17. Marine Ecology

17.1 Introduction

17.1.1 This chapter presents a preliminary assessment of the likely significant marine ecology effects arising from the Moorside Project. Pathways of effects from the Moorside Project on marine ecology receptors have been identified as those originating from the construction and operation of the marine and coastal structures and activities of the Moorside Power Station (MPS), namely the Circulating Water System (CWS), Beach Landing Facility (BLF), Marine Off-Loading Facility (MOLF) and breakwaters. The Accommodation Sites and the Additional Sites are, therefore, not considered further in this chapter. The assessment of change to marine ecology receptors is also of relevance to other environmental receptors, notably birds (with the effects on these assessed in **Chapter 19, Ornithology**) and **Chapter 10, Socio-economics and Human Population** (in particular the fisheries section). Underwater noise will be considered within this marine ecology chapter.

17.1.2 The assessment of change to marine and coastal physical processes in **Chapter 15, Marine and Coastal Physical Processes** is of relevance to this chapter as marine physical processes indicate the magnitude and extent of indirect effects from the Moorside Development on marine ecology. The linkages between marine and coastal physical processes and marine ecology are presented in **Figure 15.2**. In addition, the outcomes and results from **Chapter 16, Marine Water and Sediment Quality** are of relevance to this chapter as any changes to water and sediment quality may have an effect on marine ecology receptors.

17.1.3 **Chapter 5, Noise and Vibration** only deals with airborne noise and does not consider underwater noise. Effects from underwater noise will be assessed at a high level within this marine ecology chapter. For the Environmental Statement (ES), modelling of underwater noise resulting from the construction of the MOLF and increase in vessel traffic will be carried out. This model will aid in establishing the propagation of underwater noise created from the Moorside Project and will also contribute towards refining the environmental measures for minimising adverse effects from noise.

17.2 Limitations of the PEIR

General

17.2.1 The scale and complexity of the Moorside Project means that it is continuing to evolve at this preliminary stage, which presents limitations in terms of programme and phasing. In addition, survey data analysis work has yet to be fully completed for certain elements.

17.2.2 Decommissioning has not been specifically assessed within the PEIR, as it remains uncertain at this point which elements would be decommissioned and

when. The decommissioning phase of each Moorside Project Site will be assessed in the ES. As discussed at **Section 2.6**, decommissioning of the Moorside Power Station itself will also be included within the ES, but at a high level given that these activities will take place around 60 years after operations commence, and they will be covered by a discrete EIA of the activities at that time.

Technical

17.2.3 All marine ecology survey work described within this chapter was undertaken across the Marine Survey Area, as identified in **Figure 17.1**. As all survey design was based on the project information available at the time; further surveys may need to be undertaken, where necessary, as the Moorside Project evolves. Details of any further survey work undertaken will be reported on in the Environmental Statement (ES) that will accompany the application for a DCO in 2017.

17.2.4 The Biodiversity Management Strategy (BMS) (which will encompass the Mitigation Plan (MP), Habitat Enhancement Plan (HEP) and Habitat Management Plan (HMP)), and a Construction Environmental Management Plan (CEMP), an outline of both documents accompanies the PEIR in **Appendix 18.A** and **Appendix 2.A**, are still being developed and will continue to develop as the Moorside Project evolves (see **Section 17.6**). Again, these documents will be submitted as part of the ES that will accompany the application for a DCO in 2017. This impact assessment has been undertaken assuming that effective embedded biodiversity mitigation measures will be adopted by the Moorside Project.

17.2.5 Certain assessments of significance require hydrodynamic, thermal plume and sediment modelling which, at the time of writing this chapter, have not yet been completed. Furthermore, the full extent and location of the marine infrastructure is yet to be finalised. As such, the impact assessment on marine ecology stated in this chapter is preliminary; professional judgement has been used to develop a range of potential effect levels for each receptor. These effect levels and potential significance are not final, therefore, and may be amended as design work continues to iterate and as environmental assessment work continues to be undertaken; accordingly, the assessment of significance contained within this chapter may be revised within the Environmental Statement (to be submitted as part of the application for a DCO for the Moorside Project in 2017).

17.3 Policy and legislative context

Policy context

17.3.1 Issues that are highlighted in national policy documents that are of specific relevance to defining the scope of the assessment of marine ecology are listed below.

National Policy Statement EN-1 (NPS EN-1)

17.3.2 Sections 5.3 and 5.5 of National Policy Statement EN-1 (NPS EN-1) relate to the marine ecology aspects of the Moorside Project. To satisfy Section 5.3, the applicant must:

- *Ensure that the ES 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. The applicant should provide environmental information proportionate to the infrastructure where EIA is not required to help the Secretary of State consider thoroughly the potential effects of a proposed project* (paragraph 5.3.3);
- *Show how the project has taken advantage of opportunities to conserve and enhance biodiversity and geological conservation interests* (paragraph 5.3.4); and
- *Aim to avoid significant harm to biodiversity conservation interests, and where significant harm cannot be avoided, then appropriate compensation measures should be sought* (paragraph 5.3.7).

17.3.3 In relation to designated sites, Section 5.3 of NPS EN-1 provides the following guidance:

- The most important sites are those identified through international conventions and European directives. The Habitats Regulations provides statutory protection for these, and the same protection will be applied to European sites in the process of designation and to Ramsar sites (paragraph 5.3.9).
- Development consent should not normally be granted where, after mitigation, an adverse effect on an SSSI is likely. An exception should only be made where the benefits of development at this SSSI clearly outweigh the impacts on it and on the national network of SSSIs (paragraphs 5.3.10 and 5.3.11).
- Marine Conservation Zones are to be protected through application of the Marine and Coastal Access Act 2009 (paragraph 5.3.12).
- Locally designated sites require due consideration but should not be used in themselves to refuse development consent (paragraph 5.3.13).
- Opportunities for building beneficial biodiversity measures into the design of developments should be maximised (paragraph 5.3.15).
- NPS EN-1 notes that many individual wildlife species receive statutory protection. It also notes that other species and habitats have been identified as being of principal importance for the conservation of biodiversity, and that development consent should be refused where harm to these habitats and species (or the habitats of these species) would result, unless the benefits of the development outweigh the harm, and that

substantial weight should be given to biodiversity features of national or regional importance (paragraphs 5.3.16 and 5.3.17).

- Appropriate mitigation measures should be an integral part of proposed developments, and in particular that construction should be confined to the minimum area required and best practice followed to minimise risk of disturbance or damage to species or habitats, and habitats should be restored where practicable (paragraphs 5.3.18 – 5.3.20).

17.3.4 Section 5.5 outlines a number of criterion that the applicant must satisfy to demonstrate that the development is well adapted to possible coastal change. The assessment criterion is outlined in paragraphs 5.5.6 to 5.5.9. The applicant must:

- undertake coastal geomorphological and sediment transfer modelling to predict and understand impacts and help identify relevant mitigating or compensatory measures;
- include an assessment of the effects on the coast in the ES. In particular, applicants should assess various matters including:
  - the effects of the proposed project on marine ecology, biodiversity and protected sites; and
  - the effects of the proposed project on maintaining coastal recreation sites and features.
- Identify any effects of physical changes on the integrity and special features of Marine Conservation Zones, candidate marine Special Areas of Conservation (SACs), coastal SACs and candidate coastal SACs, coastal Special Protection Areas (SPAs) and potential coastal SPAs, Ramsar sites, Sites of Community Importance (SCIs) and potential SCIs and Sites of Special Scientific Interest.

Overarching National Policy Statement for Nuclear Power Generation (EN-6) (NPS EN-6)

17.3.5 NPS EN-6 makes particular reference to the need to consider effects on biodiversity arising from: changes to the groundwater regime; water discharge, abstraction and quality issues; habitat and species loss; fragmentation/coastal squeeze; disturbance events (noise, light and visual); and changes in air quality. It notes that possible mitigation options include variations to building layout to avoid ecologically sensitive areas and on-site measures to protect habitats and species and to avoid or minimise pollution and the disturbance of wildlife.

17.3.6 Section 3.9 of NPS EN-6 applies to marine ecology. In accordance with paragraphs 3.9.3 and 3.9.4, applicants must:

- consider the effects of the construction of a new nuclear power station on the groundwater regime and its effects on terrestrial/coastal habitats (in accordance with Section 5.3 of NPS EN-1); and

- undertake baseline studies on nationally and internationally important habitats and species that may be affected as a result of the development to inform the assessment of the cumulative ecological effects.

17.3.7 Section 3.8 of NPS EN-6 applies to coastal change. Under paragraph 3.8.3, applicants should "*assess the site's geology, soils and geomorphological processes in order to understand the ongoing natural ecological, coastal and geomorphic processes. This will include identifying impacts on coastal processes, intertidal deposition and soil development processes that maintain terrestrial/coastal and/or marine habitats*".

UK Marine Policy Statement (UK MPS)

17.3.8 The UK MPS is the framework for preparing Marine Plans and taking decisions that will affect the marine environment. The UK MPS will contribute to the achievement of sustainable development in the United Kingdom marine area and will ensure that marine resources are used in a sustainable way in line with high level marine objectives and in particular the following objective:

- Ensure a sustainable marine environment which promotes healthy, functioning marine ecosystems and protects marine habitats, species and our heritage assets.

17.3.9 The UK MPS outlines the vision for the UK marine area is for "*clean, healthy, safe, productive and biologically diverse oceans and seas*". The UK high level marine objectives published in April 2009 set out the broad outcomes for the marine area in achieving this vision, and reflect the principles for sustainable development and include the following relevant to this chapter:

- marine businesses are acting in a way which respects environmental limits and is socially responsible. This is rewarded in the marketplace;
- the coast, seas, oceans and their resources are safe to use;
- the marine environment plays an important role in mitigating climate change;
- biodiversity is protected, conserved and where appropriate recovered and loss has been halted;
- healthy marine and coastal habitats occur across their natural range and are able to support strong, biodiverse biological communities and the functioning of healthy, resilient and adaptable marine ecosystems;
- our oceans support viable populations of representative, rare, vulnerable, and valued species; and
- the precautionary principle is applied consistently in accordance with the UK Government and Devolved Administrations' sustainable development policy.

17.3.10 As of 11 April 2016, the MMO launched two consultations on the draft Statement of Public Participation for each marine area (North East, North West, South East and South West), and the draft Sustainability Appraisal

scoping report. The Statement of Public Participation sets out whom, when and how the MMO will engage with stakeholders during the marine planning process. The Sustainability Appraisal provides an independent assessment of the marine plans at each stage in their development.

NPPF and Local Policy

17.3.11 The National Planning Policy Framework (NPPF) [Reference 1, DCLG, 2012] sets out the requirement that appropriate weight should be given to the effects of developments on: designated sites of international, national and local biodiversity importance; legally protected species; habitats and species of principal importance for the conservation of biodiversity; ancient woodland; and veteran trees. It refers to the need to avoid, mitigate or compensate for significant harm and to encourage opportunities to enhance biodiversity in and around developments.

17.3.12 Policy to be considered at a local level includes the following.

- Copeland Local Plan 2013-2028: Adopted Core Strategy and Development Management Policies (adopted December 2013): Policy ENV3 (biodiversity and geodiversity) combined and proactive approach to protect and enhance designated sites, wildlife corridors and protected species. Policy DM25 supports this policy.

Guidance

17.3.13 Guidance documents that are of specific relevance to the impact assessment of the Moorside Project on marine ecology are as follows:

- Institute of Ecology and Environmental Management (2006). Guidelines for Ecological Impact Assessment in the United Kingdom (Reference 2, CIEEM);
- Chartered Institute of Ecology and Environmental Management (2010). Guidelines for Ecological Impact Assessment in Britain and Ireland – Marine and Coastal (Reference 3, CIEEM); and
- Chartered Institute of Ecology and Environmental Management (2016). Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal. Second edition, January 2016 (Reference 4, CIEEM).

17.3.14 The Cumbria Biodiversity Action Plan (BAP), which has been prepared by the Cumbria Biodiversity Partnership, includes 39 species and habitat plans, covering over 700 individual actions to conserve and/or enhance Cumbria's biodiversity. Note that the UK Biodiversity Action Plan has now been superseded by the UK Post-2010 Biodiversity Framework.

Legislation

17.3.15 The following list of legislation is relevant to the assessment of likely significant effects on marine ecology:

- The Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR convention);
- The Convention of the Conservation of European Wildlife and Natural Habitats (the Bern Convention);
- Agreement on the conservation of Small Cetaceans of the Baltic and North Seas (ASCOBANS);
- Directive 92/43/EEC - The Habitats Directive;
- Directive 2009/147/EC - The Birds Directive;
- Directive 2000/60/EC – The Water Framework Directive (WFD) (including the Shellfish Waters Directive (79/923/EEC) repealed by the WFD in July 2013 and the Freshwater Fish Directive (2006/44/EC) repealed by the WFD in October 2013);
- Directive 2008/56/EC - Marine Strategy Framework Directive;
- European eel establishing measures for the recovery of the stock of European eel (Council Regulation (EC) No 1100/2007);
- Marine and Coastal Access Act 2009;
- The Wildlife and Countryside Act 1981;
- The Countryside and Rights of Way (CRoW) Act 2000;
- The Natural Environment and Rural Communities (NERC) Act 2006;
- The Salmon and Freshwater Fisheries Act (SFFA) 1975 (as amended under the Marine and Coastal Access Act 2009);
- Conservation of Seals Act 1970;
- Eels (England and Wales) Regulations 2009; and
- The Conservation of Habitats and Species Regulations 2010.

