (Application Reference Number: 6.4.12), together with the parameters used for modelling and their source.
"Section on 'wave climate' - would be helpful to indicate on the study area figure (or another figure indicating baseline surveying locations) the location of the buoys that were deployed. Also reference to a technical appendix containing the baseline report produced for the wave buoy survey." (NRW)	A section on wave climate has now been included in chapter D12 (Application Reference Number: 6.4.12) and the wave buoys are depicted on a figure referenced in chapter D12 (Application Reference Number: 6.4.12). The baseline studies are included in the Titan Report [RD33] and information is provided in chapter D12 (Application Reference Number: 6.4.12).

Key issue raised	Action taken
"Would be helpful to have a baseline figure showing the location of the relevant designated sites referred to in the appendix, along with the location of key features such as 'Esgair Gemlyn' and 'Hen Borth'." (NRW: Section on 'identification of value and receptors')	A baseline figure showing the location of the relevant geomorphology receptors is included in chapter D12 (Application Reference Number: 6.4.12). Those sites designated for conservation reasons are covered in chapter D13 (Application Reference Number: 6.4.13).
"NRW …advise that operational effects on Cemlyn Bay SAC/SSSI associated with offshore structures potentially changing areas of erosion and deposition are fully considered in ES/Shadow HRA."	An assessment of potential operational effects resulting from offshore structures (Marine Works) has now been completed as part of the assessment.
"NRW has concerns regarding current progress on the coastal processes modelling work which underpins critical impact assessment work, including HRA. We [NRW] advise further consultation with NRW as soon as possible." (NRW)	Since this comment was made further consultation at a series of meetings in 2016 and 2017 has been undertaken with NRW on the outputs from the modelling (as they have become available) and how these help determine changes to coastal and marine processes and impacts on receptors. NRW attended a meeting on 20 June 2017 at which wave modelling work was presented.
"NRW are concerned that a number of initial conclusions are 'moderate' or 'minor adverse' rather than providing a precautionary conclusion." NRW have highlighted key examples where it disagrees with initial conclusions however it has not been able to review and advise on all conclusions. (NRW)	The initial assessment was based on professional judgement, informed by previous studies and recent literature. A detailed assessment has now been undertaken based on additional modelling of waves, currents and sediment plumes. Bed sediment information has also been collected to inform any potential changes.
NRW recommends that Horizon schedule sufficient time in order to consult NRW and incorporate their advice. (NRW)	There has been an ongoing programme of meetings with NRW in 2016 and 2017 to discuss scenarios to be modelled and to incorporate their advice. No further comments were raised.

Key issue raised	Action taken
Specific concerns were raised by NRW about the following: • progress with modelling; • assessment of effects on receptors; • a lack of evidence of use of TAN14 (particularly in helping to define the study area); • the lack of sediments work (both plume studies and information related to bed sediment changes); • dredge disposal and maintenance; • operational effects; and • SMP2 not explicitly referred to.	Subsequent to these comments presentations on progress were made to NRW at a series of meetings on 30 September, 31 October and 9 December 2016, in April 2017 and again on 5 June 2017. Additional modelling and assessment work (including data/ information on sediments) has now been undertaken to address these issues and is reported in chapter D12 (Application Reference Number: 6.4.12). The effects of changes of coastal processes on the marine environment (ecology) receptors are covered in chapter D13 (Application Reference Number: 6.4.13). Specifically, TAN14 has been followed in the additional assessment work. The further modelling has informed the boundaries of effects and the study area has been extended to accommodate the geographical extent of any potential effects (e.g. for sediment plumes). Further sediment work including sampling and bed sediment characterisation has now been completed. This provides a more comprehensive picture of potential sources, sinks and movement of bed sediment. Dredge disposal and maintenance are now explicitly covered in chapter D12 (Application Reference Number: 6.4.12). Further work on operational effects (as well as construction effects) is now detailed in the assessment chapter D12 (Application Reference Number: 6.4.12).

Key issue raised	Action taken
	SMP2 has been fully considered and further referenced in chapter D12 (Application Reference Number: 6.4.12).
Advised that climate change scenarios should be considered more fully in the Environmental Statement. (NRW)	Climate change factors have been taken into account in the hydrodynamic and wave modelling. This is explicitly described in chapter D12 (Application Reference Number: 6.4.12).
The National Trust had the following concerns: • little progress had been made on the assessment of coastal processes which in turn are related to aspects of marine, freshwater and terrestrial ecology, water quality and birds (amongst other topics); • there should be a requirement for a much greater level of information about the environmental baseline and potential impacts of the proposed works (including decommissioning) on coastal and marine processes, sediments and landforms than is currently available. This information should also inform the HRA; • The assessment should account for possible climate change and sea-level rise; and • further work required before mitigation measures can be decided upon.	A detailed assessment has now been completed, informed by the outputs from wave, current and sediment plume modelling as well as available sediments information. This is described in chapter D12 (Application Reference Number: 6.4.12). The results of the assessment have informed the marine ecology impact assessment (see chapter D13, Application Reference Number: 6.4.13). Water quality issues are also covered in the above chapter. A greater level of information about the environmental baseline is now included in the assessment (chapter D12); (Application Reference Number: 6.4.12). The outputs from the coastal and marine processes and coastal geomorphology assessments have been used to inform the HRA Climate change factors have been taken into account in the hydrodynamic and wave modelling. This is explicitly described in chapter D12 (Application Reference Number: 6.4.12). Where applicable mitigation measures are now described in chapter D12 (Application Reference Number: 6.4.12) (for effects on geomorphology receptors) and D13 (Application Reference Number:

Key issue raised	Action taken
	6.4.13) for effects on marine environment receptors.
There is a lack of information for baseline surveys and modelling studies for coastal processes, the absence of which makes a detailed evaluation of potential impacts and possible mitigation measures impossible. This is of particular relevance to the supporting features of the SPA and SAC at Cemlyn Bay (National Trust)	At the time the Pre-Application Consultation Stage Two comment was made, modelling had not been undertaken/ completed so therefore could not be presented. Since then there has been considerable progress, including a meeting with Non-governmental organisations (NGO's) (including National Trust) in Bangor on 5th June 2017 at which hydrodynamic modelling results were presented.

Pre-Application Consultation Stage Three

12.3.6 Table B12-7 outlines how key issues raised during Pre-Application Consultation Stage Three have been considered in the assessment.

Table B12-7 Key issues raised during Pre-Application Consultation Stage Three

Key issue raised	Action taken
Changes to the construction of the breakwaters and MOLF, specifically: • the length and position of the Eastern / Western Breakwaters; • design of the MOLF with two platforms would reduce seabed excavation, however no reference is made to changes during operational phase, aside from visual impacts. Potential effects may differ during the operational phase resulting from changes to the design and location of physical structures. We understand the physical processes modelling is being re-run for the operational phase and advise this must be fully addressed within the ES and supporting documents. (NRW)	Detailed modelling of coastal processes has been carried out based on the latest proposed temporary and permanent structure designs for both construction and future operation of the Power Station Site. The assessment of potential changes to coastal processes and associated effects upon geomorphological receptors are reported in chapter D12 (Application Reference Number: 6.4.12), supported by a coastal geomorphology baseline assessment (see appendix D12-1, Application Reference Number: 6.4.80), sediment regime baseline assessment (see appendix D12-2, Application Reference Number: 6.4.81), hydrodynamic modelling report (see appendix D13-8,

Key issue raised	Action taken
	Application Reference Number: 6.4.90) and wave modelling report (see appendix D12-3, Application Reference Number: 6.4.82).
NRW have not been consulted on full modelled outputs for coastal process effects of the final designs for structures (e.g. length of breakwaters, approach to the dredging in Porth-y-pistyll and design of the MOLF) It is therefore not possible to comment fully on the range of potential effects on the benthic habitats that may be affected by the proposed development. (NRW)	Detailed modelling of coastal processes has been carried out based on the latest proposed designs of temporary and permanent structures during both construction and future operation of the Power Station Site. This approach and interim results have been presented at a number of meetings with NRW and other stakeholders as detailed in table B12-9.
Horizon have made use of the NT funded Pye & Blott (2010) report on the geomorphology and coastal processes relating to Cemlyn Lagoon, but no reference is made to Pye & Blott (2016) updated report. (National Trust)	Reference to the findings of [RD34] has now been included in chapter D12 (Application Reference Number: 6.4.12) of the Environmental Statement since the report was made available.
The disposal of spoil/materials at sea has not been included as a possible impact mechanism. The predicted rates of disposal at the Holyhead Deep licensed tipping site, appear to be at the Deep's capacity limits; the type of material is varied, with potential to create sediment plumes or other changes to the immediate area (the Anglesey Terns potential SPA and North Anglesey Marine candidate SAC).	The issue of sediment plume creation (and associated deposition) has been considered for all works including the Disposal Site. From a geomorphological perspective, the effects of deposition have been assessed as negligible. The cumulative effects of capacity have also been looked at cumulatively with other disposal operations such as Holyhead port.
It is understood that the detailed modelling of the likely impacts of the MOLF and breakwater construction are proving difficult to develop and to provide conclusive predictive outcomes and the level of uncertainty is currently predicted as high. (Royal Society for the Protection of Birds (RSPB Cymru)	Detailed modelling of coastal processes has been carried out based on the proposed designs of temporary and permanent structures during both construction and future operation of the Power Station Site. This approach and interim results have been presented at a number of meetings with NRW and other

Key issue raised	Action taken
Concerns about the unknown impacts on the marine environment and coastal processes by the construction of a new harbour and harbour wall (breakwaters). (Anglesey Wildlife Walks)	stakeholders as detailed in table B12-9.
Further information is requested on the harbour design levels and therefore, the extent of excavations and dredging within Porth-y-pistyll. Further assessment will be required on maintenance dredging and disposal as this has yet to be covered. (NRW)	The outcomes and assessment of potential changes to coastal processes and associated effects of the latest proposed dredging and disposal activities (during construction and operation of the Power Station Site) upon geomorphological receptors, are reported in chapter D12 (Application Reference Number: 6.4.12), supported by hydrodynamic modelling reports for the Wylfa Newydd Development Area (see appendix D13-8, Application Reference Number: 6.4.90) and including the dredging disposal at the Disposal Site (see appendix D13-12, Application Reference Number: 6.4.94).
It would logically follow, that given the compounded effects of two uncertain scenarios; sea level rise and Wylfa Newydd breakwater, along with the policy direction for managed realignment, that the secured planning package for the DCO contributes to the PDZ18 SMP's strategic objective. (RSPB Cymru)	Detailed modelling of coastal processes has been carried out based on the latest proposed designs for temporary and permanent structures during both construction and future operation of the Power Station. The assessment includes consideration of the potential effects of climate change (including sea level rise) in line with the most up to date relevant guidance produced by the Welsh Government, NRW and EA.
The presence of the SAC features and its conservation objectives are essentially related to the physical structure and environmental parameters of the lagoon and shingle ridge.	Potential effects on coastal processes and geomorphology as well as marine ecological receptors (e.g. designated sites and species of conservation importance) have been assessed within chapters D12 (Application Reference Number:

Key issue raised	Action taken
These are intimately connected to the presence of the tern breeding colony and hence the conservation status of the SPA. (RSPB Cymru)	6.4.12) and D13 (Application Reference Number: 6.4.13). In recognition of the ecological linkages between these two chapters and the importance of the coastal geomorphology in providing habitats, we have undertaken bespoke coastal processes and wave modelling investigations. Effects on terns are referred to in the Shadow Habitats Regulations Assessment (Application Reference Number 5.2).
Individuals raised concerns about the impact on the Cemlyn Nature reserve and the tern colony – “there are no clear plans on how you will protect them and ensure there is no impact on the shingle ridge and brackish lagoon. The Cemlyn and Wylfa area is also important for other wildlife” “I am not opposed to the nuclear power station, but feel you must take a more sensitive approach to the environment and wildlife.”	All effects on coastal and marine processes and geomorphology and associated effects to marine ecological receptors are assessed in chapter D12 (Application Reference Number: 6.4.12) and D13 (Application Reference Number: 6.4.13). Effects on terns are also referred to in the Shadow Habitats Regulations Assessment (Application Reference Number 5.2). Mitigation measures embedded into the design of the Wylfa Newydd Project, would reduce potential effects to designated sites. Where appropriate, additional mitigation measures are intended to further reduce effects to designated sites. Details of additional mitigation measures would be finalised through a Statement of Common Ground to be agreed with the relevant stakeholders. The effects of changes of coastal processes on the shingle ridge and lagoon have been modelled using a wave transformation model.
Construction of a temporary causeway linking the western breakwater to the shore, the use of cofferdams and a semi-dry approach	The assessment of potential changes to coastal processes and associated effects upon geomorphological receptors are

Key issue raised	Action taken
to assist dredging have been confirmed. This is still recognised as a Major Adverse environmental impact, and adjoins NT land with no recognition of mitigation or compensation. (National Trust) Monitoring - An environmental monitoring package of physical processes is agreed to and funded. (RSPB Cymru)	reported in chapter D12 (Application Reference Number: 6.4.12), supported by a hydrodynamic modelling report (see appendix D13-8, Application Reference Number: 6.4.90) and wave modelling report (see appendix D12-3, Application Reference Number: 6.4.82). The further modelling and analysis carried out since the consultation has reduced the uncertainty associated with the modelling, such that we do not consider that monitoring is required.
"We understand that coastal processes assessment work and computer modelling is still ongoing. This area of work is essential in addressing our concerns, including the vulnerability of the shingle ridge at Cemlyn to potential alterations to coastal processes from the proposed breakwater and MOLF." (RSPB Cymru, Friends of the Earth)	Detailed modelling of coastal processes has been undertaken based on the latest proposed designs for temporary and permanent structures during both construction and future operation of the Power Station, to investigate the potential effects of changes in coastal processes on the Cemlyn Bay Lagoon shingle ridge Further investigations using historic and current (2017) LiDAR data have also been carried out to understand the baseline functioning of the shingle ridge. The outcomes and assessment of potential changes and associated effects to functioning of the Esgair Gemlyn shingle ridge are reported in chapter D12 (Application Reference Number: 6.4.12).
The proposal's impacts will change coastal geomorphological processes and wave action particularly localised effects of storm events. (RSPB Cymru)	Detailed modelling of coastal processes (tidal currents and waves) has included winter storm conditions, allowing localised 'worst case' effects upon sensitive receptors (such as the Esgair Gemlyn) to be investigated. This approach and interim results have been presented at a number of

Key issue raised	Action taken
	meetings with NRW and other stakeholders as detailed table B12-9
The Shoreline Management Plan 2011 does not take account of any synergy with impacts from the development of Wylfa Newydd. (RSPB Cymru)	Comment is duly noted. The Shoreline Management Plan is referred to in this chapter and chapter D12 (Application Reference Number: 6.4.12).
The construction of Wylfa Newydd (creation of the MOLF, breakwaters and new harbour) will see the large-scale industrialisation of this currently natural bay and coastline. The consequences of this for the existing ecology within the bay and the Cemlyn Estate include: • Loss of current benthic habitats, intertidal rocky shore, shingle banks • Loss of species, such as shingle specialist sea kale (*Crambe maritima*) • Changes to fish assemblage and potentially availability of prey items for terns • Disturbance impacts - visual, noise and vibration • Changes to the coastal geomorphology, wave energy • Creation of sediment plumes (RSPB Cymru)	The assessment of potential changes to coastal and marine processes and associated effects upon geomorphological receptors arising from the construction and future operation of the proposed Power Station Site has been informed by detailed modelling of tidal currents and waves (separately and in combination), geomorphological field investigations, aerial (LiDAR) data analysis and relevant desk studies covering current and historic data and literature sources. Additional hydrodynamic modelling of thermal and fine sediment plume dispersal (and deposition) has also been carried out. All of these findings have informed the assessment of potential effects upon marine and intertidal habitats and species reported in chapter D13 (Application Reference Number: 6.4.13).
The Wylfa Newydd MOLF and breakwater have significant potential to add to the effects of the primary energy source locally, as described in the Shoreline Management Plan: "*Within the main bay [Cemlyn], the shingle ridge has been developed within a very constrained inlet, opening to the north east. While waves can enter the bay directly from this direction causing some variation in movement of the shingle along the frontage, the main energy acting on*	Our investigations concur with the SMP description. Building upon baseline data and observations, detailed wave modelling has been carried out based on the latest proposed designs for temporary and permanent structures during both construction and future operation of the Power Station Site. The outcomes and assessment of potential changes to waves are

Key issue raised	Action taken
the natural feature is, and has been, waves diffracting around the headland. This very dominant aspect of the inshore wave climate, effectively filtering the variation in offshore wave approach and creating a uniform and tightly banded wave approach direction at the shoreline has allowed development of the long shingle ridge." {Shoreline Management Plan - PDZ 18. NORTH ANGLESEY: Twyn Cliperau to Trwyn Cwmrwd - Policy Development Coastal Area G, November 2011} (RSPB Cymru)	reported in chapter D12 (Application Reference Number: 6.4.12), supported by a wave modelling report (see appendix D12-3, Application Reference Number: 6.4.82). This approach and interim results have been presented at a number of meetings with NRW and other stakeholders as detailed in table B12-9.
In the scenario where the wider funding may not be forthcoming and the Shoreline Management Plan 2 is not implemented, the presence of Wylfa Newydd breakwaters and sea level rise are likely to act together and exacerbate the effects of unexpected storm events. There will be a resulting increased probability of a sudden unplanned and catastrophic breach or lowering of the shingle ridge and the consequent sudden risks to the SPA and SAC. Such events have occurred in recent years in the UK and have led to the need to raise emergency funding for repair work to secure the nature conservation interests of high profile international sites, for example as at Blakeney Freshes (National Trust) and Cley (Norfolk Wildlife Trust) in the storms of winter 2013/14. In this scenario, it is this NGO group's opinion that the release of funds to provide a proportion of any emergency resource for remedial works could be secured via a Bond from Horizon. (RSPB Cymru).	Assessment of potential effects during future operation of the Power Station, detailed wave modelling has been undertaken with additional consideration of potential climate change effects including sea level rise. The modelled scenarios have included winter storm conditions, allowing localised 'worst case' effects upon sensitive receptors (such as the Esgair Gemlyn) to be investigated. This is not an appropriate mechanism. DCO requirements would be included.

Key issue raised	Action taken
Regarding marine works proposed within the Power Station Site. We note in section 1.4.7 of the MCD [Main Consultation Document], that flexibility will be sought for the MOLF and breakwaters, with identification of parameters which control the development and set limits within which it may be undertaken. Tables 2-10 (Power Station Construction) and 2-11 (Power Station Operation) set out the likely environmental effects, both positive and negative. NRW would also expect possible effects to coastal processes to be identified here. As highlighted previously, Cemlyn Bay SAC may be impacted by changes in hydrodynamics and sediment transport in the area. In relation to the 'parameters' or design envelope that will be sought, NRW has advised HNP that the realistic 'worst case scenario' is modelled, in order to understand what the realistic worst case would be under different scenarios, and that sensitivity analysis would need to be undertaken to inform both the ES, HRA and WFD assessments. (NRW)	Detailed modelling of coastal processes has been carried out based on the latest proposed designs of temporary and permanent structures during both construction and future operation of the Power Station Site. Modelling studies include sensitivity testing of 'parameters' as noted. The outcomes and assessment of potential changes to coastal processes and associated effects upon geomorphological receptors are reported in chapter D12 (Application Reference Number: 6.4.12) of the Environmental Statement. These results have been used to inform the ecological assessments within chapter D13 (Application Reference Number: 6.4.13); the Shadow HRA Report (Application Reference Number: 5.2); and the WFD Compliance Assessment (Application Reference Number: 8.26).

Consultation on Additional Land

12.3.7 In February 2018, Horizon undertook consultation on additional land that had not been consulted on previously. The additional land was required to:

- accommodate proposals to create or enhance wetland sites across Anglesey as Ecological Compensation Sites;
- create two new ecological mitigation areas, and minor changes to the connection to the national grid at the Wylfa Newydd Development Area; and
- update the order limits for the A5025 Off-Line Highway Improvements, and minor refinements to the boundaries of the Off-Site Power Station Facilities and Logistics Centre.

12.3.8 The feedback from the consultation has been reviewed and there were no coastal processes or coastal geomorphology issues raised.

Non-statutory consultation

EIA Progress Report

12.3.9 An EIA Progress Report was provided to the IACC and NRW in 2016 with updated information on the design development and associated environmental assessment. Table B12-8. outlines how key issues raised in feedback from these stakeholders have been considered in the assessment.

Table B12-8 Key issues raised in response to the EIA Progress Report

Key issue raised	Action taken
Concern that the potential impacts of different options on different receptors/elements should be considered. Advised that the iterative approach to design options should be continued to reduce environmental impact (and feeding into the requirements of WFD).	NRW was informed of the detail of the approach (including contributing to choose of scenarios). This includes consultations held in September/October and November/ December 2016 and again in April and July 2017 at NRW Offices in Bangor.
Recommendation that "Clearing the Waters" guidance for developers on carrying out WFD can be used for assessments of a broader range. Recommended that the project components judged to have a non-temporary effect be screened in i.e. areas of seabed lost under the direct physical footprint of the development of the breakwater and MOLF (NRW)	One option for the assemblage of Marine Works (including a 400m western breakwater) has been modelled for the purposes of assessment. This has involved consideration of effects on different geomorphological receptors including Esgair Gemlyn. The 400m breakwater is shorter than another option (greater than 500m length) that was previously under consideration. The loss of seabed due to the physical footprint of the development is an effect included in the assessment. In undertaking the assessment of changes to coastal and marine processes and effects on geomorphology receptors we have taken into account WFD guidance now covered in the successor to the "Clearing the Waters" publication [RD24].