17.4 Data gathering methodology

Study area

17.4.1 The extent of the intertidal study area covers approximately twice the length of the spring tidal excursion in each direction from the Moorside Site coastal frontage, covering the littoral zone from St Bees Head to Drigg Point and along the banks of the River Irt for saltmarsh survey, between mean high water level of spring tides (MHWS) and mean low water level of spring tides (MLWS) (see **Figure 17.1**). This extent is defined by the tidal conditions in the area which, over a single spring tidal cycle, exhibit water movements over approximately 7 km in a NNW – SSE direction. This provides adequate coverage to support assessment of direct and indirect effects and extends far enough to include reference areas along the same stretch of coast.

17.4.2 The offshore Marine Survey Area extends to two spring tidal excursions from the Moorside Site, within the area from St Bees Head to south of the Ravenglass estuary complex and 10 km out to sea (see **Figure 17.1**). This area is also known as the Zone of Influence (ZoI), as it is the area identified as potentially being affected by the Moorside Project.

Desk study

17.4.3 A preliminary desk study and review of available data was undertaken to identify data gaps and the surveys required to fill these gaps.

17.4.4 **Table 17.1** below lists the data accessed or identified to date and its status.

Table 17.1 Third-party data sources gathered to date

Name/Topic	Brief Description	Source
Aerial photography	Aerial photography of the intertidal area in front of the Moorside Site (2009)	Environment Agency (EA) geomatics group
GIS data of Protected sites (Special Protection Area (SPA)/Special Area of Conservation (SAC)/Site of Special Scientific Interest (SSSI)/Ramsar/Marine Conservation Zone (MCZ))[1]	GIS data of Protected sites (SPA/SAC/SSSI/Ramsar/MCZ)	Joint Nature Conservation Committee (JNCC)/National Parks and Wildlife Service Republic of Ireland (NPWS)
Protected sites condition monitoring (SPA/SAC/SSSI/Ramsar/MCZ)	Condition of features of protected sites (SPA/SAC/SSSI/Ramsar/MCZ)	JNCC/SNH/Natural England (NE)/NRW/DOENI/NPWS
Data on interest features of protected sites (SPA/SAC/SSSI/Ramsar/MCZ)	Data taken from Natura 2000 data forms, Regulation 33 reports, Ramsar Information Sheets (RIS), SSSI citations and MCZ site summary documents.	JNCC/SNH/NE/NRW/DOENI/NPWS
Invasive, rare, scarce and protected species	All invasive, rare, scarce and protected species recorded within a 3 km radius of the Moorside Site	Cumbria Biodiversity Data Centre
Mapping European Seabed Habitat (MESH) data and EMODnet Seabed Habitats data	Seabed habitat maps for north-west Europe (accessed February 2016) inc. latest subtidal habitats of eastern Irish Sea Mud Basin	JNCC
Marine Theme Data	Digital Admiralty chart and Marine Theme Data (obstructions, geology, bathymetry)	United Kingdom Hydrographic Office (UKHO)

[1] Information gathered also includes data for draft SPAs (dSPA) and candidate SACs (cSAC).

Name/Topic	Brief Description	Source
Ordnance Survey (OS) mapping	OS mapping of intertidal area from St Bees to the south end of the Eskmeals Range	OS
Fish spawning and nursery areas	GIS datasets of all mapped fish spawning and nursery areas	Centre for Environment, Fisheries and Aquaculture Science (CEFAS)
Commercial fishing data	Fishing activity and fish landings for UK vessels 15 m and over from 2007 – 2011 UK Sea Fisheries Annual statistics 2012	MMO
International Bottom Trawling data	GOV trawl data of the Irish Sea	International Council for the Exploration of the Sea (ICES) - Database of Trawl Surveys (DATRAS)
Fish data	Fish monitoring data for the River Ehen and River Calder catchments 2004-2014 including salmonid monitoring on the River Ehen.	EA
Fish data	Fish monitoring data for Bowness on Solway WFD site (GB530207614700)	EA
Fish data	Irish Sea and Bristol Channel surveys beam trawl data	Cefas
Commercial fish abundance data	Fisheries landing statistics from 2008 to 2012 UK and foreign landings by port/vessel	UK Sea Fisheries
Marine mammal distribution	Review of marine mammal distribution prepared for Walney offshore windfarm EIA	The Crown Estate Marine Data Exchange
Marine mammal distribution	Atlas of cetacean distribution in north-west European waters	JNCC
Marine mammal sightings	Sightings from vessel and from land from 2007 – 2009	Manx Whale and Dolphin Watch
Marine mammal information	Background information on marine mammals for Strategic Environmental Assessment 6	Sea Mammal Research Unit (SMRU)
Marine mammal strandings	Strandings data for Cumbria from 1990 - 2014	UK Cetacean Strandings Investigation Programme (CSIP)
Marine mammal sightings	Marine mammal sightings at Liverpool Bay in 2013	Liverpool Bay Marine Life Trust
Marine mammal data	Marine mammal data obtained from the UK Digital Marine Atlas (UKDMAP)	British Oceanographic Data Centre (BODC)

Name/Topic	Brief Description	Source
Basking shark sightings	Basking shark records 1987-2013	Marine Conservation Society (MCS)
Marine ecology data - saltmarsh, benthic invertebrates, rocky shore, phytoplankton/chlorophyll a	Data collected as part of the second cycle of the River Basin Management Plan (RBMP) under the WFD for the Cumbria Coast (GB 641211630002) and Solway Outer South (GB641211630003) water bodies.	EA (Data request still being processed)
Marine benthic invertebrates	Marine benthic invertebrate samples collected by 0.1 m^2 Day grab	EA
Subtidal and intertidal habitats	GIS layers of Habitats of Conservational Importance (HOCI) and Broad Scale Habitats from MCZ features mapping	NE
Fish egg and larvae data	Larvae counts and lengths	ICES
Phytoplankton records	Phytoplankton data collected during the second cycle of the RBMP for the Cumbria Coast (GB 641211630002) water body 2011 - 2014	EA
Plankton ecology	SEA Area 6 Technical Report – Plankton Ecology of the Irish Sea	University of Liverpool
Clean Seas Environmental Monitoring Programme (CSEMP) data	CSEMP data for stations in the wider area (including past 5 years)	Marine Environment Monitoring and Assessment National database (MERMAN)/Cefas
Seabed geology	Seabed sediment type and extent of hard substrates	British Geological Survey (BGS)

Survey work

Plankton

17.4.5 For plankton sampling, Cefas were commissioned to undertake monthly plankton surveys off the Cumbrian coast, covering the area between St Bees Head and the Ravenglass Estuary. Surveys were carried out monthly on the first neap tide from April 2015 to March 2016. The December 2015 survey was not carried out due to adverse weather conditions during the month. Also due to poor weather conditions, the February 2016 survey was carried out on the second neap tide instead of the first neap tide.

17.4.6 During the surveys, the following data were collected:

- phytoplankton and water (e.g. nutrients and chlorophyll *a*) samples;

- supporting environmental data, such as CTD (conductivity, temperature and depth); and
- zooplankton, including ichthyoplankton samples.

17.4.7 No more plankton surveys are scheduled.

Intertidal zone

17.4.8 Mapping of the intertidal zone was based upon the Handbook for Intertidal Phase 1 Surveys (Reference 5, Wyn et al) and the JNCC Marine Monitoring Handbook procedural guideline 1.1 (Reference 6, Davies et al). Within the intertidal survey area, 15 transects were identified for the sampling of infauna and sediment, with three samples to be collected at each transect, covering the upper-shore, mid-shore and lower-shore elements. Points were selected to be representative of the particular section of the littoral zone. Macroalgal surveys on rocky areas followed the methods outlined within the UK Technical Advisory Group (UKTAG) Intertidal Rocky Shore Macroalgal Index method statement (Reference 7, UKTAG) and guidance given in Wells (2005; Reference 8, Wells). Areas of saltmarsh present were surveyed according to the UKTAG Saltmarsh Tool method statement (Reference 9, UKTAG) and according to the National Vegetation Classification (NVC). The survey was carried out in two parts: 28 June to 4 July 2015, and 10 to 14 August 2015.

17.4.9 Once further details of the MOLF and breakwaters are available, it is anticipated that a Phase 2 intertidal survey on the rocky biotopes will be carried out within the vicinity of the MOLF in the summer of 2016. At the same time a condition assessment of the *Sabellaria* reef within the construction zone will also be carried out. This will be reported on in the ES.

Drop-Down Video survey

17.4.10 A drop-Down Video (DDV) survey was carried out to ground-truth[2] the proposed grab sample locations and determine which were suitable for grab sampling and which could only be surveyed through DDV. The survey was carried out on 14 to 15 May 2015.

17.4.11 No more Drop-Down Video surveys are currently scheduled.

Benthic Grab Sampling survey

17.4.12 The benthic grab sampling survey followed ISO 16665:2014 Standard guidelines, using a 0.1 m^2 day grab, as recommended in UKTAG (Reference 10, UKTAG), thus also making the survey compliant under the WFD. At each sampling station, a single grab sample was collected for biological analysis; this sample was sieved through a 1 mm mesh, as recommended by UKTAG for samples from coastal waters (Reference 10, UKTAG), and the invertebrates retained and preserved for subsequent identification to the lowest taxonomic level possible. At each sampling station a separate grab sample was also

[2] Ground-truth are direct observations and samples of the seabed to provide information that can be used to interpret remotely sensed images and indirect inference of data.

collected for sediment analysis. This was subject to a visual assessment, then the sediment was retained and transported to the laboratory for particle size analysis (PSA), total organic carbon (TOC) analysis and analysis for contaminants (including radionuclides). Interstitial salinity and redox potential were also measured where interstitial water levels allowed (such measurements not being possible in well-drained sediments). The survey was carried out between 23 and 25 May 2015.

17.4.13 No more benthic grab sampling surveys are currently scheduled.

Fish surveys

17.4.14 Fish surveys were undertaken on a quarterly basis in order to characterise the spatial and temporal variations in less-mobile demersal and epibenthic invertebrate assemblages (through beam trawling) and in more mobile demersal and pelagic fish (through otter trawling). Beam trawl samples were collected using a 2 m scientific beam trawl, with a tow duration of 15 minutes, each covering approximately 1 km distance. Otter trawl samples were collected using an otter trawl of at least 10 m width, with a tow duration of 30 minutes. For both trawls, the catch was separated into species, with the number of each species being recorded. The length of all species of fish captured and commercially-important invertebrates were also recorded, prior to the catch being returned to the sea. Species were measured using the methods set out in EC Regulation 850/98 for the Conservation of Fisheries Resources through Technical Measures for the Protection of Juveniles of Marine Organisms. The four quarterly surveys were carried out in March, May, and September 2015 and January 2016.

17.4.15 No more fish surveys are currently scheduled, although it is recognised that this is dependent on availability and quality of third-party data such as, but not limited to, ICES DATRAS data, fish landings statistics, and Environment Agency fish surveys. At the time of writing this chapter, an exercise on identifying all third-party data and analysis for quality is underway.

Marine Mammal surveys

17.4.16 Twelve, monthly marine mammal surveys, between January and December 2015, were undertaken within the offshore survey area, repeating five pre-determined transects of 25 km each survey. Data were collected by a qualified and dedicated Marine Mammal Observer (MMO), following the requirements and standards of the JNCC's Joint Cetacean Protocol (JCP)[3]. All MMOs employed on the survey were JNCC-accredited and suitable breaks were built into the survey day to reduce survey fatigue and maintain acuity levels.

17.4.17 No more marine mammal surveys are currently scheduled.

[3] http://jncc.defra.gov.uk/page-5657

Consultation

17.4.18 Further to the details outlined in **Chapter 3, EIA Methodology** regarding the consultation that has taken place to date, it should be noted that consultation responses received from the following organisations have been used to inform the scope of the assessment:

- Copeland Borough Council (CBC);
- Cumbria County Council (CCC);
- Environment Agency (EA);
- Natural England (NE);
- Marine Management Organisation (MMO);
- Friends of the Lake District;
- North Western Inshore Fisheries and Conservation Authority (NW-IFCA); and
- Allerdale Borough Council.

17.4.19 This consultation has included the responses to the regular meetings and discussions held on the Survey and Monitoring Plans, quarterly update meetings, EIA Scoping Report, and consultation carried out during the course of the preparation of this PEIR. **Table 17.2** provides details of the issues which have been raised during these consultations, and a response on how they are being considered in the EIA process.

Table 17.2 Consultation responses received

Issue raised	Consultees	Response
Due to the lack of detailed information on the Moorside Project and construction methods, it is advised that marine receptors are not scoped out until the spatial extent and scope of works are confirmed.	CCC MMO	Marine receptors will not be scoped out due to the lack of clarity on construction and operational details of the Moorside Project's marine infrastructure unless it is absolutely clear from the baseline information that there is no pathway of effect from the Moorside project to the receptor.
A clearer sub-division between receptors in each of the statutory marine sites may help to clarify which receptors have been considered in respect to which impacts. The inclusion of a table summarising the ways in which different impact pathways interact with the different sites and features of sites would also be a valuable addition.	CBC	A source-pathway-receptor (SPR) flowchart was produced for the quarterly reports, outlining the ways in which different impact pathways will interact with marine receptors. This flowchart is currently being revised as more project design information is released. The revised SPR flowchart will be inserted into the ES once there is more information on the construction and operation of the Moorside Project's marine infrastructure.
It is useful if the zones of effect and infrastructure location are mapped in relation to designated sites and other receptors.	CBC MMO	This will be provided once locations of infrastructure are confirmed and will most likely be presented in the ES.
Clarification is required on the interrelationship between environmental assessment and project development, showing evidence of an integrated approach between environment and engineering.	CBC	This integrated approach is ongoing, particularly for topics like migratory fish and the design of the CWS and has been highlighted where possible in this chapter. Also, the aim is to have continuous discussions with relevant stakeholders throughout the EIA process.
The identification of receptors has been confusing in previous iterations of the PEIR, with a lot of receptors combined together mainly under designated sites.	MMO CBC	Receptors have been separated into additional groupings in this final PEIR iteration.
The proposed BMS makes no reference to mitigation for wider biological elements without protected/priority status. Ensure mitigation plans include all WFD biological elements and avoid	EA	The BMS is still in very early stages of development. The aim would be to create an integrated BMS that is appropriate for EIA and also WFD and HRA.

Issue raised	Consultees	Response
producing multiple mitigation plans to cover EIA, WFD and HRA separately.		
Considering the longevity of the proposal, preliminary assessment of potential climate change effects and natural events (e.g. storms) would be welcome (in respect of marine ecology).	CBC	This aspect is very much dependent on the marine physical processes outcomes, particularly from modelling results. As this topic progresses, effects from climate change and natural events on marine ecology will become more apparent and will be incorporated into the ES.
We welcome reference to the two recommended MCZs – 'West of Walney' & 'Allonby Bay' – in tranche 2 as requiring consideration within the EIA. We advise that Mud Hole rMCZ could be in tranche 3 of DEFRA's designation programme, and be designated by the end of 2016. It would therefore be prudent to take this into consideration within the EIA.	NE	Mud Hole rMCZ is now incorporated into the assessment.
It is advised that the principles for MCZ assessment are slightly different from European sites and SSSI assessments. It is suggest that a separate assessment is required for MCZ sites.	NE	MCZ will be assessed according to guidance and regulations and it is anticipated that a separate assessment will be carried out and reported on. It is expected that the separate assessment will be appended to the ES.
There are gaps in the scoping report with regard to data relating to fish impingement and entrainment; only 8 species of fish are identified using ICES data, and spawning and nursery areas are only given for 13 species of fish. There are potentially more than 80 species of fish known to be impinged and entrained at power station intakes in the area; no data are presented relating to impingement and entrainment at other large direct cooled power stations in the UK or proposed mitigation. These data are readily available and should be provided in any subsequent Application.	MMO	It is noted that there are more than just eight species of fish in the area, and this is highlighted in the baseline **Section 17.8**. Impingement and entrainment fish data from other power stations are currently being sought, namely from the following power stations: Heysham, Wylfa Magnox, Pembroke, Kilroot, Ballylumford, and Hunterston.
Beam and otter trawls are not considered an appropriate means to survey migratory fish. Alternative methods should be used for	CBC	Agreed that beam and otter trawls are not suitable for sampling migratory fish. As agreed with the Environment Agency, third-

Issue raised	Consultees	Response
sampling migratory fish.		party data, such as rod catch returns and river surveys will be used.
There are concerns that there is not enough mention of impacts of biocides and other effluents on receptors.	NE Friends of the Lake District	It is difficult at this stage to determine what the impacts of biocides and other effluents will be as it has not yet been determined which chemicals will be used in the CWS. However, an assumption can be made on the type of chemicals used, e.g. chlorination and where possible this is examined in this chapter.
There should be a separation between commercial fisheries and the ecology of natural fish populations.	MMO	The marine ecology chapter's focus is on natural fish populations, and not the dynamics of commercial fisheries. However, if a fish species is commercially important this will be highlighted in this chapter. Commercial fisheries will be assessed as part of **Chapter 10, Socio economics and Human Population**.
The potential impact in and around thermal plume on the fish community has not been assessed fully; the thermal plume may affect fish living within the estuarine areas (including eels) as well as migratory fish.	EA	All receptors, not just fish, will be assessed for effects of the thermal plume if there is a pathway of effect; this will be determined once the thermal plume modelling is concluded. Until then, educated assumptions have been made and will be updated for the ES.
It has been noted that no further fish surveys are scheduled. This was raised at the Quarter 4 meeting in February 2016. The MMO, along with a number of other stakeholders requested a meeting to discuss this requirement in more detail before it could be agreed that no further surveys were required. To support this assertion, NuGen were to provide justification for why only one year of survey data is sufficient to inform a baseline. To date we have not received any further communication on this issue. It is important that this issue is addressed as soon as possible to allow you opportunity to arrange additional surveys should it be determined that what has been undertaken to date is not sufficient.	MMO EA CBC	The EIA on fish population will be carried out using a combination of both survey data and third-party data. An analysis of quality and quantity of third-party data is currently underway, but initial results suggest that there is adequate quantity of good quality data from ICES/DATRAS and Cefas surveys, in addition to the large number of small-scale studies carried out in the Eastern Irish Sea. It is also our intention to arrange a meeting to discuss this issue specifically.
Impacts listed for fish does not include noise levels. Impacts of noise	MMO	Due to the uncertainty of MOLF construction, it was difficult to

Issue raised	Consultees	Response
on marine biodiversity as a potential issue should be addressed and considered in the EIA. A proposed methodology for the assessment of marine noise has not been provided. Guidance has already been provided with regard to the recommended standard for the collection of noise data.	EA CBC	determine if there were going to be any impacts from noise on sensitive receptors. Now that we have confirmation that the MOLF will be piled, the potential for noise to affect sensitive marine receptors will be included in the EIA and assessed as per guidance documents, e.g. Reference 11, Popper et al., Reference 12, Southall et al., Reference 13, Robinson et al (National Physical Laboratory) and Reference 14, NOAA.
The EA advises that they require two years of plankton data to be analysed and assessed, particularly with the WFD tool. However, both years do not have to be from surveys, one year of data can be from monitoring the EA carries out on an annual basis as long as the data is robust once it is inputted into the WFD tool.	EA	One year of plankton surveys have been carried out to date. Further data has been requested, and received, from the EA and is currently being assessed as to its suitability to be used with the WFD tool.
As per previous comments raised by the Council during quarterly meetings, no mitigation is currently presented for operational risks such as jellyfish bloom impingement on the cooling water system infrastructure.	CBC	Impingement of jellyfish blooms is being considered by the engineers in their design of the CWS.
Invasive Non Native Species (INNS) and potential impacts associated with the spread of INNS on receptors during construction and operation have not been considered.	CBC EA	INNS and effects from their spread now form part of the marine ecology impact assessment.
There is a lack of information on how the rocky foreshore will be surveyed. The design appears to focus on soft sediments and does not consider hard substrates or other habitats identified in the scoping report. The surveys are primarily designed for characterisation, MMO considers that they are not appropriate for designing a baseline intertidal survey as it will not allow robust statistical analysis required for subsequent EIA assessment. We consider that a more detailed methodology is required for rocky areas.	MMO NE	Intertidal surveys so far have consisted of a phase 1 biotope mapping survey, macroalgae survey on coastal rocky shoreline for WFD, and soft sediment core sampling. Once the location of the MOLF has been confirmed, a phase 2 survey of the rocky aspects of the foreshore and a condition assessment survey of the *Sabellaria alveolata* reef is proposed. The phase 2 survey will target the area affected (directly and indirectly) by the MOLF. The surveys will be designed according to guidelines provided by the JNCC's Marine Monitoring Handbook.

Issue raised	Consultees	Response
MMO noted the survey design for subtidal habitats is inappropriate to establish a baseline for subsequent EIA assessment. They are only sufficient for site characterisation. MMO requested additional clarification over which period the surveys will be undertaken. We noted that the original proposal of one year survey either in late spring or early summer will not provide any evidence of seasonal variability. It is recommended that guidance provided by Ware and Kenny 2011 "*Guidelines for the conduct of benthic studies at marine aggregate extraction sites*" is used.	MMO	The subtidal survey was carried out following the guidelines recommended by the MMO during the development of the SMP: Reference 15, Kenny and Ware "Guidelines for the Conduct of Benthic Studies at Marine Aggregate Extraction Sites". These are considered to be the accepted guidelines for designing a subtidal survey for EIA purposes.
We are concerned that there is little mention of the impact of the proposed fish deterrent and biocide on migrating salmonids and its knock on impact on SACs of which they are interest features. We are also concerned regarding the potential impact on the breakwater on migratory fish and whether there will be a knock on impact on the pearl mussel community's recruitment in the river Ehen as the salmon form an important part of the pearl mussels' lifecycle.	Friends of the Lake District	Fish deterrents and biocides are considered within the assessment, particularly with migrating salmonids into the River Ehen. The extent of effects from biocides will be determined through the modelling of the thermal/chemical plume. Various fish deterrents will be considered, e.g. strobe lighting to deter eels from entering the intake, although the efficacy of this deterrent will be measured against levels of water turbidity.
Habitat loss and general impacts of the footprint of scour protection are not well considered (in the January marine ecology PEIR chapter). The actual area of scour protection is likely to be greater than that of the associated piles. Effect of long term presence of MOLF on intertidal habitats has not been sufficiently considered. Particularly, algae are key characteristic species of a number of biotopes that are components of the designated features and these will not grow in the shade of the MOLF.	NE	Area of scour protection and scour can only be assessed once the modelling is done. The effects of long term presence of the MOLF will be assessed once the location of the MOLF is finalised. For example, there are extensive rock scars in front of the Moorside development that are barnacle and periwinkle dominated, with occasional to rare algae extents; therefore, effects from shade on algae will be minimal to non-existent if algae is not present.
The choice of receptors throughout all the PEIR marine chapters appears to confuse requirements under Environmental Impact Assessment (EIA) and Habitats Regulation Assessment (HRA) which are very distinct processes. For example, only designated sites	MMO	Grouping of receptors has been removed. However, designated sites have been kept in as a receptor as the integrity of the site as a whole has to be considered.

Issue raised	Consultees	Response
(SAC/MCZ) have been identified as receptors in **Chapter 15, Marine and Coastal Physical Processes**, **Chapter 16, Marine Water and Sediment Quality** and **Chapter 17, Marine Ecology** and there is no consideration of impacts to with wider environment in EIA terms. This approach means that the assessment of environmental impacts has significant gaps which we advise will have to be filled prior to submission. An EIA should assess whether a project is likely to have a significant effect on the environment, not just those receptors that are protected. In addition, there are a number of protected features/receptors within each site that may or may not be affected by different activities within each chapter, so it is not appropriate to group together 'receptors' by designated site. By grouping the receptors in this way it appears as though only protected sites have been assessed.		
MMO advises that there should be a chapter, or at least a separate assessment specifically for commercial fisheries in the PEIR 'Fish and benthic invertebrates have been combined together as a potential receptor with a broad description of the predicted impacts.	MMO	There is a separate assessment for commercial fisheries within **Chapter 10, Socio-economics and Human Population**. For the PEIR, this assessment is high level; a detailed assessment will be carried out for the ES.

17.5 Scope of the assessment

Potential receptors

17.5.1 Following initial screening of the key receptors presented in the EIA Scoping Report, the following designated sites have been identified as having the potential to be subject to likely significant effects from the Moorside Project as they are within the ZoI: Drigg Coast SAC, Solway SAC and Cumbria Coast MCZ. In addition, the following sites will be considered in the assessment: Allonby Bay MCZ, West of Walney MCZ, Mud Hole rMCZ. However, it is anticipated that Allonby Bay and West of Walney MCZs will be scoped out of further assessment during the EIA process as they are both designated for sessile features and both are situated outside the ZoI and, therefore, unlikely to be significantly affected by the construction and operation of the Moorside Project (see **Figures 17.1** and **17.2**). Although Mud Hole rMCZ is outside the ZoI, the site will be considered within the EIA assessment process due to its close proximity to the ZoI.

17.5.2 **Table 17.3** lists all the habitats and species that are protected at either international or national level, all of which have been considered in the preliminary assessment that is reported on in this chapter.