Key issue raised	Action taken
21.108 - Modelling studies will need to be re-run to account for the additive effects of a change over time, at an appropriate frequency. (NRW)	Modelling studies are ongoing. NRW have provided input to the scope/scenarios for these studies.
21.115 - The effects of sediment dispersion arising from disposal of sediment at the disposal site would need to be assessed. There are potentially large volumes of sediment to be considered which could have an effect on the surrounding environment. (NRW)	The effects of sediment dispersion from dredging disposal at the Disposal Site have been assessed. This has been through hydrodynamic modelling that shows depths of sediment deposition and extent of fine sediment plumes. These effects (on geomorphology receptors) are reported in chapter D12 (Application Reference Number: 6.4.12).
“Table 21.9 - Anglesey North (coastal waterbody) is currently failing to achieve 'good status' and is deemed 'moderate'. This is a chemical failure for mercury. The table needs to be updated.” (NRW)	This update has been covered although it is noted that water chemistry per se is addressed in chapter D13 (Application Reference Number: 6.4.13).
“21.126 - Report says that any impact would be 'localised' and 'temporary'. Short-term timescales are considered to be the 'construction phase' which may typically be 8–10 years. NRW consider that such a duration is unlikely to be acceptable for any anticipated environmental impacts and we advise HNP [Horizon Nuclear Power] seek further advice from NRW with regard to this matter.” (NRW)	There have been ongoing discussions/ presentations with NRW in 2016 and 2017 to specifically outline the approach to assessment of coastal and marine processes and geomorphology. The hydrodynamic modelling takes into account construction sequencing and the Marine Works construction would be of much shorter duration (less than two years) and not the 8-10 years quoted by NRW. The WFD Compliance Assessment (Application Reference Number: 8.26) specifically discusses timescales in relation to temporary and permanent effects.

Draft Environmental Statement

12.3.10 During September 2017, draft Environmental Statement chapters were provided to statutory and key non-statutory stakeholders. Table B12-9 outlines key issues raised and how these have been addressed within the Environmental Statement.

Table B12-9 Key issues raised in response to the Draft Environmental Statement

Key issue raised	Action taken
"The Ch 12 Coastal Processes and coastal geomorphology ES bases its assessment of effects on geomorphological receptors using desk study data, observational data, previous investigations by Halcrow 2012 and modelled scenarios using SWAN [Simulating Waves Nearshore] and Delft3D outputs. NRW have provided detailed comments to HNP on the modelling reports D13.08, D13.12 and D12.03. In summary, the SWAN wave modelling scenarios are based on time series outputs of a sustained wave height and wave period using the 99 percentile for extreme storm events. It is individual rare storm events of short duration which cause the most damage to coastal morphology. There has been no such modelling conducted which models individual events such as those waves experienced during the 2013/14 storms and now Ophelia which over a 24hour period can generate much larger waves with a much longer wave period. Longer wave period storm waves will carry far more energy and are more destructive than winter storm waves with shorter wave periods. More emphasis should be placed on determining the effects of the marine works in reflecting these storm waves and where the focussing of energy will be i.e. towards Cemlyn Bay SAC, for baseline and when the construction works / fully built works are in place. The SWAN modelling showed that there is an area of wave focusing during NW extreme storm waves to	For individual rare storm events, there has been no previous request or agreement to model a 'design storm event'. Overall, the events that have been modelled represent 99% and 98% likely scenarios. On this basis, it is considered proportionate to the assessment required. For wave period, the SWAN model has found that wave focussing is sensitive to direction. Further sensitivity tests are being undertaken with a wider range of directions (every 5 degrees) to demonstrate whether the impact of focusing varies with direction and how frequently the effect is likely to occur. For wave reflection/shoaling, appendix D12-2 (Application Reference Number: 6.4.81) notes, in relation to wave modification that 'shoaling (wave steepening) and eventually wave breaking will occur as waves move progressively into shallower water and towards the shore'. In s.6.6, p.109 it states: 'There is a small ebb tide delta in Cemlyn Bay from the watercourse that drains into the sea from Cemlyn lagoon'. Appendix D12-3 (Wylfa Newydd Main Site Wave Modelling Report) (Application Reference Number: 6.4.82) notes (p.24) that 'directions and heights of the reflected waves from the two sections of the western breakwater, coupled with refraction and shoaling effects as they approach the coast, appear to be causing a small amount of refocussing of the wave energy in Cemlyn Bay '.

Key issue raised	Action taken
the west of Esgair Gemlyn and stated in D12.2 that the increased wave heights were due to the reflection off the western breakwater. However, the ES Chapter 12 states "during model runs for the north-west wave direction, a localised area to the west of Cemlyn Bay of slightly elevated wave height is evident; potentially a result of shoaling across the ebb tidal delta deposit formed by the long term drainage from the lagoon". This is not what was stated in D12.0.2. There has been no evidence provided which supports this determination. Further investigation is required to establish the full impacts on the Esgair Gemlyn Shingle ridge from extreme short duration storms during construction and operation." (NRW D12/2)	The combined effects of wave reflection and shoaling, and bathymetric variation reported in both technical appendices are therefore drawn upon within the Environmental Statement. Further investigation using the outputs of additional sensitivity runs undertaken since this consultation, will be carried out to refine the assessment (see Appendix D12.03) (Application Reference Number: 6.4.82).
“The hydrodynamic modelling of wave and current combined to determine bed shear stresses (D13.08) do not incorporate the 99 percentile extreme wave condition as was used in SWAN but the 98 percentile wave condition and only from one direction. There is a difference of 1.36m in wave height between the 98 and 99 percentile extreme north wave which would have a direct bearing on the bed shear stress and mobilisation of sediment in the nearshore zone. Longer wave periods associated with short duration storm waves carry more energy. It is not clear from the marine hydrodynamic modelling report D13.08 what wave period was used to represent the extreme wave events. Further, only the fully built scenario has been considered by the hydrodynamic model and NRW requests that the partial built scenario is included in the assessment of maximum bed shear stress. In order to make an informed	For the Delft3D hydrodynamic model 98%ile high wave from north assessment: a small area of minimal change is identified by the SWAN wave modelling for the 99%ile NW winter wave event. This represents a worst case with respect to wave height across all northerly wave directions (see table D12-2) (Application Reference Number: 6.4.12). There has been no previous request or agreement to model a 'design storm event'. On that basis, it is considered that the 98%ile event from the north is an appropriate scenario for the assessment. For wave factor difference between 98th & 99th percentile at offshore point (1.36m): The observation is correct that there is a difference in the extreme wave condition used in the coupled hydrodynamic model (2.85m at Point 3 - the 98%ile) and that used in the pure wave modelling (99%ile). The purpose of the coupled

Key issue raised	Action taken
assessment on the impacts to Cemlyn Bay SAC and Esgair Gemlyn Shingle Ridge due to increased shear stresses which can mobilise sediment into suspension, and lead to potential deposition on the shingle ridge, further hydrodynamic modelling is required. NRW advise that further modelling should be carried out to investigate the impacts of extreme waves from the NW, N and NE sectors using the 99 percentile for both partial built and fully built conditions as was used in the SWAN wave modelling and a further scenario included which represents a short term storm event with longer wave periods (similar to conditions during the 2013/14 storms). Maximum shear stresses for baseline, partial built and fully built conditions under each extreme event and difference plots of maximum bed shear stress between development phases and baseline will facilitate NRW in determining the coastal processes and geomorphological assessment of effects on the Cemlyn Bay SAC including Esgair Gemlyn and Cemlyn Lagoon due to excess shear stresses." (NRW D12/3)	hydrodynamic wave model simulations (which provided bed shear stress values due to currents combined with waves) was to examine the potential for the development to change coastal processes. The 98%ile wave was selected for these coupled simulations as an example of a very high (extreme) wave from the north. This wave condition was assumed to occur throughout the coupled simulation of a spring-neap-spring cycle and is therefore a very extreme condition being effectively a storm event lasting two weeks. For wave period for hydrodynamic model: value updated in chapter D12 (Application Reference Number: 6.4.12). For shear stresses for partially built conditions, we have modelled 99%ile for waves for the partially and fully built conditions. These results show a worse effect arising from the fully built scenario. On that basis, there is no justification for remodelling hydrodynamics if the fully built is confirmed as the worst condition for waves. For resuspension of sediments, the SWAN wave model demonstrates negligible change in wave height for a rare 99%ile event. On that basis, we have investigated resuspension for the marginally more likely 98%ile event which we consider to be an appropriate assessment. Further investigation using the outputs of additional sensitivity runs undertaken since this consultation,

Key issue raised	Action taken
	will be carried out to refine the assessment.
"The Delft3d 23m grid extent shown in figure D12-1 and D12-2 does not extend across Cemlyn Bay and include the Cemlyn Lagoon and Esgair Gemlyn shingle ridge. Report D13.08 shows modelled outputs that do include the whole of Cemlyn Bay SAC. Please amend". (NRW D12/4)	Figures D12-1 & D12-2 have been reviewed and updated - see figure booklet volume D (Application Reference Number: 6.4.101) The Delft3D model is not an appropriate tool to investigate the enclosed Cemlyn Lagoon, where flows are controlled by the weir structure at the outlet.
"Please show a figure of the time series of observed wave heights recorded at the four moorings over the deployment period to substantiate your review of wave heights". (NRW D12/13)	A time series is not essential for substantiating the content, these are not raw data gathered for this assessment but part of the desk study. The reference included in text provides the source document. Further analysis of the observed wave heights data can also be found within appendix D12-2 (Application Reference Number: 6.4.81).
"Please refer to general comment (NRW/D12/2) above on model scenarios for the current wave coupling in Delft3D. There is no reference in Table 12-3 to what wave period was used in the model. Swell waves with longer wave periods have more energy than locally generated wind waves and it is fundamental that an appropriate wave period is chosen to represent swell generated storm waves. The Delft3d modelling chooses only a North directed extreme wave height using the 98 percentile, whereas the SWAN baseline modelling uses the 99 percentile wave height and the SWAN results shows that the highest waves impacting Esgair Gemlyn come from the NE and the highest waves impacting Porth-y-Pistyll and overall arise from the NW. In order to have a full understanding of baseline	Concerning the Delft3D model wave period the table and text in chapter D12 (Application Reference Number: 6.4.12) have been updated with wave period values. For the Delft3D hydrodynamic model 98%ile high wave from north assessment: please refer to the response above for NRW/D12/3 General comments. Further investigation using the outputs of additional sensitivity runs have now been undertaken since this consultation and used to determine whether a change to the level of significance of effects is indicated.