Table 17.3 Protected habitats and species that may potentially be affected by the construction and operation of the Moorside Project

Criteria	Receptors
Agreement on the Conservation of Small Cetaceans in the Baltic, North East Atlantic, Irish and North Seas (ASCOBANS)	All small cetacea (including harbour porpoise)
Appendix III of Bern Convention	Allis and twaite shad, river and sea lamprey
OSPAR list of threatened and/or Declining Species & Habitats	Allis shad, European eel, basking shark, common skate, cod, sea lamprey, thornback ray, Atlantic salmon, dog whelk, leatherback turtle, harbour porpoise
IUCN Red List (Critically Endangered)	European eel, common skate
"Annex I" Habitats Directive	Stony reef habitats *Salicornia* and other annuals colonising mud and sand Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)
"Annex II" and "Annex IV" Habitats Directive	Annex II species are grey seals, harbour porpoise, allis and twaite shad, river and sea lamprey, Atlantic salmon, and bottlenose dolphin Annex IV species are all cetacea and five species of turtle
Former UK BAP Priority	Honeycomb worm reefs

Criteria	Receptors
Habitats	Subtidal sands and gravels Mud habitats in deep water
Relevant habitats of Principal Importance NERC Act 2006	Coastal saltmarsh, coastal sand dunes, coastal vegetated shingle, intertidal mudflats, maritime cliff and slopes, blue mussel beds, estuarine rocky habitats, intertidal boulder communities, intertidal chalk, mud habitats in deep water, peat and clay exposures, Sabellaria alveolata reefs, Sabellaria spinulosa reefs, sheltered muddy gravels, subtidal sands and gravels, tide-swept channels
Former UK BAP Priority Species	**Fish**: allis and twaite shad, European eel, river and sea lamprey, Atlantic salmon, basking shark, herring, cod, monkfish, whiting, ling, plaice, mackerel, sole **Marine mammals**: common dolphin, harbour porpoise **Other**: leatherback turtle
Relevant species of Principal Importance NERC Act 2006	Allis and twaite shad, European eel, herring, basking shark, common skate, river and sea lamprey, cod, whiting, plaice, mackerel, sole, Atlantic salmon, sea trout, skates and rays, loggerhead turtle, leatherback turtle, common dolphin, harbour porpoise
Wildlife and Countryside Act 1981 – relevant species	All cetacean, seven species of turtle, allis and twaite shad, basking shark, common skate (Note level of protection varies between species.)
Conservation of Seals Act 1970	All pinnipeds and cetacea

17.5.3 In addition to the protected habitats and species listed in **Table 17.3**, the following marine receptors have also been identified as having the potential to be subject to significant effects from the construction and operation of the Moorside Project:

- fish, including, but not limited to, species such as dragonets, gobies, pipefish, gurnards, and dogfish (i.e. all fish within the Marine Survey Area with no conservation protection status);
- intertidal and subtidal habitats including non-mobile invertebrate, macroalgae and saltmarsh species (i.e. all intertidal and subtidal habitats present within the Marine Survey Area with no conservation protection status); and
- plankton, which covers phytoplankton and zooplankton - the latter includes icthyoplankton.

Spatial and temporal scope

17.5.4 The extent of the ZoI was initially calculated based on preliminary modelling work on tidal influences, which identified a maximum tidal excursion of 7 km. This was further refined to include statutory designated sites and notable species records, thus extending the ZoI to approximately 12 km north and south of the Moorside Site (from St Bees Head to Ravenglass Estuary) and

extending out to approximately 10 km offshore. Both offshore and intertidal environments are encompassed within the ZoI.

17.5.5 At this stage the temporal scope of the assessment covers the construction and operational phases of the development at each Moorside Project Site.

Potentially Significant effects

17.5.6 During the scoping phase of the EIA process, it was determined that there was no pathway of effect on marine ecology receptors from the Moorside Project except for the construction and operation of the MOLF, breakwaters and CWS. A BLF is also proposed, and this will be assessed once further details of the BLF are available. The potential effects from the construction and operation of the MOLF, breakwaters and CWS include, but are not limited to, the following.

- **Plankton**: Effects on the plankton community could arise from changes in water quality due to the thermal/chemical plume that is anticipated from the operation of the Moorside Power Station and any increase in turbidity from sediment run-off and disturbance of seabed during its construction. Effects on ichthyoplankton could also occur through entrainment into the CWS;
- **Intertidal and benthic habitats**: Effects on intertidal (including saltmarsh) and benthic habitats from noise, vibration, light, pollution from spills, pollution and sedimentation from runoff, habitat loss, scour and alterations to seabed topography and from changes in water quality and temperature due to the thermal/chemical plume during the construction and operational phases of the MPS;
- **Fish**: Have the potential to be significantly affected by temporary loss of key habitats (e.g. areas of spawning and nursery ground) through construction noise and vibration, pollution from spills, increased sedimentation, direct seabed disturbance/removal of habitat, and change to food resources. There is also the potential for entrainment, entrapment and impingement of fish in the CWS during all stages of the fish life cycle and there could be barrier effects as a result of temperature changes from the thermal plume and change in water quality from a potential chemical plume;
- **Marine mammals and turtles**: Could be significantly affected by construction noise and vibration, changes to food resource availability during both construction and operation, and potentially temporary exclusion from the area through increased noise and vibration, increased suspended sediments and direct seabed disturbance;
- **Invasive, non-native marine species:** These could be introduced during construction from vessels associated with construction activity.

17.6 Environmental measures incorporated into the proposed development

17.6.1 Details of environmental measures that have been incorporated into the overall design of the Moorside Project are set out in **Chapter 2, Project Description** of the PEIR. Specific measures relating to this environmental topic and how these have been targeted to specific marine ecology receptors at and around the Moorside Site are set out in **Table 17.4**. Where environmental measures are currently unknown, or uncertain, they are not included within **Table 17.4**. Further measures will be included in the ES for the DCO submission as they are designed and confirmed.

17.6.2 Effects on marine ecology from the construction and operation of the MOLF, breakwaters, intake and outfall seabed infrastructure and intake and outfall shafts will be minimised by the implementation of a detailed Biodiversity Management Strategy (BMS). As part of the BMS, a Mitigation Plan will be implemented, which will set out the planned work that is required specifically to mitigate effects on protected and priority species and to create habitats to offset any habitat loss. Furthermore, the BMS will also contain a Habitat Enhancement Plan (HEP) and Habitat Management Plan (HMP). The HEP will detail the work planned to deliver a positive effect on biodiversity by enhancing the nature conservation value of habitats and their associated species. The HMP will detail the planned management of retained, created and enhanced habitats, during and post-construction. The outline BMS, is included at **Appendix 18.A**.

17.6.3 Furthermore, a Construction Environmental Management Plan (CEMP) will set out how environmental effects will be minimised and effective mitigation measures embedded in activities associated with construction. The CEMP will include, for example, measures to mitigate the introduction of INNS, which will be based on the Marine Biosecurity Planning Guidance for England and Wales (Reference 16, Cook et al), during construction. An outline CEMP is included at **Appendix 2.A**.

Table 17.4 Rationale for Incorporation of Environmental Measures

Potential receptor	Predicted changes and potential effects	Incorporated measure
Moorside Site only		
Allonby Bay MCZ West of Walney MCZ Mudhole rMCZ Drigg Coast SAC Solway Firth SAC (see **Figures 17.1** and **17.2**).	Indirect disturbance to habitats and species within these protected areas from changes in sediment transport and seabed topography arising as a result of the presence of the MOLF, breakwater, and CWS intake and outfall infrastructure.	Siting and design of MOLF, breakwaters, intake and outfall structures to limit, as far as reasonably possible, changes to seabed topography and sediment transport regimes. It is envisaged that the MOLF will be a piled structure which will minimise direct blockage of sediment transport.

Potential receptor	Predicted changes and potential effects	Incorporated measure
	Potential indirect adverse effects from heat and chemical substances discharged via the CWS outfall during operation of the Moorside Power Station (including biocides and oxygen scavengers).	Use of chemicals during operation of the Moorside Power Station will comply with best available techniques (BAT) to ensure that chemical use is appropriate and controlled and that the mitigation which is inherent to the generic design of the AP1000 reactor and included in the Generic Design Assessment (GDA) is applied. Discharge quality will be regulated through conditions established by the environmental permit to ensure that adverse environmental effects are avoided. Appropriate siting and design of CWS outfall to provide adequate dispersion and dilution of thermal/chemical plumes combined with pre-treatment of effluent streams where necessary will ensure protection of the marine environment.
Cumbria Coast MCZ (see **Figures 17.1 and 17.2**).	Direct removal of sensitive habitat as a result of the construction of the MOLF and breakwater.	Careful siting of the MOLF (and breakwaters) to avoid sensitive habitat such as the honeycomb worm reef (as far as practicable). The tunnels for the CWS intake and outfall will be constructed using Tunnel Boring Machines (TBM), starting from above Mean High Water and tunnelling under the MCZ.
	Potential adverse effects from mobilisation of sediments and spills from vehicles, vessels and machinery during construction of the MOLF, breakwater and CWS intake and outfall.	Implementation of standard construction management best practice techniques (which will be outlined in the CEMP).
	Disturbance to habitats and species within this protected area from changes in sediment transport and seabed topography arising as a result of the construction and operation of the MOLF, breakwater and CWS intake and outfall structures.	Siting and design of MOLF, breakwaters, intake and outfall structures to limit changes to seabed topography and sediment transport regimes. It is envisaged that the MOLF will be a piled structure which will minimise direct blockage of sediment transport.

Potential receptor	Predicted changes and potential effects	Incorporated measure
	Potential adverse effects from heat and chemical substances discharged via the CWS outfall during operation of the Moorside Power Station (including biocides and oxygen scavengers).	Use of chemicals during operation of the Moorside Power Station will comply with best available techniques (BAT) to ensure that chemical use is appropriate and controlled and that the mitigation which is inherent to the generic design of the AP1000 and included in the GDA is applied. Discharge quality will be regulated through conditions established by the environmental permit to ensure that adverse environmental effects are avoided. Appropriate siting and design of CWS outfall to provide adequate dispersion and dilution of thermal/chemical plumes, combined with pre-treatment of effluent streams if necessary, will ensure protection of the marine environment.
Plankton	Adverse effects, such as an increase in phytoplankton blooms, due to changes in water temperature and water quality as a result of the thermal/chemical plume from the operation of the CWS, discharge of process chemicals and discharge of treated sewage.	Use of chemicals during operation of the Moorside Power Station will comply with best available techniques (BAT) to ensure that chemical use is appropriate and controlled and that the mitigation which is inherent to the generic design of the AP1000 and included in the GDA is applied. Discharge quality will be regulated through conditions established by the environmental permit to ensure that adverse environmental effects are avoided. Appropriate siting and design of CWS outfall to provide adequate dispersion and dilution of thermal/chemical plumes, combined with pre-treatment of effluent streams if necessary, will ensure protection of the marine environment.
Intertidal/subtidal habitats.	Direct removal of habitat as a result of construction of the MOLF, breakwater and CWS intake and outfall.	Siting and design of MOLF, breakwaters, intake and outfall structures to limit loss of sensitive/valued habitats, as far as practicable, combined with

Potential receptor	Predicted changes and potential effects	Incorporated measure
		habitat enhancement (where practicable).
	Potential adverse effects from mobilisation of sediments and spills from vehicles and machinery during construction of the MOLF, breakwater and CWS intake and outfall.	Implementation of standard construction management best practice techniques (which will be outlined in the CEMP).
	Disturbance to habitats from changes in sediment transport and scour arising as a result of the construction and operation of the MOLF, breakwater and CWS infrastructure. If included, there is the potential for an increase in sedimentation, and therefore smothering, of habitats due to the presence of the breakwater creating a "shadow". This will cause a decrease in water velocity that could cause the finer suspended sediments to settle out of the water column.	Siting and design of MOLF, breakwaters, intake and outfall structures to limit changes to seabed topography and sediment transport regimes. It is envisaged that the MOLF will be a piled structure which will minimise direct blockage of sediment transport.
	Potential adverse effects from heat and chemical substances discharged via the CWS outfall during operation of the Moorside Power Station (including biocides and oxygen scavengers).	Use of chemicals during operation of the Moorside Power Station will comply with best available techniques (BAT) to ensure that chemical use is appropriate and controlled and that the mitigation which is inherent to the generic design of the AP1000 and included in the GDA is applied. Discharge quality will be regulated through conditions established by the environmental permit to ensure that adverse environmental effects are avoided. Appropriate siting and design of CWS outfall to provide adequate dispersion and dilution of thermal/chemical plumes, combined with pre-treatment of effluent streams if necessary, will ensure protection of the marine environment.
Fish and ichthyoplankton.	Impingement, entrainment and entrapment of fish and other marine species during the abstraction of water for the CWS.	Design of the intake to minimise entrainment, provision of a fish deterrence system at the intake and provision of a system to collect and return fish (Fish Recovery and Return (FRR) system) and other fauna to the

Potential receptor	Predicted changes and potential effects	Incorporated measure
		marine environment.
Fish and benthic invertebrates.	Adverse effects, such as startle response and avoidance of area, from noise and vibration during construction of the MOLF, breakwater and CWS infrastructure.	If possible, avoid construction at key periods of spawning and migration.
Migratory fish.	Barrier effect from thermal/chemical plume preventing migration up river.	Appropriate siting and design of CWS outfall to provide adequate dispersion and dilution of thermal/chemical plumes, combined with pre-treatment of effluent streams if necessary, will ensure minimisation of any barrier effect.
	Barrier effect from noise generated through piling activities.	Measures to reduce the impact from piling noise on migratory fish can include the following: changing the timing of the construction to minimise disruption to migration; limiting the amount of noise generated in a given length of time; use of devices such as bubble curtains to reduce the propagation of noise; choose a piling method that limits the amount of noise produced (if possible); and altering the piling method to reduce noise emissions such as using caps (if possible). All measures will be detailed in the CEMP.
	Barrier effect from lighting on the MOLF and during construction of MOLF	Changes in artificial light intensity and duration to minimise any barrier effects. All measures will be detailed in the CEMP.
Marine mammals.	Increased levels of underwater noise during construction of MOLF, breakwater and CWS resulting in direct disturbance or harm and changes to prey distribution.	Where significant levels of underwater noise are expected to be generated, a dedicated Marine Mammal Observer (MMO) to be present on construction vessels. Under UK guidelines[4], the MMO can advise start-up delay if marine mammals are present within a certain distance of the sound source for piling operations (the exact distance will be determined based on the type of piling carried out and therefore

Potential receptor	Predicted changes and potential effects	Incorporated measure
		noise propagation and marine mammals present). If percussive piling is required, then a soft-start technique will be employed. Should it be determined that piling will have the potential to disturb marine mammals, an EPS licence[4] will be sought.

17.7 Assessment methodology

Methodology for prediction of effects

17.7.1 The EIA Regulations indicate what is to be considered when determining the impacts of proposed developments on environmental receptors. As required by the EIA Regulations, only effects that are likely to be significant require detailed assessment and these are the focus of this preliminary assessment. In combination with guidance from the Chartered Institute of Ecology and Environmental Management (References 3 & 4, CIEEM), the EIA Regulations provide a framework for the methodology adopted in this PEIR to assess the potential effects on marine biodiversity receptors.

17.7.2 The CIEEM guidance 2006 has been revised with the new edition published in January 2016. As the new guidance was published part way through the drafting of this PEIR, CIEEM guidance 2006 has been considered; any changes made to the 2016 guidance will be considered and incorporated into the Environmental Statement (ES) as necessary.

17.7.3 Due to the complexity of ecological system processes and the uncertainty of some impacts and efficacy of some mitigation measures, experienced professional judgement also plays a key role in the evaluation of features and in determining significance of effects.

17.7.4 This preliminary assessment of potential effects has been undertaken based on the expectation that mitigation measures to be set out in the BMS will be adopted as an embedded part of the Moorside Project.

Significance evaluation methodology

17.7.5 The methodology for assessing the significance of effects is outlined in **Chapter 3**, **Section 3** and combines judgments of receptor conservation value/sensitivity with an assessment of the magnitude of change (**Table 3.2**). Topic specific criteria for receptor value/sensitivity and magnitude of change are described in this section (**Table 17.5 & 17.6**). Industry guidance, including

[4] European Protected Species (EPS). Licence application may be made through the UK Government website: www.gov.uk/government/publications/european-protected-species-apply-for-a-mitigation-licence

the CIEEM Guidance (References 2, 3 & 4, CIEEM), has also influenced the specific methods and criteria used (as explained below).

17.7.6 The significance of the potential effects is guided by considering the conservation value/sensitivity of biodiversity receptors and the degree to which they may be affected (magnitude of change) by the Moorside Project. This is presented as a matrix (see **Table 3.2** in **Section 3.3**), though it should be noted that this is for guidance only as in practice the assessment involves professional judgement based on the nature of the potential impact and detailed understanding of the receptor affected.

Sensitivity

17.7.7 Determining the sensitivity (or value) of biodiversity receptors within the study area uses criteria that guide the determination of conservation value; in the assessment of conservation value, the importance of the site for those receptors present (judged on the basis of the habitats present and the level of use by the species under consideration) is taken into account. The approach of this assessment, therefore, is to consider the value of the site for the receptor under consideration and the number of individuals of that species using it rather than only considering the nature conservation importance of the receptor itself[5].

Table 17.5 Nature conservation value and associated sensitivity

Sensitivity	Conservation Values	Examples
Very High	International	A feature (e.g. habitat or population) that forms part of an internationally designated site (SPA, SAC, Ramsar, etc.). Habitats Directive Annex I habitats and Annex II/IV species (92/43/EEC). A feature that represents more than 1% of the international resource.
High	National	A feature that forms part of the cited interest of nationally designated site (SSSI, NNR, MCZ). Features listed in Schedule 1, 5 and 8 of the Wildlife and Countryside Act 1981. A feature that represents more than 1% of the national resource. Section 41 Species/Habitats of Principal Importance (NERC Act 2006).
Medium	Regional	A feature that represents more than 1% of the regional resource. Any population of a bird species listed on the BoCC Red List. LBAP species.
Low	Local	A feature that is of nature conservation value in a local context only, with insufficient value to merit a formal nature conservation designation. A wider feature of international/national/regional conservation value (as defined above), but which is only present either very infrequently; in very low numbers; or of limited extent within the study area.

[5] A species could for example be considered to be of international importance by virtue of being listed on Annex II of the Habitats Directive; though a site used sporadically by an individual Annex II species while foraging would clearly not be considered to be of international importance.

Sensitivity	Conservation Values	Examples
Very low	Negligible	A feature that is common and widespread. Loss of such a feature would not be seen as detrimental to the biodiversity interests of the area.

Legal protection of species

17.7.8 There is also a need to identify all legally protected species that could be affected by the Moorside Project in order that measures can be taken to ensure that contravention of the relevant legislation is avoided. This may include the adoption of mitigation which is acceptable to NE. By implication, therefore, it is inappropriate to assess the significance of effects within the context of species' legal protection – measures to avoid or reduce effects on such species are legally required. In certain situations, however, adherence to measures that are designed to ensure that the law is not contravened may not prevent a significant effect relating to a species' conservation value, in which case further mitigation is required to reduce the significance of effect.

Magnitude of change

17.7.9 The impact magnitude is determined by the interaction between the scale of the effect in time, area, intensity and the sensitivity of the affected receptor. It is important to note that a change resulting from a proposed development can be positive or negative and this is reflected in **Table 17.6** which sets out the criteria used to determine the magnitude of change.

Table 17.6 Criteria used to determine the Magnitude of Change

Magnitude	Description
Very high	The change permanently (or over the long-term) beneficially/adversely affects the conservation status of a habitat/species, increasing/reducing the ability to sustain the habitat or the population level of the species within a given geographic area. Relative to the wider habitat resource/species population, a large area of habitat or large proportion of the wider species population is affected. For designated sites, integrity is strengthened/compromised. There may be an increase/decrease in the level of biodiversity conservation value of the receptor.
High	The change permanently (or over the long-term) beneficially/adversely affects the conservation status of a habitat/species increasing/reducing the ability to sustain the habitat or the population level of the species within a given geographic area. Relative to the wider habitat resource/species population, a small-medium area of habitat or small-medium proportion of the wider species population is affected. There may be an increase/decrease in the level of biodiversity conservation value of the receptor.
Medium	The quality or extent of designated sites or habitats or the sizes of species' populations, experience some small scale increase/reduction. These changes are likely to be within the range of natural variability and there is not expected to be any permanent change in the conservation status of the species/habitat or integrity of the designated site. The change is unlikely to modify the evaluation of the receptor in terms of its biodiversity conservation

Magnitude	Description
	value.
Low	Although there may be some effects on individuals or parts of a habitat area or designated site, the quality or extent of sites and habitats, or the size of species populations would experience little or no increase/reduction. Any changes are likely to be within the range of natural variability and there would be no short-term or long-term change to the conservation status of habitat/species receptors or the integrity of designated sites.
Very low	A change the level of which is so low, it is not discernible on designated sites or habitats or the sizes of species' populations, or changes that balance each other out over the lifespan of a project.

17.7.10 The criteria in **Table 17.6** refer to the terms 'integrity' and 'conservation status'. For habitat areas and species, an effect is assessed as being significant if the favourable conservation status of a receptor would be changed by the Moorside Project. Conservation status is defined by the CIEEM (References 2 & 3) guidelines as follows:

- "*For habitats, conservation status is determined by the sum of the influences acting on the habitat and its typical species, that may affect its long-term distribution, structure and functions as well as the long-term survival of its typical species within a given geographical area; and*
- *For species, conservation status is determined by the sum of influences acting on the species concerned that may affect the long-term distribution and abundance of its populations within a given geographical area*".

17.7.11 The decision as to whether the conservation status of each specified biodiversity receptor has been changed has been made using professional judgement, drawing upon the results of the initial assessment of how each receptor is likely to be affected by the Moorside Project.

17.7.12 A similar procedure has been used for designated sites that are likely to be affected by the Moorside Project, except that the focus is on the effects on the integrity of each site, defined by the CIEEM (Reference 2) guidelines as "*the coherence of its ecological structure and function, across its whole area, that enables it to sustain the habitat, complex of habitats and/or the levels of populations of the species for which it was classified*". The assessment of effects on integrity draws upon the assessment of effects on the conservation status of the features for which the site has been designated. Where these features are not clearly defined, professional judgement is used to identify the interest features.

17.7.13 It is important to recognise that effects can be beneficial rather than adverse. Positive effects can be measured along the same scales of magnitude. A positive effect is assessed as being significant if development activities are predicted to cause:

- an improvement in the condition of a habitat/species population from unfavourable to unfavourable recovering or favourable (noting that condition data are only available for SSSIs but that professional judgement

has been used to apply the same principle to habitats/species elsewhere); or

- partial or total restoration of a site's favourable condition.

17.7.14 If a species' population, habitat or site is already in favourable condition, it is still possible for there to be a significant positive effect. There is, however, no simple formula for determining when such effects are significant and decisions about significance therefore have to be made on a case by case basis using professional judgement.

17.8 Preliminary assessment of residual effects

Baseline conditions

Plankton

17.8.1 Preliminary analysis has identified at least 65 different taxa of phytoplankton present within the Marine Survey Area. Whilst diatoms, dinoflagellates and microflagellates were present in the highest abundances over the nine-month survey period, ciliates, silicoflagellates, euglenophyceae and chlorophyceae were also present in smaller numbers. Diatoms and dinoflagellates were present in samples from every station of each survey, although their abundances were notably lower during the October and November 2015 surveys.

17.8.2 The macrozooplankton consisted primarily of crustaceans and ctenophores. The crustaceans included several mysid and shrimp species, as well as developmental stages of crab and other decapod taxa. Zoea of the genus Porcellana were the most prevalent of the decapod taxa; they were found in high abundances during July, August and September 2015. Ctenophore abundances peaked in June and in September 2015. Hydromedusae appeared in the samples in significant numbers between September and November and Chaetognaths formed a key feature of the zooplankton in the autumn.

17.8.3 The most abundant fish eggs observed in the samples were rockling eggs. Other abundant species included sprat and Dover sole eggs, which were found frequently between April and May 2015. Solenette and dragonet eggs were also consistently observed in samples collected up to and including the July 2015 survey. Lesser weever eggs were commonly found in samples collected in July and August 2015. High abundances of unidentified fish eggs (with no oil globules) were recorded; these eggs were either dab or flounder, since both species spawn in this location in July and August 2015. However, it is impossible to conclusively separate these species during the identification process. The most abundant fish larvae in the first two surveys were clupeidae (herrings). It was possible to positively identify some of these clupeidae as sprat; but a positive identification is only possible for specimens in good condition. Sand eel larvae were consistently observed in low numbers during the April 2015 survey. The larvae of several flatfish species, including dab, plaice, flounder, dover sole and solenette were all present in samples at

various times. Gobies have been consistently found throughout all surveys. Blenny larvae were found in surveys from June 2015 onwards, and a small number of sea bass larvae were observed in the August 2015 survey

17.8.4 Initially, concentrations of dissolved inorganic nutrients were high across the Marine Survey Area, and typical of early spring nutrient levels for the eastern Irish Sea (Reference 17, Gowen and Stewart). May and June 2015 survey results indicated the onset of the spring phytoplankton bloom, and subsequent development of zooplankton communities; both linked to the clear seasonal pattern in environmental conditions, with water column temperature increasing from April to September. Average sea surface temperatures were coolest in April (8.53ºC), increasing to over 16ºC by September. Turbidity profiles indicate that turbidity levels at all sites declined between April and May 2015, before increasing throughout the summer months, with the highest values in August, and the lowest in May 2015. Surface turbidity was generally higher in summer 2015 than in spring 2015.