Key issue raised	Action taken
conditions, NRW advise further modelling scenarios to be undertaken to determine the maximum combined wave-current bed shear stresses for the different extreme wave conditions as was modelled in SWAN." (NRW D12/18)	
"The statement in 12.3.43 is not strictly correct Figure D12-6 shows there to be an equal number of sediment samples taken in Cemaes Bay too. In actuality, 28 sediment samples were taken and PSA …(Particle Size Analysis)…results are represented in figure 31 report D12.0217. In sequence, samples 11, 12 and 17 are missing. Were these samples corrupted in some way? Additionally, sample WS28 is not included on the figure but figure 31 shows results for this location. Is this sample an intertidal sample? Further, only one grab sample represents Cemlyn SAC and this is offshore (WS3). No sea bed sediment samples have been collected from the seafloor within Cemlyn Bay as part of the surveys undertaken for the EIA. Please note that that the geophysical survey data, on which the seabed character interpretation is largely based, do not extend up to the low water mark and as a result, the seabed sediment in nearshore of Esgair Gemlyn Shingle Ridge is based on assumptions that the zone is contiguous. NRW advise that further samples are taken close to shore to determine the potential for sediment mobilisation under the action of storm waves close to Esgair Gemlyn." (NRW D12/25)	For sediments sampled in Cemlyn Bay, the text has been updated to reflect the locations around Cemaes and Cemlyn Bays. Concerning the missing sample data, during the sediment campaigns between 2010-15 some data points were not sampled during all years. The sediment sample location figure presented in chapter D12 (Application Reference Number: 6.4.12) is reproduced in appendix D12-2 (Application Reference Number: 6.4.81). The points in the map represent data recorded in 2010. The PSA results are presented in appendix D12-1 (Coastal Geomorphology Baseline for the Wylfa Newydd Project – 2014) (Application Reference Number: D12.1). These are referred to in figure 31 - please note this numbering has since been updated and this is now figure 33 in that document) - which includes data from surveys undertaken in 2011. NRW is correct in observing that these data sample locations are not shown on the map as shown in either document. The figure has been updated with these locations following internal data checks. Although not represented on the current figure, all recorded data have been taken into consideration within the baseline sediment regime and assessment chapter.

Key issue raised	Action taken
	For sediment nearshore of the shingle ridge, based upon available GI, walkover survey, side scan data and desk study reports, it is considered there is sufficient evidence to support the assumption that sediment type in near shore zone is contiguous. Furthermore, the assessment of changes in bed shear stress and particle mobilisation have not indicated areas of concern that justify a need for more detailed sampling or investigation.
“See general comments regarding the hydrodynamic modelling. NRW advise that further modelling using waves with relatively long period and wave height that is representative of extreme wave heights (99 percentile) approaching from the northwest, north and northeast as was used in SWAN, and a representative short duration wave event similar to the waves generated during the 2013/14 storms are required to determine the maximum bed shear stress in Cemlyn Bay which are particularly significant in terms of morphological impact on the Esgair Gemlyn shingle ridge and in the environmental assessment of whether and where geographically in Cemlyn Bay the bed shear stresses will mobilise sands and gravels.” (NRW D12/28)	For the Delft3D hydrodynamic model 98%ile high wave from north assessment, please refer to the response provided above for NRW/D12/3 General comments. Concerning sediment mobilisation, we agree that the primary investigations into changes in bed shear stress underpin the assessment of potential impact upon the Esgair Gemlyn shingle ridge. We consider the current modelling to be proportionate and showing minimal change. Further investigation using the outputs of additional sensitivity runs undertaken since this consultation, will be carried out to refine the assessment.
"What "observational data" support the foregoing analyses? Please expand and include a figure which shows the SSC… [suspended solid concentration]…time series results recorded during the oceanographic field campaign. Table D12-10 refers to water quality samples. Where in the water column	For observational data, these data are referred to within the paragraph as those presented in table D12-10. Text has been clarified to avoid confusion. For the figure showing suspended solid concentration time series, analysis of the suspended solid concentration raw data is provided within appendix D12-2 (Application Reference Number: 6.4.81).

Key issue raised	Action taken
do these samples represent?" (NRW D12/29)	At each water quality monitoring station, samples were taken using a lund tube which captures an integrated sample of water from the surface to 10m depth (see appendix D13-1, Application Reference Number: 6.4.83).
“Was the Esgair Gemlyn Ridge breached during the 2013/14 storms? If so, individual storm events such as the 2013/14 storms should be included in the baseline wave modelling assessment and a determination made to the change in wave climate following the construction of the western breakwater. See general comments relating to SWAN wave modelling and hydrodynamic marine modelling." (NRW D12/34)	For individual rare storm events, please refer to responses provided above. There has been no previous request or agreement to model a 'design storm event'. Overall, the events that have been modelled represent 99% and 98% likely scenarios. Further investigation using the outputs of additional sensitivity runs undertaken since this consultation, has been carried out to refine the assessment (see appendix D12-3, Application Reference Number: 6.4.82).
“Are the wave heights shown in Table 12-14 typical of conditions at the Holyhead Disposal Site? As it states processes in the Irish Sea? Has an analysis been undertaken to determine if wave heights of 8-10m penetrate to the shallower regions of the disposal site. This is an important assessment given that waves are not included in the disposal modelling”. (NRW D12/37)	The Disposal Site is in open water offshore within the Irish sea, therefore typical values for wave heights are considered to be representative. The water depths at the Disposal Site are specified in chapter D12 (Application Reference Number: 6.4.12) and ranges between 35m and 100m in depth.
“Only the wave modelling includes future sea level rise scenarios. The hydrodynamic modelling includes only present day scenarios for baseline and fully built conditions.” (NRW D12/38)	The statement made by NRW is correct and is explained in appendix D13-8 (Marine hydrodynamic and coastal processes modelling) (Application Reference Number: 6.4.90). Also, please refer to response provided above for NRW/D12/3 General comments - regarding modelling of partially and fully built conditions.

Key issue raised	Action taken
“Please clarify in the text how long the temporary causeway will be in place after the western breakwater has been constructed. Will it be in place for 12months on completion of marine works? If so, then the worst case scenario footprint for the wave and current modelling should be fully built with western breakwater finished and including causeway and cofferdam.” (NRW D12/40)	Clarification is provided within chapters D1 (proposed development) (Application Reference Number: 6.4.1) and D12 (Application Reference Number: 6.4.12).
“It's important to note that the marine hydrodynamic modelling does not include potential effects for the construction period other than dredge plume modelling. Only baseline and fully built scenarios are considered in the estimation of bed shear stresses. Further hydrodynamic modelling is requested to determine bed shear stresses under combined wave and currents during construction phase.” (NRW D12/41)	For shear stresses for partially built conditions, please refer to the response provided above for NRW/D12/3 General comments. Further investigation using the outputs of additional sensitivity runs, undertaken since this consultation, has been carried out and used to refine the assessment presented in chapter D12 (Application Reference Number: 6.4.12).
“This paragraph states that the Delft3D hydrodynamic model has been used to assess the influence of the licensable marine activities associated with the Wylfa Newydd Project on the tidal currents during construction. If that is the case, then NRW advise that the results are presented in report D13.08 and include figures which show the current alteration due to construction works and bed shear stress estimates based on different extreme wave scenarios from NW, N and NE. Until this work is presented the assessment cannot conclude "Overall the work has shown that changes in tidal current speeds are minimal". (NRW D12/42)	Please refer to responses for appendix D13-8 (Application Reference Number: 6.4.90). For additional scenarios: please refer to response provided above for NRW/D12/3 General comments. Further investigation using the outputs of additional sensitivity runs, undertaken since this consultation, has been carried out and used to refine the assessment.
“States the assessment "changes in bed shear stress (and associated sediment mobilisation) due to the	Please refer to response provided above for NRW/D12/3 General comments.

Key issue raised	Action taken
presence of the new breakwater structures would be of small magnitude. The resulting significance of this localised effect upon the low value seabed receptor has therefore been assessed as minor". Until further bed shear stress modelling has been conducted (see overarching comments) NRW cannot advise further until further evidence is provided." (NRW D12/50)	Further investigation using the outputs of additional sensitivity runs, undertaken since this consultation, has been carried out and used to refine the assessment.
NRW cannot comment until further analysis is conducted (NRW D12/49; D12/51; D12/52; D12/ 53; D12/54; D12/55; D23/56; D12/57; D12/58)	Please refer to response provided above for NRW/D12/3 General comments. Further investigation using the outputs of additional sensitivity runs, undertaken since this consultation, has been carried out and used to refine the assessment.
"Individual sections of the chapter summarise the character of tidal current, wave and combined current plus wave modelling using DELFT 3D and SWAN. Unfortunately, relevant figures referred to in the chapter have not been provided (this is also true of other draft DCO ES [Environmental Statement] chapters)". (National Trust)	The relevant figures were provided for the October 2017 consultation with NRW and most had been shared previously in meetings with stakeholders. The final figures are provided as part of chapter D12 (Application Reference Number: 6.4.12).
"Table 12-4 in this chapter summarises tidal levels which are reported to be derived from measured tide gauge data at Cemaes; however, these appear to be predicted levels from Admiralty tide tables rather than measured levels. No long-term tide gauge data exist for this section for the coast. Short-term 15-minute interval tide gauge measurements were reportedly made at the jetty of the existing power station between March 2010 and February 2011, but the data are not presented in any of the reports so far made available as	The table title has been updated in chapter D12 (Application Reference Number: 6.4.12) to make it clear what tide gauge data has been used. Cemaes water levels have been removed and a summary of the temporary tide gauge measurements at the existing site jetty is provided in appendix D12-2 (Application Reference Number: 6.4.81).