Intertidal marine ecology

17.8.5 The Cumbria Coast MCZ stretches for 27 km along the Cumbrian coastline and the intertidal zone covers an area of approximately 11 km^2. It is designated for a range of habitats, namely: high energy intertidal rock, intertidal biogenic reefs, intertidal sand and muddy sand, moderate energy infralittoral rock, honeycomb worm reefs, intertidal underboulder communities and peat and clay exposures. Key habitats present within the MCZ are the cobble and boulder scars and the intertidal honeycomb worm reefs, both of which support rich communities of flora and fauna. The honeycomb worm reefs were formerly designated as UK BAP Priority Habitats and are now Habitats of Principal Importance under the NERC Act 2006. **Figure 17.3** shows the mapped biotopes within the Marine Survey Area.

17.8.6 At the northern end of the Marine Survey Area, St Bees Head supports a large expanse of littoral sand with outcrops of seaweed communities on cobble and boulder scars, forming the most extensive examples of intertidal rocky shore habitats on the north-west coast, a predominantly sedimentary coastline. From the southern end of St Bees, the intertidal environment changes to be dominated by honeycomb worm reefs on rock intersected by large boulder and cobble scars, with seaweed communities along the upper shore fringes, spanning south as far as Seascale, after which the honeycomb reefs become more sparse.

17.8.7 Between the rocky scar and honeycomb reef communities, extensive areas of sandy beach are dominated by polychaete worms, isopods and amphipods. The extensive areas of sandy beach becomes more predominant towards the southern end of the search area, with fewer areas of high and moderate energy infralittoral rock towards Ravenglass estuary.

17.8.8 Saltmarsh communities are not present in the immediate vicinity of the Marine Survey Area, but are present to the south of the wider survey area at the mouth of the Ravenglass Estuary and inland of the River Irt, part of the Drigg Dunes and Gullery, Ravenglass Local Nature Reserve (LNR) which is located

within the Drigg coast SAC and SSSI. In total seven saltmarsh community types have been recorded, of which one community (SM13 *Pucinellia maritima* saltmarsh) was divided into four sub-communities.

17.8.9 Of the seven saltmarsh communities recorded, the annual Salicornia saltmarsh community is listed as Annex 1 Habitat "*Salicornia* and other annuals colonising mud and sand" under the EU Habitats Directive (Reference 18, CEC). The other six communities are listed as Annex 1 Habitat "Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)".

Subtidal marine ecology

17.8.10 The subtidal marine environment in the vicinity of the Marine Survey Area, slopes gradually to a depth of around 30 m (25 km offshore); then becomes more variable with numerous shallow banks, approximately 50 km offshore of the Marine Survey Area. **Figure 17.3** shows the mapped biotopes within the Moorside Site.

17.8.11 During the EIA Scoping Report consultation, the "Mud Hole" rMCZ, which borders the western extent of the offshore survey area, was highlighted by Natural England as a further potential area of interest. It was advised, by Natural England, that the Mud Hole rMCZ could be in the third tranche of DEFRA's designation programme, with potential designation by the end of 2018, and will be considered in the assessment of effects from the Moorside Project.

17.8.12 The seabed sediment characteristics of the Marine Survey Area constitute muddy sediments to the north and north western extent, with silt levels decreasing to the south and east inshore along the coastline, where the sediment becomes sandier. Patches of mixed sediments are found to the north of the Marine Survey Area near St Bees Head, with a belt of mixed sediment stretching south eastwards parallel to the coastline. Outcrops of hard substrate are found in the eastern section of the search area with some small patches in the south east adjacent to Seascale and Drigg.

17.8.13 Key subtidal habitats present within the Marine Survey Area include subtidal sands and gravels, confined to the shallower inshore region along the coast and the area to the south-east of the Marine Survey Area and mud habitats in deep water, found at depths below 20 m across the survey area. These are both Habitats of Principal Importance under the NERC Act 2006.

17.8.14 Stony reef habitats, listed as an Annex I Habitat under the Habitats Directive (92/43/EEC) were found at seven of the survey stations, focused mainly in the central inshore area of the Marine Survey Area, with two patches further south, continuing seaward from the intertidal rock habitats at Whiterigg and Barn scars.

Fish ecology

17.8.15 The Irish Sea, in general, is an important area for spawning and nursery grounds of a number of commercial fish species. Nursery grounds within the Marine Survey Area have been identified for cod, spurdog, tope, herring,

mackerel, anglerfish, plaice, sandeels, spotted ray, sole, thornback ray and whiting. (Reference 19, Ellis et al.). Spawning grounds within the Marine Survey Area have been identified for ling, mackerel, sandeels, whiting, sole, plaice and cod (Reference 19, Ellis et al.).

17.8.16 All fish species caught during both the beam and otter trawl surveys were typical of that region of the Irish Sea. An initial examination of the Marine Survey Area survey data shows that the most abundant fish species present were dab, sprat, whiting and plaice. Dab abundance was found at its highest during spring and summer. Whiting abundance was very low during the winter and spring months but increased greatly during the summer months. In contrast, sprat numbers were highest during the winter months and reduced greatly during the spring and summer months.

17.8.17 In addition to the commercially important fish species caught during surveys, a number of non-commercially but ecologically important fish species were also caught. The most abundant non-commercially important fish species caught were dragonets, lesser spotted dogfish, gobies, pipefish and gurnards.

17.8.18 A number of migratory fish species are present in the Irish Sea and adjoining rivers, many of which are also SAC qualifying species. Key species present as Annex II SAC qualifying features are the Atlantic salmon, sea lamprey, and the river lamprey. In addition, the European eel, and allis and twaite shad are found in the area. The basking shark is known to migrate through the Irish Sea during the spring and summer, although none were observed during the offshore surveys carried out.

Marine mammals

17.8.19 Twelve surveys were completed, recording a total of 192 marine mammals. Of these, 137 (71%) were observed and recorded by the dedicated on-duty MMO, and will be used in further analysis; the remaining 55 animals (29%) were recorded by either bird observers on the same survey vessel, or any observer on a break from surveying: these records will be treated as incidental observations, and not included within further statistical analysis. This is based on guidance provided by the JNCC (Reference 20), which states that the MMOs should be experienced to ensure a high level of confidence in the data collected. The main species recorded were harbour porpoise (122 individuals) and grey seal (14 individuals), representing 89% and 10% of the total, respectively. In addition, a single common dolphin was recorded by the dedicated MMO. During the August survey, a single leatherback turtle was also recorded by one of the bird surveyors.

17.8.20 In a wider context, the eastern Irish Sea does not boast regular sightings of large numbers of marine mammals, in particular cetaceans. Review of Reid et al. (Reference 21) suggests that the harbour porpoise is the primary species present in the area, along with low representation of dolphin species, including common dolphin. Strandings data collected from the UK Cetacean Strandings Investigation Programme (CSIP) also supports this, with 110 of a total 148 strandings recorded along the Cumbrian coast being harbour

porpoise. There are currently no designated sites for harbour porpoise in the vicinity of the Moorside Project.

17.8.21 All marine mammal species present are protected by a range of conservation designations, including listing on Annex IV of the Habitats Directive (92/43/EEC). As with all cetaceans, the harbour porpoise is also protected under the Wildlife and Countryside Act, 1981. The grey seal is subject to protection under Annex II of the Habitats Directive, but although listed as 'present' at a number of SACs around the Irish Sea coastline, there are no significant, protected haul-outs within the vicinity of the Marine Survey Area.

Predicted residual effects and their significance

17.8.22 A summary of the preliminary assessment of the predicted residual effects (i.e. the effects taking into account the incorporated measures) with respect to the types of potential impacts upon each of the key receptors or receptor groups at the Moorside Project Site is provided in **Table 17.7**. As previously noted, only effects originating from the construction and operation of the marine and coastal structures and activities of the Moorside Project (the CWS, BLF, MOLF and breakwaters) are considered.

17.8.23 The effects resulting from the MOLF and breakwaters are primarily considered in respect of the construction phase of the Moorside Development, though where these are retained, any effects of their presence will extend into the operational period of the MPS. While it is anticipated that the longer MOLF will be decommissioned once the Moorside Power Station is in operation, it is currently understood that the shorter 500 m MOLF will be retained for maintenance purposes during the operating life of the Moorside Power Station. As such, effects as a result of the operation of the shorter MOLF that is expected to be retained are considered.

17.8.24 The evaluation table generally presents a preliminary assessment of the potential adverse effects arising from the Moorside Project unless explicitly stated to be neutral or beneficial in the rationale. Where insufficient development, and/or baseline information, is available to undertake a prediction of the magnitude of change, and therefore draw preliminary conclusions regarding the significance of effects, the respective column has been populated by an asterisk (*) only.

17.8.25 It can be seen from **Table 17.7** that significance of effect was unable to be reached for certain effects and, therefore, the respective columns have been populated by an asterisk (*). These are, in brief:

- Any effects associated with the construction and operation of the BLF. Construction methods, development design, and location of the BLF are currently unknown; therefore, it is difficult to determine what the magnitude of change will be on affected receptors and what the potential significant effect is.
- Any effects associated with the construction of the MOLF on intertidal *Sabellaria* reef. *Sabellaria* reef has the potential to regenerate itself, but this is dependent on the condition of the reef and extent of reef damaged.

Whilst a worst-case scenario can be made on extent of reef damage, the condition of the reef is currently unknown. This will be determined during a condition assessment survey to be carried out in summer 2016. Until then, it is difficult to determine the extent of impact from the construction of the MOLF on *Sabellaria* reef and its ability to regenerate.

- With regards to effects from the thermal plume, thermal plume modelling is currently underway. Until modelling is completed, it is difficult to determine magnitude of change on affected receptors.
- With regards to changes to prey, e.g. marine mammals prey and increase in predation from the fish return outfall. This is dependent on a number of factors, for some of which a significance of effect is yet to be decided, such as effects of the thermal plume upon receptors. Until these unknown significance of effects are understood, effects resulting from changes to prey species are difficult to determine.

17.8.26 With respect to the decommissioning of the Moorside Project, potential effects associated with decommissioning are likely to be no greater than the effects arising from the construction phase. It is not anticipated that additional receptors would be affected beyond those identified for the construction phase assessment as this has assumed a reasonable worst case. It is anticipated that the decommissioning works would be of shorter duration and would occupy more limited footprints than those currently assumed for construction of the relevant facilities. As such, it is anticipated that the magnitude of change as a result of decommissioning would be less than that as a result of construction. Subject to further design and delivery details, and for the purposes of this PEIR, a worst case scenario assumption has therefore been applied, i.e. it has been assumed that the effects would be the same as those identified for the construction phase. Decommissioning is therefore not considered in addition to construction in the assessment tables below (that consider both the construction and operational phases).

Table 17.7 Moorside Site: Summary of predicted residual effects

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
Construction					
Habitats					
Intertidal and subtidal habitat loss from the construction and presence during the construction period of the MOLF, breakwaters and CWS infrastructure.	Likely	High to Medium	High to Medium	Moderate (Potentially significant)	The extent of habitat loss caused by the construction of the MOLF, breakwaters and CWS infrastructure will be assessed once hydrodynamic modelling has been finalised (anticipated in the second quarter of 2016) and the location of the infrastructure subsequently determined. However, it is anticipated that micro-siting of the MOLF, breakwaters and possibly CWS infrastructure may be possible to reduce any adverse effects. Recovery rates of *Sabellaria alveolata* reefs is dependent on the extent of damage caused. Studies have shown that minor damage to the worm tubes as a result of trampling was repaired within 23 days (Reference 22, Cunningham et al). However, where reefs are extensively removed, recovery relies on the recolonization of the site by larvae and these larvae can be stimulated to settle by the presence of adult tubes (Reference 23, Qian). Therefore, it is possible to promote restoration of *Sabellaria alveolata* reefs; however, this is dependent on the extent of damage and whether the damage will extend to only part of a *Sabellaria* biotope extent or the whole biotope extent.
Disturbance and loss of intertidal habitat from the construction of the BLF.	Likely	High	*	*	A BLF is currently proposed prior to the construction of the MOLF. Should a similar BLF be proposed as that of EVAP D for Sellafield the effects of the BLF on intertidal habitats are likely to be minimal and not significant. However, this is dependent on construction

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
					method, materials used and, importantly, siting of the BLF. Until further details are available on the construction and location of the BLF, it is not possible to conclude significance of effect.
Disturbance of the seabed and changes in topography leading to an increase in suspended sediments and smothering of habitats during construction of MOLF, breakwaters and CWS infrastructure.	Likely	Low	Medium	Minor (Not Significant)	The significance of effect of the construction of the MOLF, breakwaters and CWS infrastructure on intertidal/subtidal habitats will be assessed once construction methods and hydrodynamic modelling have been finalised (anticipated in the second quarter of 2016) and the location of the infrastructure determined. Strict adherence to the CEMP and implementation of construction management best practice techniques will minimise any adverse effects. The extent of scour and sediment movement from the presence of the marine infrastructure will be determined through modelling. It is anticipated that there will be a localised adverse effect on habitats that are sensitive to changes in sediment movement but no overall adverse significant effect.
Disturbance and damage to intertidal *Sabellaria alveolata* reefs caused by the construction of the MOLF and breakwaters.	Likely	High	*	*	The construction of the MOLF has the potential to adversely affect the *Sabellaria* reefs through either direct removal of the habitat and through disturbance and damage cause by the construction of the MOLF and associated machinery required to construct the MOLF and access route to the construction site. Through careful siting of the MOLF and strict adherence to the CEMP and implementation of standard construction mitigation measures and construction management best practice techniques, these effects can be reduced. Effects can be further reduced by designating a single access track to the construction

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
					site and reduction of vehicle/equipment movement on the intertidal zone to as minimal as possible. Again, this will be detailed in the CEMP. The construction of breakwaters also has the potential to adversely affect *Sabellaria* reef indirectly. This could arise from a change in water quality from mobilisation of contaminated sediments and from accidental pollution/spills from construction machinery. Strict adherence to the CEMP and implementation of standard construction mitigation measures and construction management best practice techniques will minimise any adverse effects. Recovery rates of *Sabellaria alveolata* reefs is dependent on the extent of damage caused. Studies have shown that minor damage to the worm tubes as a result of trampling was repaired within 23 days (Reference 22, Cunningham et al). However, where reefs are extensively removed, recovery relies on the recolonization of the site by larvae and these larvae can be stimulated to settle by the presence of adult tubes (Reference 23, Qian). Therefore, it is possible to promote restoration of *Sabellaria alveolata* reefs; however, this is dependent on the extent of damage and whether the damage will extend to only part of a *Sabellaria* biotope extent or the whole biotope extent. A condition assessment survey of the *Sabellaria* reef within the construction zone is scheduled to be carried out in summer 2016. This will assist in identifying the recovery rate of the reef post-construction. The significance of effect will be re-evaluated once the project design and construction methods have been

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
					finalised (anticipated in the second quarter of 2016) and once the *Sabellaria* reef condition assessment survey is carried out in summer 2016.
Potential adverse effects on intertidal and subtidal habitats (including saltmarsh) from spills from vehicles, vessels and machinery during construction of the MOLF, breakwaters and CWS intake and outfall.	Unlikely	High	Very low	Minor (Not significant)	Pollution events can occur through spillage of fluids and material from construction equipment. This will be mitigated through implementation of standard construction management best practice techniques (which will be outlined in the CEMP). Whilst the sensitivity of the receptor is high, the magnitude of change is very low leading to a potentially significant effect, which is mitigate if best practice techniques are followed during construction. Therefore, there is no significant adverse effect on intertidal and subtidal habitats from spills from construction vessels and machinery.
Potential adverse effects on saltmarsh from an increase in suspended sediments and release of pollutants from sediment disturbance from the construction of the MOLF, breakwaters and CWS.	Unlikely	Very High	Very Low	Moderate (Potentially Significant)	Saltmarsh habitats are found in the River Irt (located within the Drigg coast SAC and SSSI), which is at the edge of the ZoI from the Moorside Site. It is highly unlikely that sediment mobilisation from the construction site will reach the saltmarsh (see **Chapter 15, Marine and Coastal Physical Processes**); however, this will be determined through modelling. Final determination of significance of effects (or even whether saltmarsh can be scoped out if there is no pathway of effect) can only be determined once construction methods are finalised (anticipated in the second quarter of 2016), which will allow a comprehensive impact assessment to be carried out.
Marine mammals					

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
Direct disturbance or harm	Likely	Low	Very low	Negligible (Not Significant)	Marine mammals are sensitive to noise generated during construction, particularly if piling is to be carried out in the construction of the MOLF. However, marine mammals in the ZoI are transient and low in numbers. There are no seal haul out sites (the closest haul out is at South Walney nature reserve) and it is not a major feeding ground for either Cetacea or Pinnipeds. Even though marine mammals are afforded the highest protection level (therefore Very High sensitivity), the numbers found at the Moorside Site are very low, and therefore sensitivity is assessed as low. This, along with the environmental measures within the BMS and CEMP, suggests no significant effect. However, final determination of significance of effect can only be determined once construction methods are finalised (anticipated in the second quarter of 2016), which will allow a comprehensive impact assessment to be carried out. This will also allow the creation of a noise model which will map the extent of noise propagation from noise source (i.e. piling), which will, therefore, allow more accurate mitigation to be devised (i.e. it will determine the distance from which piling is delayed if the on-board Marine Mammal Observer observes the presence of a marine mammal).
Changes to prey distribution causing relocation of marine mammals	Likely	*	*	*	Marine mammals have a wide range of prey species, including fish, squid, and shellfish to name a few. The magnitude of change will depend upon the type and sensitivity of prey species affected by construction.
Fish					
Change in water quality from	Likely	Very High to Low	Low	Major	The extent of mobilisation of seabed and the resultant

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
mobilisation of contaminated sediments during construction of the MOLF, breakwaters and CWS infrastructure, leading to an increase in suspended sediments				(Significant) to Negligible (Not Significant)	suspended sediment load arising from the construction of the MOLF, breakwaters and CWS infrastructure will be dependent on design and construction methods; therefore, the likelihood of a significant effect may range from not significant (if construction is restricted both spatially and temporally) to significant. The release of contaminants from sediment will depend on the quality of sediment at the site of construction. Until the exact location of construction is determined and results of site investigation received, it is not possible to conclude significance of effect.
Avoidance of area and possible startle response by migratory fish (Atlantic salmon, sea/river lamprey, allis and twaite shad) from construction noise (assumed worst case scenario of percussive piling)	Likely	Very High	Very Low	Moderate (Potentially Significant)	Migratory fish can potentially show a change in behaviour as a result of noise; this will be dependent on the type of noise created during construction of the MOLF, breakwaters and CWS infrastructure and, therefore, dependent on the type of construction and machinery/vessels used, as well as the time of year construction takes place and duration. This can lead to changes in migratory behaviour, potentially leading to reduced migration into the River Ehen due to the proximity of construction to its mouth, with the noise creating a barrier to migration. Significance of effect will be determined once the method of construction and equipment used is finalised (anticipated in the second quarter of 2016). However, mitigation measures for reducing effects from noise on fish are well documented and the choice of mitigation measures will be detailed in the CEMP. Adherence to the CEMP, which will dictate construction methods will assist in mitigating these effects. Finally, the creation of a noise propagation model will identify the extent of noise effects and will also aid in identifying the

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
					appropriate mitigation measures with the aim of achieving no significant effect.
Avoidance of area and possible startle response by commercially and non-commercially but ecologically important fish species without designated protection status from construction noise and increase in vessel movement (assumed worst case scenario of percussive piling)	Likely	Low	Very Low	Negligible (Not Significant)	Without knowing the type of construction and noise output, it is difficult to determine the significance level of noise effects upon fish from construction of the MOLF, breakwaters and CWS infrastructure. Significance of effect will be determined once the method of construction and equipment used is finalised (anticipated in the second quarter of 2016). However, mitigation measures for reducing effects from noise on fish are well documented and the choice of mitigation measures will be detailed in the CEMP. Adherence to the CEMP, which will dictate construction methods will assist in mitigating these effects. Finally, the creation of a noise propagation model will identify the extent of noise effects and will also aid in identifying the appropriate mitigation measures with the aim of achieving no significant effect.
Benthic invertebrates					
Avoidance of area and possible startle response of invertebrates, particularly shellfish to noise from construction of MOLF, breakwaters and CWS infrastructure and increase in vessel movement	Likely	Low	Very Low	Negligible (Not Significant)	A local shellfishery of approximately 1,000 pots is known to exist within the ZoI that may be adversely affected by the construction of the MOLF, breakwaters and CWS infrastructure. Nephrops are also present within the muddy areas of the construction zone. Significance of effect will be determined once the method of construction and equipment used is finalised (anticipated in the second quarter of 2016). However, mitigation measures for reducing effects from noise are well documented and the choice of mitigation

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
					measures will be detailed in the CEMP. Adherence to the CEMP, which will dictate construction methods will assist in mitigating these effects. Finally, the creation of a noise propagation model will identify the extent of noise effects and will also aid in identifying the appropriate mitigation measures with the aim of achieving no significant effect.
Plankton					
Effects on plankton growth due to construction of marine infrastructure, including mobilisation of potentially contaminated sediments	Likely	Medium to High	Low	Minor (Not Significant) to Moderate (Potentially Significant)	Plankton growth may be affected by changes in water quality from mobilisation of contaminated sediments and an increase in suspended sediments during construction of MOLF, breakwaters and CWS infrastructure. Effects may also arise from a decrease in water quality from potential spills from machinery/vessels. Through strict adherence to the CEMP and implementation of standard construction mitigation measures and construction management best practice techniques, these effects can be minimised. The predicted effect will be determined when construction methods for the MOLF, breakwaters and CWS infrastructure have been finalised and hydrodynamic modelling has been completed.
Drigg Coast SAC					
Disturbance and damage to the interest features of the SAC caused by the construction of the MOLF, breakwaters and CWS infrastructure, which includes	Unlikely	Very High	Very low	Moderate (Potentially Significant)	The construction of the offshore/coastal infrastructure, i.e. the MOLF, breakwaters and CWS infrastructure, may potentially adversely affect the marine interest features of the SAC. These include 'Estuaries' (a primary interest feature), 'mudflats and sandflats' and

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
the outfall/intake structures and vertical shafts.					'salt marsh'. There will be no direct damage or removal of any marine interest feature from the construction of the marine infrastructure, as the SAC is outside the construction zone. Whilst there may be some potential adverse indirect effects (such as sediment mobilisation) initial hydrodynamic modelling suggests this is highly unlikely (see **Chapter 15, Marine and Coastal Physical Processes**). The significance of effect, if any, will be evaluated once the project design and construction methods have been finalised (anticipated in the second quarter of 2016).
Disturbance and damage to the interest features of the SAC caused by the presence of the MOLF during the construction period.	Unlikely	Very High	Very low	Moderate (Potentially Significant)	It is anticipated that the modification of the hydrodynamic/wave regime will be extremely limited for a piled MOLF and changes in longshore sediment transport are, therefore, also expected to be similarly limited (see **Chapter 15, Marine and coastal physical processes**). Therefore, it is predicted that the magnitude of change will be very low and there will be no significant effect.
Disturbance and damage to the interest features of the SAC caused by the presence of the breakwaters during the construction period.	Unlikely	Very High	Very low	Moderate (Potentially Significant)	It is anticipated that the breakwaters will create a zone of calmer water and, therefore, modify the hydrodynamic/wave regime (see **Chapter 15, Marine and coastal physical processes**). The magnitude of change and associated probability of this occurring will be dependent upon the design of any breakwaters, in particular its size, shape, location and orientation. The significance of effect will be re-evaluated using sediment transport modelling once the project design has been finalised (anticipated in the second quarter of

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
					2016).
Allonby Bay and West of Walney MCZs					
Disturbance or damage to the interest features of the MCZs during the construction of the MOLF, breakwaters and CWS infrastructure, which includes the outfall/intake structures and vertical shafts.	Unlikely	High	Very low	Minor (Not Significant)	The construction of the offshore/coastal infrastructure, i.e. the MOLF, breakwaters and CWS infrastructure, may potentially adversely affect the designation features of the MCZs. However, it is anticipated that Allonby Bay and West of Walney MCZs will be scoped out of further assessment as they are both designated for sessile features and are both situated outside the Zone of Influence (ZoI), thus removing the potential for interconnectivity and, therefore, for effects to arise.
Disturbance and damage to the interest features of the MCZs caused by **the presence** of the MOLF, breakwaters and CWS infrastructure (which includes the outfall/intake structures and any vertical shafts) **during the construction period**.	Unlikely	High	Very Low	Minor (Not Significant)	It is anticipated that Allonby Bay and West of Walney MCZs will be scoped out of further assessment as they are both designated for sessile features and are both situated outside the Zone of Influence (ZoI), thereby removing the potential for interconnectivity and therefore for effects to arise.

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
Mudhole rMCZ					
Disturbance or damage to the protected features of the rMCZ during the construction of the MOLF, breakwaters and CWS infrastructure, which includes the outfall/intake structures and any vertical shafts.	Unlikely	High	Very low	Minor (Not significant)	The construction of the offshore/coastal infrastructure, i.e. the MOLF, breakwaters and CWS infrastructure, may potentially adversely affect the designation features of the rMCZ. The Mudhole rMCZ will be included in the assessment during the EIA process due to its proximity to the ZoI (although it is not within the expected ZoI); however, due to the sessile nature of its interest features and the limited connectivity, it is anticipated that there will be no significant effect. The significance of effect will be re-evaluated once the project design and construction methods have been finalised (anticipated in the second quarter of 2016).
Disturbance and damage to the interest features of the rMCZ caused by the presence of the MOLF, breakwaters and CWS infrastructure (which includes the outfall/intake structures and any vertical shafts) during the construction period	Unlikely	High	Very low	Minor (Not significant)	The Mudhole rMCZ will be included in the assessment during the EIA process due to its proximity to the expected ZoI (although it is not within the ZoI); however, due to the sessile nature of its interest features and the limited anticipated changes to the offshore hydrodynamic/wave regime from the infrastructure, it is anticipated that there will be no significant effect. The significance of effect will be evaluated once the project design and construction methods have been finalised (anticipated in the second quarter of 2016).
Cumbria Coast MCZ					
Disturbance and damage to the protected features of the MCZ caused by the construction of	Likely	High	Medium	Major (Significant)	The construction of the MOLF has the potential to adversely affect the interest features of the MCZ, particularly honeycomb worm reefs.