Key issue raised	Action taken
part of the consultation process and no detailed comparison with predicted levels can be independently made" (National Trust)	
"Paragraph 12.3.70 refers to a comparison of Esgair Cemlyn crest level elevations based on LiDAR surveys in 2010 and 2017. Crest levels are reported for four cross-sectional profiles (P10, P8, P6, P3) which are interpreted to be those referred to in the report to the National Trust by Pye & Blott (2016), although this is not stated explicitly. The changes in crest elevation indicated by the LiDAR comparison are consistent with the pattern of change between 2010 and February 2016 reported (following RTK GPS ground survey) in the Pye & Blott (2016) report. Although a request was made to Horizon in June 2017, the May 2017 LiDAR survey data have not yet been provided for independent analysis. (National Trust)"	A copy of the 2017 LiDAR data has now been made available and shared with Professor Pye (National Trust). An updated figure (D12-10) is included within chapter D12 (Application Reference Number: 6.4.12) showing the results of comparative analyses between the 2010 and 2017 LiDAR data and selected cross sections (specifically located to concur with those reported in [RD34]. Analysis of the new LiDAR (2017) data are now integrated within chapter D12 (Application Reference Number: 6.4.12) and the sediment regime baseline (see appendix D12-2, Application Reference Number: 6.4.81).
"Paragraph 12.5.81 of the chapter concludes that a potential maximum increase in a relatively low winter wave height of 4%, indicated by the SWAN wave modelling as a result of the breakwater construction, is likely to have negligible impact on the shingle ridge (also paragraph 12.5.84). However, the uncertainty associated with climate change projections is recognized and a programme of monitoring both levels of the shingle ridge and water level in the lagoon behind is proposed. As noted in section 2 above, the potential wave climate change analysis used only time-average conditions and did not consider the potential implications of changes in extreme conditions (both wave	The analysis examined potential changes in extreme conditions with respect primarily to wave height and direction for individual storms typical of winter (high wind wave) spring-tide (high tidal wave) conditions. These were considered to be indicative of extreme conditions for the purposes of this impact assessment. While the wave period information may not be referred to explicitly, we consider the inclusion of the specific 'worst case' storm events (not on a time-averaged basis) examined in the baseline and in the future, and compared for the partial and fully built scenarios, provides a conservative investigation of the potential implication of changes and their

Key issue raised	Action taken
height and period) associated with individual storms which have greatest significance in terms of morphological change and over-washing of the shingle ridge. This issue warrants further examination including use of a numerical model such as XBeach-G". (National Trust)	significance for the purposes of this assessment. The degree of change in wave conditions was not found to warrant further examination of potential impacts upon geomorphological receptors using a numerical model. The further modelling and analysis carried out since the consultation has reduced the uncertainty associated with the modelling, such that we do not consider that monitoring is required.

Topic-specific stakeholder engagement

12.3.11 In addition to the three formal stages of consultation outlined above, topic-specific consultation has been undertaken with relevant stakeholders. Table B12-9 summarises the details of the consultation that has taken place with respect to the coastal and marine processes and geomorphology assessment.

Table B12-9 Summary of topic specific consultation

Date	Stakeholder	Title and format	Issues arising	Action taken
22 January 2015	NRW and IACC	Marine modelling workshop; face-to-face meeting in Bangor	Discussion of modelling undertaken to date, including wave modelling and future assessment works.	Agreed to keep NRW informed of progress with modelling work and results.
11 March 2015	NRW and IACC	Geomorphology and WFD; face to face meeting in Bangor	Discussion with an NRW hydromorphologist concerning guiding principles on fluvial geomorphology and a general discussion about requirements under the WFD for rivers and coasts.	Agreed to keep NRW engaged in WFD for rivers and coasts as it evolved.
2 April 2015	NRW and IACC	Marine modelling workshop; face-to-face meeting in Bangor	Update on progress with marine modelling and coastal geomorphology elements. Discussion about potential effects on sensitive receptors.	Agreed to keep NRW informed of progress with hydrodynamic and wave modelling.
21 May 2015	NRW and IACC	Marine elements workshop; face-to-face meeting	Presentation of marine options and further modelling approaches.	Agreed to keep NRW informed of progress with hydrodynamic and wave modelling.
31 May 2016	NRW	Response to EIA Progress Report	Discussion of comments including the need to agree the hydrodynamic modelling with NRW and for them to provide comment on calibration and validation studies. NRW requested Horizon: • model the updated design; • expand the study area;	Agreed to keep NRW informed of further progress with hydrodynamic and wave modelling.

Date	Stakeholder	Title and format	Issues arising	Action taken
			• model the effects of structures on waves, currents and sediments; • determine plume effects and dredge disposal for both construction and maintenance dredging; and • provide more information on survey methods and results to be able to provide comment on the suitability of the baseline understanding on which the impact assessment is based. There were separate comments on the need to consider (as appropriate) significant impacts on geological features comprising the Regionally Important Geological Site.	
30 September 2016	NRW	Approach and progress with coastal processes and coastal geomorphology	Meeting to discuss coastal processes and coastal geomorphology progress. Focused on methods and the types of scenario NRW would like to see included.	Agreed to keep NRW informed of progress with hydrodynamic and wave modelling.
31 October 2016	NRW	Marine modelling methodology meeting (update); face-to-face with audio-visual and telephone conferences.	Meeting to discuss coastal processes and coastal geomorphology progress. Focused on methods and the types of scenario NRW would like to see included.	Agreed to keep NRW informed of further progress with hydrodynamic and wave modelling.
9 December 2016	NRW	Marine modelling and coastal processes update meeting	Meeting to discuss approach to coastal processes and coastal geomorphology.	Agreed to keep NRW informed of progress with hydrodynamic and wave modelling and

Date	Stakeholder	Title and format	Issues arising	Action taken
				coastal processes and coastal geomorphology assessment.
17 February 2017	NRW	Holyhead North kick-off meeting	Meeting to outline approach proposed for the dredging Disposal Site at Holyhead North.	Agreed to keep NRW informed as approach to modelling of the Disposal Site develops.
27 April 2017	NRW	Marine modelling and coastal processes update meeting	Meeting to discuss progress of marine modelling, coastal process and coastal geomorphology work.	Agreed to keep NRW informed of further progress with hydrodynamic and wave modelling and coastal processes and coastal geomorphology assessment.
5 June 2017	NGOs	Marine environment meeting	Meeting in Bangor with RSPB Cymru, National Trust, North Wales Wildlife Trust and the British Trust for Ornithology to present an outline of baseline and modelling results (including some illustrative plots of effects of previous marine layouts) for coastal and marine processes and geomorphology.	Agreed to provide NGOs with an update on modelling results for the assessment (using the latest breakwater)

Date	Stakeholder	Title and format	Issues arising	Action taken
19 July 2017	NRW	Marine modelling and coastal processes update meeting	Meeting to discuss progress of marine modelling, coastal processes and coastal geomorphology work. This includes all modelling outputs and assessments likely to appear in chapter D12 (Application Reference Number: 6.4.12). NRW asked for further modelling to be undertaken, particularly in relation to different wave directions and including the interaction with the western breakwater and potential effects on Esgair Gemlyn.	New work procured to look at effects of western breakwater on the wave heights for various wind directions.
December 2017	NGO's (with NRW present)	Marine environment meeting	Meeting in Bangor with NGO's (including National Trust) with Environment Agency representatives in attendance. A further presentation on coastal and marine processes and geomorphology. Included discussions concerning the Esgair Gemlyn shingle beach.	Agreed to provide NGOs with an update on modelling sensitivity runs once available (post submission)
10 January 2017	NRW	Marine modelling meeting.	Meeting to update NRW on wave modelling results and coastal and marine processes and coastal geomorphology assessments undertaken within chapter D12 (Application Reference Number: 6.4.12).	Agreed to make some further minor changes to chapter D12 (Application Reference Number: 6.4.12) with further clarifications to be undertaken as part of consultations

12.4 Topic-specific methodologies and assessment criteria

Introduction

12.4.1 The overarching approach to the EIA, including the approach to the assessment of cumulative effects, is provided in chapter B1 (Application Reference Number: 6.4.1). This section outlines the specific methodology used to assess the effects of the Wylfa Newydd Project (specifically Marine Works) on coastal processes and coastal geomorphology. It outlines the methods and criteria used to:

- define the study area and identify topic receptors;
- establish the environmental baseline for topic receptors; and
- determine the value/sensitivity of receptors, the magnitude of change and significance of effect.

Assessment of parameters

12.4.2 As outlined in chapter B1 (Application Reference Number: 6.4.1), the approach adopted for the design of the WNDA Development, Off-site Power Station Facilities and Associated Development is to set parameters, where necessary, for the extent of the development and key aspects of that development. The final design and construction methodology would be limited to these parameters and limits of deviation. The approach to assessment of effects on coastal processes and geomorphology within the context of the parameters and limits of deviation for the WNDA Development is outlined in chapter 12 within volume D (Application Reference Number: 6.4.12).

Identification of study areas

12.4.3 Three separate study areas have been defined for coastal and marine processes and geomorphology and are illustrated further in chapter D12 (Application Reference Number: 6.4.12). These are described below.

12.4.4 Firstly, a study area for coastal geomorphology receptors close to the Wylfa Newydd Development Area (specifically Marine Works) potentially affected by changes to waves and currents caused by marine activities (such as the breakwater).

12.4.5 Secondly, a wider study area covering the potential extents of sediment plumes and sediment deposition on geomorphology receptors and the seabed close to the Wylfa Newydd Development Area. Fine sediment released from activities such as dredging has the potential to be carried large distances.

12.4.6 Thirdly, a study area to capture the potential extents of sediment plumes and sediment deposition on geomorphology receptors and the seabed close to the Disposal Site. Fine sediment released from activities such as disposal has the potential to be carried large distances.

Approach to defining study areas

12.4.7 TAN 14 on coastal planning [RD7] was initially consulted to allow context for the initial selection of the three study areas. This TAN indicates a major sediment cell extending along the coastline geographically, from Bardsey Sound to Great Orme, encompassing the Ynys Enlli to Llandudno Coastal Group. It also depicts a sub-cell encompassing the Isle of Anglesey. The broader hydrodynamics of this coastal cell have been taken into consideration through the SWAN model (see below) to inform the definition of the fine mesh hydrodynamic model extent for fine sediment dispersion (see appendix D-13, Application Reference Number: 6.4.82).

12.4.8 Expert knowledge of geomorphological and hydrodynamic processes operating within the wider marine environment was then applied *a priori* to initially determine the three study areas. These areas were later refined using more detailed information as it became available through the wave, current and sediment plume work. Support to these early choices was tentatively given by evidence provided in the previous work by Halcrow on coastal processes at Wylfa Newydd Development Area [RD35]. The modelling grids have the potential to be extended as far from the construction and disposal sites (into the Irish Sea and around Anglesey) as practicably needed.

12.4.9 Wave and current modelling demonstrate that potential changes in waves, currents and sediment processes (excluding fine sediment) resulting from the proposed scheme, would be highly unlikely to extend beyond the embayment. The points demarking this study area are major promontories around which it is not anticipated there would be significant littoral sediment transport. Based on field observations, it was considered (*a priori*) that there would be no changes to waves and currents caused by the marine activities at Porth-y-pistyll beyond these promontories. This was also supported by the earlier study on coastal processes at the Wylfa Newydd Development Area [RD35], albeit with a slightly different arrangement of marine structures. This has since been supported by subsequent wave and current modelling undertaken in 2016/2017.

12.4.10 Data on key geomorphological features (for coastal water receptors) were initially collected by field survey in 2014 (for a distance of approximately 2km east and 3km west from Wylfa Head, encompassing the Wylfa Newydd Development Area. Expert geomorphological assessment informed by available literature was used [RD34].

12.4.11 Studies of rocky coastlines around the United Kingdom have demonstrated that following the Holocene marine transgression, the local sediment regimes operating within coastal embayments typically act as closed systems (e.g. [RD36], [RD37] and [RD38]). In the context of present-day prevailing sea level rise conditions, the relict sediment stores that have been worked within coastal cell units are in depletion and/or being driven inland, as in Cemlyn Bay ([RD38]; chapter D12 (Application Reference Number: 6.4.12).

12.4.12 The Disposal Site is some 12.5km from the shore at its furthest point. A significant part of the Disposal Site is formed of a trench with depths in the range 70m to 100m. Elsewhere within the site, depth can be 35m to 50m.

Storm waves can affect the seabed at such depths, particularly the shallower depths stated.

12.4.13 It is known that fine sediment plumes arising from construction and disposal activities in the marine environment can extend over considerable geographical distances, eventually becoming dispersed by tides, currents and waves. As a function of the dispersal process, the depth of deposition of fine sediment on coastal features tends to decline with distance from source.

12.4.14 Due to the low sensitivity as a geomorphological receptor (see table B12-16 for an explanation of receptor valuations) of the seabed at the Disposal Site and likely dispersal processes, it is considered unlikely that sediment deposition would lead to a significant impact. However, the potential effects on marine environment receptors arising from changed coastal processes are informed by these results and assessed separately in chapter D13 (Application Reference Number: 6.4.13).

12.4.15 The study area extent has been informed by both hydrodynamic and wave modelling investigations which employ a series of nested model grids with the ability to detect changes far into the Irish Sea. The nested model grids function together as a range of resolutions, with the finest detail centred upon the proposed activity site. These nested grids are used to predict the potential effects of activities on coastal and marine processes.

12.4.16 Initially it was concluded (following discussion with NRW) that for the purpose of sediment plume modelling, a distance of two tidal excursions either side of Wylfa Head would be a reasonable starting point for determining the study area. This would include (if necessary) Carmel Head to the west and Torllwyn to the east. The tidal excursion along the north coast of Anglesey is approximately 25km to the south-west (ebb) and 20km east to south-east (flood) respectively. Subsequently, however, modelling showed there to be no discernible effects beyond the outer grid (70m medium resolution). That is approximately 2km west and 3km east of Wylfa Head. This is referred to in more detail in chapter D12 (Application Reference Number: 6.4.12).

12.4.17 Likewise modelling showed there to be no discernible effects beyond an area of approximately 1.86km^{-2} of the Disposal Site from dredging disposal. This was modelled within an area of 10.6 km^{-2} by 13km^{-2}.

Identification of changes to coastal processes

12.4.18 The approach taken to determine potential changes to coastal processes (currents, waves, fine sediments, sediment transport) arising from marine activities is based on a combination of a desk study, site walkovers and other surveys, field monitoring and wave/current and fine sediment modelling. The sources of data and information used are summarised in table B12-10. The extents of the studies are shown in chapter D12 (Application Reference Number: 6.4.12).

Data Sources

Table B12-10 Baseline data and information sources

Baseline data source	Description of data
Desk studies of seabed sediment properties	Use of published data on sediment, leading to characterisation of seabed floor and intertidal zones, see [RD33].
Subtidal and intertidal benthic habitats and species survey including sediment quality and particle size analysis	Benthic grab, drop-down camera surveys, diver transects, cores, biotope mapping and quadrat surveys. Collection of samples from the seabed and intertidal zones to assess their characteristics (physical, chemical and biological) (summarised chapter D13) (Application Reference Number: 6.4.13).
Bathymetric and geophysical surveys for seabed characterisation	Use of side-scan sonar and a sub-bottom profiler and magnetometer to characterise the seabed in the near field zone (October 2009) as summarised in [RD33].
	Use of side-scan sonar for an extended study area of the mid-field zone is summarised in [RD33].
	Sediment grabs collected in both Cemaes and Cemlyn Bay used to conduct in-house gravimetric analysis of the suspended fraction of sediment samples following approved procedures. National Laboratory Service results were used to convert turbidity (FTU) to suspended sediment concentration (mg/l).
Coastal metocean surveys	Collection of data from fixed mooring buoys to measure currents and waves (summer 2010 to summer 2011). Two moorings were located offshore from Wylfa Head (S4 and S2). There was also one mooring in the western bay (S9) and another mooring in the eastern bay (S11), see [RD33]. [RD33] is also referenced in chapter D12 (Application Reference Number: 6.4.12). Use of a bottom-mounted acoustic doppler current profiler with directional wave capability, see [RD33]. [RD33] is also referenced in chapter D13 (Application Reference Number: 6.4.13).
	Near bed optical backscatter sensor turbidity measurements for recording of suspended sediment concentration data and for sediment transport analyses.
	Vessel-based surveys to determine the depth, form and structure of the sea floor and currents, see [RD33].

Baseline data source	Description of data
	Synoptic surveys of current speed and direction throughout the water column at different states of the tide either side of Wylfa Head, the western and eastern bay transect paths and the western boundary line transect line using a vessel-mounted acoustic Doppler current profiler. Use of tidal excursion drogues.
	Fixed meteorological mast at National Grid Reference 35709307 (1km south of the Existing Power Station Site) to determine wind direction and strength. Records also available from RAF Valley on Anglesey.
	Installation of a tide gauge on the existing jetty to record tide data every 15 minutes over a 12-month period from March 2010 to February 2011 [RD33]. [RD33] is also referenced in chapter D12 (Application Reference Number: 6.4.12).
Geomorphological processes and forms study	A desk study, including examination of historical maps and images and drawing on the available hydrodynamic information. Subsequently, a coastal geomorphology walkover survey was undertaken on 19th and 20th November 2014 and is presented in appendix D12-1 (Application Reference Number: 6.4.80)
Other sources (including publicly available)	• Ordnance Survey 1:10,000 and 1:25,000 maps; • Geological maps (British Geological Survey [RD39]; • UK Hydrographic Office; • British Oceanographic Data Centre; • Guidance documents and publications from the Department for Environment, Food and Rural Affairs; • Cemlyn Bay and Adjoining Areas, Anglesey: Geomorphological Assessment. [RD34] for National Trust Wales; • WFD water bodies and catchment information taken from websites • MAGIC [RD40]; and • *Western Wales River Basin Management Plan 2015–2021* [RD14].

12.4.19 The data sources for the Wylfa Newydd Development Area and the Disposal Site are presented separately below.

Wylfa Newydd Development Area

12.4.20 A preliminary hydrodynamic investigation undertaken by Titan in August and September 2009 [RD33] highlighted that the marine area within and around the Wylfa Newydd Development Area experiences complex flow regimes and is also subject to seasonal variations due to density gradients in the Irish Sea. To build upon this initial work, Titan was further commissioned to undertake longer-term monitoring of flows initially over a 20-month period between July 2010 and May 2012. This was to understand the variability in the hydrodynamics and hydrological parameters, both temporally and spatially in the short-term due to tidal effects and in the longer term due to seasonal effects. The Titan field programme consisted of long-term (one-year deployment) fixed point current meter moorings and hydrological observations at four locations. The location of the fixed moorings is shown in chapter D12 (Application Reference Number: 6.4.12). This work [RD38] is referred to in chapter D13 (Application Reference Number: 6.4.13).

Bathymetry

12.4.21 The collection of additional bathymetric data by Titan in 2009, 2011 and 2012 [RD33] used a single-frequency echo sounder. Seabed mapping was achieved using a sidescan sonar system collected via towfish. Further details are given in table B12-10.

Geology

12.4.22 A baseline description and assessment of potential impacts of the proposed development upon soils and geology is provided in appendix D7.2 (Application Reference Number: 6.4.25).

12.4.23 For the purposes of this chapter, the bedrock and drift geology underlying the coastal and marine geomorphological features has been informed by the British Geological Survey [RD39] as well as British Geological Survey interactive mapping tools. These data were validated by a wide range of other field observations.

Sediments

12.4.24 A report describing the baseline sediment regime and characterisation is appended to chapter D12 (Application Reference Number: 6.4.12). See D12.2 (Application Reference Number: 6.4.81)

12.4.25 Data derived from an offshore geophysical survey by Fugro [RD41], environmental sonar survey and seabed sediments [RD33] have been combined using spatial analysis tools in ArcGIS to create integrated maps of offshore seabed features identified within the offshore drift deposits.

12.4.26 Additional sediment observations and sampling are reported in appendix D13-2 (benthic ecology report) (Application Reference Number: 6.4.84). Geotechnical investigations have been collected together to build a complete picture of geomorphological feature character and function in relation to biotic interactions, for example where marine macrophytes could affect patterns of deposition and/or erosion. These inform the potential effects of changes in coastal processes (seabed erosion, transportation and deposition). These

data provide particle size analyses and, from boreholes, sediment thicknesses.

12.4.27 Measurements of suspended sediment concentration were taken between 12 May 2010 and 12 October 2011 (appendix D13-1) (Application Reference Number: 6.4.83). These concentrations were collected at both ebb and flood tides, at depths producing both surface and mid-depth samples, on a monthly basis.

Disposal site

The Disposal Site for the Wylfa Newydd project is the newly licensed Holyhead North (IS043) site. The baseline for this site has been largely derived from the Environmental Statement and supporting technical appendices for the Minesto Deep Green Holyhead Deep Project [RD42] supported by targeted surveys.

12.4.28 High resolution multibeam bathymetric data were collected by SEACAMS between 2013 and 2014 showing that much of the site is 40-60m deep, although at the northernmost point reaches 100m [RD43].

12.4.29 The seabed is largely defined by the presence of an extensive subsea platform of hard pre-Cambrian rock which extends north-westerly for a distance of about 25km offshore. There are patches of exposed bedrock or bedrock overlain thinly by boulders and lag gravel. There are some areas with the remains of glacial moraines. It is an area of overall tide-scoured rough ground [RD44]. Benthic grab samples taken between 2013 and 2014 found a range of sediments from very coarse gravels to coarse gravels in the south-east part of the Disposal Site to isolated areas of ‘sandy very fine gravel’ and ‘sandy medium gravel’ in the north east region [RD43]. Targeted surveys collected additional benthic faunal samples and underwater photographs and are reported in appendix D13-2 (Application Reference Number: 6.4.84)

Approach to modelling

Wylfa Newydd Development Area

12.4.30 A combination of numerical modelling tools has been employed to assist in determining the magnitude of the potential effects of marine activities on coastal processes at regional and local scales (table B12-11). The models were chosen by a range of experts advising the project. The Delft3D coastal modelling software provides hydrodynamic (2D and 3D), wave, sediment transport and water quality outputs. The SWAN wave model was originally chosen to look at the impacts of overtopping of the new breakwater. However, this was extended using numerically simulated wave propagation towards the Cemlyn Bay shore and agitation into the harbour. This work was undertaken by HR Wallingford and forms appendix D12-3 (Application Reference Number: 6.4.82).

12.4.31 Using the parameters of the HR Wallingford wave model a Delft3D model was also set up to look at the impacts individually of waves and currents combined (as well as singularly) appendix D13-8 (Application Reference Number: 6.4.90).

Table B12-11 Sources of data used in the characterisation of coastal and marine processes

Coastal process	Regional scale (far field)	Local scale (near field)
Waves	SWAN	Artemis/ SWAN and Delft3D
Currents (tidal flow)	Delft3D	Delft3D
Sediment (plumes)	Delft3D	Delft3D and empirical methods including overlay of bed shear stress over sediment types and thicknesses maps

Wave modelling

12.4.32 The locally complicated coastline of the Wylfa Newydd Development Area presents a challenge for wave modelling, as it includes west-, north- and east-facing elements. This is included in appendix D12-3 (Application Reference Number: 6.4.82). An additional difficulty for wave modelling is that, whilst the highest wave conditions a short distance offshore come from broadly westerly directions, the highest wave conditions at the Wylfa Newydd Development Area come from broadly northerly directions (see appendix D12-3) (Application Reference Number: 6.4.82). The SWAN model (with Artemis inside the harbour area) has been used to predict the effects of waves moving from offshore to nearshore. This is a third generational spectral wave model which can simulate the transformation of waves as they travel closer to the shoreline. This considers the following processes:

- wave shoaling;
- wave refraction;
- depth-induced breaking, bottom friction and whitecapping;
- wave growth due to the wind;
- wave reflections from structures and rocky shorelines; and
- far-field wave defraction around headlands.

12.4.33 The SWAN model area includes all of the north coast of Anglesey, has a grid size of 20m in the surf zone and extends offshore to a seabed level of at least -30m Chart Datum. It was used to transform the 35-year time series of offshore WaveWatch III regional wave model data to equivalent information for offshore from the Wylfa Newydd Development Area. The SWAN model and results have to provide input to other wave modelling studies. In particular, this includes a determination of bed shear stresses pre- and post-development using Delft3D.

12.4.34 A number of construction scenarios representing worst case have been considered within the wave model.

12.4.35 Further information on the wave modelling approach is presented in appendix D12-3 (Application Reference Number: 6.4.82).

Tidal current modelling

12.4.36 The Delft3D hydrodynamic model has been used to assess the potential influence of the activities associated with the Wylfa Newydd Project (particularly Marine Works) on the tidal currents in the study area during construction and operation. In particular, this determines changes to current speeds and associated bed shear stress.

12.4.37 Tidal current dynamics in the eastern Irish Sea and Liverpool Bay have been studied extensively over the past few decades [RD45]. This has led to the development of a number of regional models at the scale of the Irish Sea. Horizon's Phase 2 hydrodynamic model has been developed to simulate the marine environment around the Wylfa Newydd Development Area and up to 50km offshore (see appendix D13-8, Application Reference Number: 6.4.90) and at the Disposal Site (see appendix D13-12, Application Reference Number: 6.4.94). The Delft3D model is based on the Dutch Continental Shelf Model developed by Deltares which includes the Irish Sea and has been used extensively to model marine and coastal infrastructure developments. The model utilises bathymetric (depth of seabed) data collected during targeted surveys for the proposed development and also from hydrographic charts.

12.4.38 The model design includes two 3D grids nested within an outer 2D grid, providing the high-resolution outputs necessary to enable an assessment of different scenarios. The finer resolution discharge, mixing outputs for the near field modelling, are provided by tools which include Delft3D, computational fluid dynamics, other physical models, process/analysis packages and a geographical information system. These tools are industry standard and are considered to be well proven.

12.4.39 The model has been well validated, most recently using data sets gathered by Titan between 2009 and 2012. The accuracy and robustness of any modelling output is reliant on the most up-to-date input data being provided and on the resolution that the models and tools use. This is what has been used. It is not unusual to use data sets 5 to 8 years old, particularly in situations where the sea floor and coastal landforms are anticipated not to change significantly over short timescales. The results reported in chapter D12 (Application Reference Number: 6.4.12) represent those based upon the best available model outputs and the most up-to-date site parameter information.

12.4.40 The scenarios chosen for modelling and listed in table B12-12 were selected in consultation with NRW, to investigate the baseline and 'worst case scenarios' for potential changes to the existing coastal processes resulting from the proposed development, and subsequent effects upon coastal geomorphological and associated marine ecology receptors.

12.4.41 Each of the outputs is plotted spatially and then compared with the sediment information to determine any potential changes, using ArcGIS overlays.

12.4.42 Delft3D has been used to couple waves and currents (using the SWAN model data) to give combined bed shear stress and covered in appendix D13-8 (Application Reference Number: 6.4.90).

Table B12-12 Scenarios selected for modelling

Type	Currents, waves or combined (shear stress)	Description	Output
Baseline	Tides (spring and neap).	Without development.	Map of tidal currents.
Baseline	Waves and currents (shear stresses).	Typical summer wave conditions (10:1 wave condition taken as representative).	This run provides a map of wave height and period. It gives the relative importance of currents and waves affecting bed shear stress.
Baseline	Waves and currents (shear stresses).	Typical winter wave conditions (10:1 wave condition taken as representative).	Provides a map of wave height and period.
Baseline	Extreme waves and currents (shear stresses).	For spring tide only.	Provides data to inform sediment mobility assessment (i.e. excess shear stress).

Sediment Movement

12.4.43 Delft3D has also been used to determine the dispersion of suspended sediments and rate/depth of deposition resulting from fugitive dredged sediments. The model allows for tracking the 3D movement of the sediment particles. This has been applied at the Wylfa Newydd Development Area and at the Disposal Site (see appendix D13-8, Application Reference Number: 6.4.90 and appendix D13-12, Application Reference Number: 6.4.94).

12.4.44 The Delft3D model has been coupled with the SWAN wave model to provide a description of baseline conditions and to assess the potential effects arising from the Marine Works. Bed shear stresses are calculated from these models for currents and waves singularly and in combination. The outputs are placed in geographic information system and an excess shear stress map compiled to enable the significance of excess bed shear stress caused by the marine activities to be determined.

Modelling setup

12.4.45 Table B12-13 outlines the scenarios for construction and operation that were selected.

Table B12-13 Scenarios for construction and operation

Type	Currents, waves or combined (shear stress)	Description	Output
Construction	Effects upon hydrodynamics and waves combined with the fate of sediment plumes.	This shows the fate of sediments from fluvial and dredge inputs. Changes in currents, bed shear stress, deposition rates (including remobilisation) are determined. Scenario assumes two weeks of dredging followed by two weeks of re-suspension.	Graphics showing changes to tidal current field and changes to wave climate.
Construction	Extreme wave.	This scenario does not include dredge sediment inputs but does include fluvial inputs. Since dispersal of dredge material is sensitive to tidal phase, this run considers ebb versus flood coincident operations. Re-suspension on extreme wave condition assumed.	Graphic showing effects on fine sediment.
Operation	Tides (spring and neap).	With development.	Map of tidal currents.
Operation	Typical wave run for winter.	This scenario addresses changes in currents, bed shear stress and deposition rates (including remobilisation). It helps to determine if/where land outfall contribution of suspended sediments might potentially be distributed as a consequence of the development.	Graphics showing changes to tidal current field, changes to wave climate, to show the fate of sediments from fluvial inputs.
Operation	Typical wave run for summer.	Change in currents, bed shear stress, deposition	Graphic showing changes.

Type	Currents, waves or combined (shear stress)	Description	Output
		rates (including remobilisation).	
Operation	Typical wave run for winter extreme wave condition.	Change in currents, bed shear stress, deposition rates (including remobilisation). This run helps determine if/where a land outfall contribution of suspended sediments might potentially be distributed as a consequence of the development.	Graphic showing changes.

Disposal Site at Holyhead North

12.4.46 The Delft3D model was used for various scenarios of currents (see appendix D13-12, marine modelling of the Disposal Site, Application Reference Number: 6.4.94). Inclusion of waves in the model and was also used to sensitivity test to determine if waves help with dispersion of the fine sediment. It was found that they do help with dispersion so waves were therefore excluded from the modelling runs as a conservative approach.

12.4.47 The model scenarios (1-6) are shown in table B12-14. To assist comprehension of the scenarios 'Holy-TQ-Base' is a label placed by the hydrodynamic modeller. It refers to the Baseline for the Holyhead North Disposal Site based on a Technical Query (TQ) made in response to the likely nature of the dredging works. 'Chezy' refers to the roughness coefficient used in the modelling (65 being a specific value) and 'Fines' means fine sediment.

Table B12-14 Scenarios for construction and operation

Scenario ID	Description
1. Holy-TQ-Base.	Full 35 day timeframe + 7 days, no disposal of material.
2. Holy-TQ-Disposal-Once.	Single 3,500m^3 disposal + 11 days.
3. Holy-TQ-Disposal-WAVE.	Single 3,500m^3 disposal + 11 days Waves ("High Typical") included.
4. Holy-TQ-Disposal.	Full 35 day disposal timeframe + 7 days, 2 x3,500m^3 disposals per day for 35 days.
5. Holy-TQ-and-Port.	Full 35 day disposal timeframe + 7 days, 2 x3,500m^3 disposals per day for 35 days.

Scenario ID	Description
	Plus 6 x 2,500 m^3 fine material only disposals per day for 19 days associated with maintenance dredging at Holyhead Port.
6. Holy-TQ-No-Disposal-Mod.	No disposal, + 11 days, local bathymetry reduced by 1m and bed roughness increased from Chezy 65 to Chezy 30 in a client-defined area to consider hydrodynamic effects of non-mobile rock disposal in a defined area.

12.4.48 The scenarios (1-6) shown include single release, single release with waves, full disposal, full disposal programme plus port operations, rock disposal – hydrodynamic changes.

Topographic Assessment

12.4.49 A topographic assessment of digital terrain model data of the Esgair Gemlyn has been undertaken comparing historic LiDAR data with recent cross-profile dimensions (using 2017 information).

Conceptualisation of sediment movement

12.4.50 An approach involving conceptualisation of sediment transport and exchange has been used to inform the existing mobilisation of all types of sediment in relation to varying hydrodynamic conditions. This allows potential changes to be assessed in relation to high and low energy modelled scenarios. This has specifically been used to inform investigations into the mobilisation of coarse sediment in relation to potential linkages within Cemlyn Bay. Also, in combination with the recorded turbidity and water quality data, the baseline regime informs investigations into the mobilisation and deposition of fine sediments.

Scale of change to coastal processes

12.4.51 This section covers changes of coastal processes for the Wylfa Newydd Development Area (particularly Marine Works) and the changes of marine processes at the Disposal Site.

12.4.52 Whilst marine activities have the potential to alter waves and the current and sediment regime (both locally and possibly more widely), the significance of these changes cannot be assessed directly. Coastal and marine processes can only be predicted and described with respect to an established baseline. The nature of a change in current (due to a breakwater for example) can only be described by reference to known current speed in the locale and the nature of the change determined in relation to natural variability. In turn, the effects of such changes can be determined with respect to those environmental receptors influenced by changes in the speed of the current. Specific effects upon geomorphological receptors are identified in chapter D12 (Application Reference Number: 6.4.12). Effects on marine fauna and flora and water quality are assessed in the marine environment chapter D13 (Application

Reference Number: 6.4.13), having regard for the information on coastal and marine processes presented in this chapter (Application Reference Number: 6.4.12).

Criteria for determining scale of change to coastal and marine processes

12.4.53 A scale of change for coastal and marine processes (defined below) has been developed for the purposes of this assessment taking account of (as relevant) hydrodynamic (tidal) regime (see appendix D13-8, Application Reference Number: 6.4.90), wave regime (appendix D12-3, Application Reference Number: 6.4.82) and sediment regime (appendix D12-2) (Application Reference Number: 6.4.81) (including sediment plume and fine sediment deposition) arising from Marine Works in line with the EIA assessment methodology. The scale differentiates the magnitude of change as being large, medium, small or negligible, which aligns with the general EIA methodological approach to assessment of impact upon receptors. Categorisation has been defined in relation to maximum and minimum thresholds based on the professional judgement of two highly experienced geomorphologists informed by previous studies.

Identification of coastal and marine geomorphology receptors

12.4.54 The identification of geomorphology receptors (appendix D12-1) (Application Reference Number: 6.4.80) was through expert geomorphological assessment by desk study of the bathymetry, geology and sediments (of both the Wylfa Newydd Development Area and Disposal Site), field survey along the shore, and previous studies looking at the potential effect of a similar arrangement of marine activities on nearshore coastal features [RD35]. Identification and selection of key geomorphology receptors was undertaken, allowing these to be either scoped into or out of the assessment. These are dealt with in outline in table B12-15 below. A fuller explanation is provided in chapter D12 (Application Reference Number: 6.4.12).

Table B12-15 Geomorphology receptors

Geomorphology Receptor	Description	WFD water body
The seabed.	This covers the area within Porth-y-pistyll and surrounding bays west of Wylfa Head. It is also considered to be the only geomorphology receptor potentially impacted by dredge disposal at the Holyhead North disposal site.	Skerries and Anglesey North water bodies.
Cemaes Bay.	This is situated to the east of Wylfa Head within the Anglesey North water body.	Anglesey North water body

Geomorphology Receptor	Description	WFD water body
Cemlyn Bay.	This is situated within the Skerries WFD water body immediately to the west of Wylfa Head.	Skerries water body
Esgair Gemlyn.	A shingle beach situated about 400m from the Power Station Site at its central point, protected as part of the Cemlyn Bay SAC.	Cemlyn Lagoon water body
Cemlyn Lagoon.	This is designated as a SAC and SSSI and is also covered by the Ynys Feurig, Cemlyn Bay and the Skerries SPA. The existence of the lagoon is dependent on the presence of Esgair Gemlyn.	Cemlyn Lagoon water body
Hen Borth Cliff	A geological SSSI which is an important (cliff) exposure of a glacial drumlin feature, located approximately 1,500m from the Power Station Site at its central point.	Skerries water body

12.4.55 With the exception of the Disposal Site these receptors are all aligned with the hydromorphological elements of the EU designated water bodies in the study area, namely the Skerries, Anglesey North and Cemlyn Lagoon water bodies.

12.4.56 Due to the position offshore and depth of water, the seabed represents the one potential geomorphology receptor selected for Disposal Site study area.

Identification of baseline conditions for geomorphological receptors

12.4.57 Information on the baseline conditions was obtained through a desk study drawing on various sources such as site designations and other literature. A field survey was also undertaken along the shore over a two-day period in 2014, it was coincident with low tides as far as possible, so as to visually see as much of the shoreline as possible. This survey allowed characterisation of the coastline. Existing sediment grab samples, geotechnical investigations and bathymetric surveys were all used to characterise the environment below the low-tide mark.

12.4.58 The hydrodynamic model and baseline sediment regime study also provided information on the processes and functioning of the geomorphological features, in particular in relation to the evolving baseline.

12.4.59 Further investigations into the baseline form and dynamics of the Esgair Gemlyn shingle ridge and shoreline were undertaken using LiDAR digital terrain model data flown in 2010 and 2017. These investigations were concerned in particular with the understanding of morphological and

volumetric changes in response to recent storm events. These findings are reported in both chapter D12 (Application Reference Number: 6.4.12) and appendix D12-2 (Application Reference Number: 6.4.81).

Assessment of effects on geomorphological receptors

12.4.60 The assessment of the potential effects on geomorphology receptors is evidence-based, informed by observed and modelled baseline information and scenario outputs, with interpretation led by professional judgement and expertise. There is no published technical guidance identifying criteria for assessing and evaluating effects on coastal geomorphology within the context of an EIA. The assessment is therefore based on the EIA methodology for the Environmental Statement in general in chapter B1 (Application Reference Number: 6.4.1) with topic-specific adjustments informed by other types of assessment, such as the UK Technical Advisory Group guidance for WFD assessment [RD31]. The following sections describe the criteria used for evaluating environmental effects.

Value of receptors

The criteria used to determine the importance (value/sensitivity) of the receptor under consideration are defined in table B12-16.

Table B12-16 Criteria for value of a geomorphology receptor

Value/ sensitivity	Topic-specific criteria
High	• Receptor is of international/national importance, e.g. a geological/geomorphological SSSI or an ecologically-designated SAC, SPA or SSSI which is heavily dependent on its geomorphology, or an area which meets the published selection criteria for designation, irrespective of whether or not it has yet been notified. • Receptor occupies a very small part of the study area. • Receptor is rare or uncommon on an international or national scale. • Receptor has important natural characteristics. • Receptor has high economic value.
Medium	• Receptor is of regional/county importance, e.g. it is a designated feature. • Receptor occupies a relatively small part of the study area. • Receptor is rare or uncommon on a regional/county scale. • Receptor has moderate natural characteristics. • Receptor has moderate economic value.
Low	• Receptor is of district/local importance, e.g. it is a designated feature of a local site.

Value/ sensitivity	Topic-specific criteria
	• Receptor physically occupies a relatively large part of the study area. • Receptor is relatively common. • Receptor has some natural characteristics. • Receptor has low economic value.
Negligible	• Receptor is of very low importance. • Receptor is ubiquitous covering a very large part of the study area. • Receptor is abundant. • Receptor has very few or no natural characteristics. • Receptor has very low/no economic value.

Magnitude of change

The magnitude of effects in relation to the geomorphology receptors has been evaluated and quantified using the scale large, medium, small, or negligible as defined within table B12-17. The magnitude of change to a geomorphology receptor is different from the scale of change determined for coastal processes. This is because a value can be given to a geomorphology receptor and in turn a significance of impact ascribed. Coastal and marine processes (such as waves, currents or sediment particles) do not in themselves have a value and only their change in magnitude can be assessed.

Table B12-17 Criteria for magnitude of change of a coastal geomorphology receptor

Magnitude of change	Topic-specific criteria
Large	• The activity is likely to permanently affect the integrity of the receptor in terms of the coherence of its structure and function and could affect the status of the receptor. • The receptor is degraded to the extent that natural characteristics are destroyed. Receptors experience continuous, irreversible, long-term change. • Recovery, if it occurs, would be expected to be long-term, i.e.10 years after the source of effect has been removed.
Medium	• The activity is not likely to permanently affect the integrity of the receptor, but the effect is likely to be substantial in terms of its structure and function and could affect the status of the receptor. • Receptor is degraded to the extent that essential natural characteristics experience a reduction in number or range in the medium to short term. Receptors experience frequent intermittent change.

Magnitude of change	Topic-specific criteria
	• Recovery would be expected to occur in the medium term, i.e. within five years after the source of effect has been removed.
Small	• The activity would not permanently affect the integrity of the receptor, but receptors could experience some limited degradation. • Disturbance is experienced within the range of natural variability in the medium to short term. Receptors experience intermittent infrequent change. • Recovery would be expected to occur in the short term, i.e. within one year after the source of effect has been removed.
Negligible	• The activity would not permanently affect the integrity of the receptor and there would be little or no degradation. • Disturbance is experienced within the range of natural variability in the short term. Receptors experience occasional change. • Recovery would be expected relatively quickly, i.e. less than six months after the source of effect has been removed.

Assessment of significance

12.4.61 Across the Wylfa Newydd Project, the approach in general is to consider that an environmental effect may be significant if, in the professional judgement of the expert undertaking the assessment, it would meet at least one of the following criteria:

- it leads to an exceedance of defined guidelines or widely recognised levels of acceptable change;
- it is likely that the consenting authority will reasonably consider applying a planning condition, requirement or legal agreement to the consent to require specific mitigation to reduce or overcome the effect;
- it threatens or enhances the viability or integrity of a receptor or receptor group of concern; or
- it is likely to be material to the ultimate decision about whether or not the consent application should be approved.

12.4.62 Having described an effect on a specific receptor the EIA process requires a level of significance to be assigned to that effect. For each geomorphology receptor the value (or sensitivity) is taken and combined with the magnitude of change derived from hydrodynamic and/or wave modelling results (such as change in bed shear stress or change in wave height caused by the marine activities). Significance is assigned using a pre-assigned matrix used across all topics included in chapter B1 (Application Reference Number: 6.4.1). Therefore, a minor change of bed shear stress acting on the sediments on the seabed (which is itself assigned a low value) leads to a minor or insignificant effect.

12.4.63 Arrival at a particular level of significance must necessarily draw upon a number of factors including industry and professional guidance and advice from statutory consultees and other stakeholders, as well as professional judgement of the assessors. Such a bespoke approach is necessary as each physical environment/geographical location is unique and where supporting scientific information/data/evidence is absent then this needs to be substituted by professional judgment.

12.4.64 Professional judgement or reasoned argument in this context means the application of relevant training, knowledge and experience, informed by relevant up to date studies and research from published papers and other literature.

Limitations

12.4.65 As a consequence of the extremely large tidal range and tidal currents, surface sediments are kept in a state of constant flux within the study area due to the dynamic nature of the sub-tidal and intertidal zones. The nature of changes to coastal and marine processes is highly variable both temporally and spatially. Variations may occur over a single tidal cycle, seasonally or over a period of many years. Changes to tidal currents may be more marked at peak flood. Seasonal changes of wave climate could also mean that different changes occur at different times of the year. Changes in coastal and marine processes can also vary according to location; i.e. there could be an increase in tidal currents (for example) at one location and a decrease at another. Specific limitations and assumptions are covered in the following baseline and modelling appendices: appendix B12-1 (Application Reference Number: 6.4.80); appendix B12-2 (Application Reference Number: 6.4.81); appendix B12-3 (Application Reference Number: 6.4.82); appendix B13-8 (Application Reference Number: 6.4.90); and appendix B13-12 (Application Reference Number: 6.4.94).

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