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
the MOLF.					The MOLF could cause direct removal of habitat; of particular concern is the honeycomb worm (*Sabellaria*) reef. Through careful siting of the MOLF and strict adherence to the CEMP and implementation of standard construction mitigation measures and construction management best practice techniques, these effects can be minimised and it is likely that significant effects on the MCZ can be minimised. Recovery rates of *Sabellaria alveolata* reefs is dependent on the extent of damage caused. Studies have shown that minor damage to the worm tubes as a result of trampling was repaired within 23 days (Reference 22. Cunningham et al, 1984). However, where reefs are extensively removed, recovery relies on the recolonization of the site by larvae and these larvae can be stimulated to settle by the presence of adult tubes (Reference 23. Qian, 1999). Therefore, it is possible to promote restoration of *Sabellaria alveolata* reefs; however, this is dependent on the extent of damage and whether the damage will extend to only part of a *Sabellaria* biotope extent or the whole biotope extent. The significance of effect will be re-evaluated once the project design and construction methods have been finalised (anticipated in the second quarter of 2016).

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
Disturbance and damage to the protected features of the MCZ caused by the presence of the MOLF during the construction period.	Likely	High	Low	Moderate (Potentially Significant)	It is expected that the modification of the hydrodynamic/wave regime will be extremely limited for a piled MOLF; therefore, it is anticipated that indirect effects of the MOLF on the MCZ, such as scour and change in sediment load/movement will be low in magnitude (see **Chapter 15, Marine and Coastal Physical Processes**). The significance of effect will be evaluated once the project design and construction methods have been finalised (anticipated in the second quarter of 2016).
Disturbance and damage to the protected features of the MCZ caused by construction of the breakwaters.	Likely	High	Very low	Minor (Not significant)	The construction of a breakwaters has the potential to adversely affect the interest features of the MCZ indirectly. This could arise from a change in water quality from mobilisation of contaminated sediments and from accidental pollution/spills from construction machinery. Strict adherence to the CEMP and implementation of standard construction mitigation measures and construction management best practice techniques will minimise any adverse effects. The significance of effect will be evaluated once the project design and construction methods have been finalised (anticipated in the second quarter of 2016).
Disturbance and damage to the protected features of the MCZ caused by presence of the breakwaters during the construction period of the MPS.	Likely	High	Medium	Major (Significant)	The presence of any breakwaters is likely to modify the hydrodynamic/wave regime due to the creation of a zone of calmer water (this will be its purpose). This reduction in wave energy could alter the sediment transport regime potentially causing an increase in sedimentation and, therefore, smothering of habitats that make up the Cumbria Coast MCZ (see **Chapter 15, Marine and Coastal Physical Processes**). It can also

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
					affect the *Sabellaria* reef as it is dependent on a sediment source. The significance of effect will be re-evaluated once the project design and construction methods have been finalised (anticipated in the second quarter of 2016), in particular the size, location and orientation of any breakwaters and numerical modelling has been undertaken.
Disturbance and damage to the protected features of the MCZ caused by the construction of the CWS infrastructure.	Unlikely	High	Very low	Minor (Not significant)	The construction of the tunnels will be carried out using a TBM with the tunnel entrance located above Mean High Water; therefore, there will be no impacts from the construction of the tunnels on the MCZ. The construction of the CWS outfall/intake structures and vertical shafts could cause indirect effects through potential changes in water quality arising from mobilisation of contaminated sediments and from accidental pollution/spills from construction machinery. Strict adherence to the CEMP and implementation of standard construction mitigation measures and construction management best practice techniques will minimise any adverse effects. The significance of effect will be evaluated once the project design and construction methods have been finalised (anticipated in the second quarter of 2016).
Disturbance and loss of intertidal habitat from the construction of the BLF.	Likely	High	*	*	A BLF is currently proposed prior to the construction of the MOLF. Should a similar BLF be proposed as that of EVAP D for Sellafield, the effects on intertidal habitats are likely to be minimal and not significant. However, this is dependent on construction method, materials

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
					used and location of the BLF. Until further details are available on the construction and location of the BLF, it is not possible to conclude significance of effect.
Operation					
Habitats					
Disturbance and loss of intertidal and subtidal habitat from the presence of the MOLF, breakwaters and CWS infrastructure	Likely	High to Medium	Medium to High	Moderate (Potentially significant)	The extent of habitat loss caused by the presence of the MOLF, breakwaters and CWS infrastructure will be assessed once hydrodynamic modelling has been finalised (anticipated in the second quarter of 2016) and the location of the infrastructure subsequently determined. However, it is anticipated that micro-siting of the MOLF, breakwaters and possibly CWS infrastructure may be possible to reduce any adverse effects.
Disturbance and loss of intertidal habitats from the presence of the BLF	Likely	High	*	*	A BLF is currently proposed prior to the construction of the MOLF. Although it is anticipated to be a temporary structure, adverse effects may arise from changes in sediment transport due to the presence of the BLF and an increase in disturbance in other, adjacent intertidal habitats from vessel movements and propellers. Until further details are available on the location of the BLF, and therefore the sensitivity of affected habitats, it is not possible to conclude significance of effect.
Adverse effects on subtidal habitats from the discharge of the thermal/chemical plume	Unlikely	Low	Very low	Negligible (Not significant)	The discharge of cooling water from the CWS outfall will be higher in temperature and may contain a variety of chemicals that are essential to the CWS, such as chlorine or hydrazine. However, the discharge waters will be buoyant and will rise to the surface;

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
					therefore, it is highly unlikely that there will be significant adverse effects on subtidal habitats. This will be confirmed once thermal plume modelling is finalised (anticipated in the second quarter of 2016).
Adverse effects on intertidal habitats (including saltmarsh) from the discharge of the thermal/chemical plume	Likely	Very High to High	*	*	The thermal/chemical plume has the potential to adversely affect the interest features of the intertidal habitats, including saltmarsh (located within the Drigg coast SAC and SSSI). Effects will be minimised by appropriate siting and design of the outfall and control of emissions. Following completion of hydrodynamic modelling (anticipated in the second quarter of 2016), the residual temperature reaching the intertidal habitats will be assessed against the thermal tolerance of the species/habitat present and compliance of chemical contaminants with relevant EQS will be assessed. Therefore, the significance of effect will be determined once the project design has been finalised and thermal/contaminant plume modelling completed (anticipated in the second quarter of 2016).
Marine Mammals					
Entrainment, impingement and entrapment in the CWS	Unlikely	Low	Very low	Negligible (Not significant)	Marine mammals in the ZoI are transient and low in numbers. There are no seal haul out sites (the closest haul out is at South Walney nature reserve) and it is not a major feeding ground for either Cetacea or Pinnipeds. Even though marine mammals are afforded the highest protection level (therefore Very High sensitivity), the numbers found at the Moorside Site are very low, and therefore sensitivity is low.

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
					Although there have been examples of marine mammals being found within CWS in the past, this is an unlikely event. However, it has been included here for completeness, and will be further assessed once additional information regarding CWS design is known.
Disturbance of prey species as a result of the thermal/chemical plume	Likely	High	*	*	Marine mammals have a wide range of prey species, ranging from fish, squid, and shellfish for example. The magnitude of change will depend upon the type and sensitivity of prey species exposed to the thermal/contaminant plume and will be assessed once thermal/contaminant plume modelling is complete (anticipated in the second quarter of 2016).
Fish					
Barrier effect on migratory fish from temperature changes within the thermal/chemical plume from the operation of the CWS	Likely	Very High	*	*	At this stage of the project it is very difficult to determine the likelihood of a barrier effect occurring from the thermal plume, which might interrupt the migration of fish, such as Atlantic salmon. The significance will be determined once the siting of the outfall is finalised and thermal plume modelling is completed (anticipated in the second quarter of 2016).
Entrainment, impingement and entrapment in the CWS intake	Likely	Very High to Low	Very low	Negligible (Not significant) to Moderate (Potentially significant)	Effects of potential entrainment/impingement/entrapment of fish will be minimised by appropriate intake design and use of a fish deterrence system and fish return system. Entrained fish will be captured on the screens and returned to the sea. Significance of effect will be determined once the project design is further advanced (anticipated in the

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
					second quarter of 2016).
Increased predation on fish (in particular migratory fish) as an indirect effect of the thermal plume, MOLF and Fish Return and Recovery (FRR) system.	Likely	Very High to Low	*	*	The increase in water temperature from thermal plumes are known to both attract fish and increase the food availability leading to an increase in fish population. This can also lead to an increase in predatory fish, such as sea bass. The MOLF structure will act as fish aggregating device (FAD), which may lead to increase predation from birds using the MOLF. Finally, the FRR system will return fish through a pipe which will be fixed in a stationary location. The returned fish provide an easy target for predatory fish, birds and marine mammals. At the time of writing, a study is currently underway to determine the extent of impact of predation on fish. Additionally, it is difficult to determine the magnitude of change until further is known about the FRR system design and fish deterrents used.
Benthic invertebrates					
Adverse effects on mobile benthic invertebrates, such as *Nephrops norvegicus*, from the thermal/chemical plume	Unlikely	Medium	Very low	Negligible (Not significant)	The discharge of cooling water from the CWS outfall will be higher in temperature and may contain a variety of chemicals that are essential to the CWS, such as chlorine or hydrazine. However, the discharge waters will be buoyant and will rise to the surface; therefore, it is highly unlikely that there will be adverse effects on mobile benthic invertebrates. This will be confirmed once thermal plume modelling is finalised ((anticipated in the second quarter of 2016).

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
Plankton					
Entrainment of ichtyoplankton in the CWS	Likely	High	*	*	Effects of entrainment of ichtyoplankton into the CWS will depend upon the volume of water being taken into the CWS, as well as the siting of the intake pipeline. The significance of effect will be determined based on the finalisation of the project design and results and analysis of the full baseline surveys of ichthyoplankton.
Adverse effects on plankton from change in water quality and temperature	Likely	Medium	Low	Minor (Not significant)	Appropriate siting of the CWS outfall to maximise dispersion and dilution of the thermal plume will minimise any adverse effects caused by a rise in sea temperature and control of contaminant emissions through the environmental permitting regime will ensure that potential for effects is minimised. Assessment will be finalised when thermal/contaminant plume modelling is completed (anticipated in the second quarter of 2016).
Drigg Coast SAC					
Ongoing disturbance to the interest features of the SAC caused by the presence of the MOLF, e.g. through changes to the sediment transport regime.	Unlikely	Very High	Very Low	Moderate (Potentially Significant)	It is anticipated that the modification of the hydrodynamic/wave regime will be extremely limited for a piled MOLF and changes in longshore sediment transport are, therefore, also expected to be similarly limited (see **Chapter 15, Marine and coastal physical processes**). Therefore, it is predicted that the magnitude of change will be very low and there will be no significant effect.
Disturbance to the protected interest features of the SAC caused by the presence of the	Unlikely	Very High	Very Low	Moderate (Potentially Significant)	It is anticipated that the breakwaters will create a zone of calmer water and, therefore, modify the hydrodynamic/wave regime (see **Chapter 15, Marine**

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
breakwaters.					**and coastal physical processes**). The magnitude of change and associated probability of this occurring will be dependent upon the design of any breakwaters, in particular its size, shape, location and orientation. However, it is currently anticipated that the magnitude of change would be very low with no significant effects on SAC interest features. The significance of effect will be re-evaluated using sediment transport modelling once the project design has been finalised (anticipated in the second quarter of 2016).
Disturbance and damage to the interest features of the SAC by the thermal/chemical plume from the operation of the CWS	Unlikely	Very High	*	*	It is anticipated that there will be no effect on the terrestrial interest features of the SAC, as there is no identified pathway of effect. Effects of the thermal/contaminant plume on the marine and saltmarsh features of the SAC will be informed by the thermal/contaminant plume modelling (completion anticipated in the second quarter of 2016).
Cumbria Coast MCZ					
Ongoing disturbance to the protected features of the MCZ caused by the presence of the MOLF, e.g. through changes to the sediment regime.	Likely	High	Low	Moderate (Potentially Significant)	It is expected that the modification of the hydrodynamic/wave regime will be extremely limited for a piled MOLF; therefore, it is anticipated that indirect effects of the MOLF on the MCZ, such as scour and change in sediment load/movement will be low in magnitude (see **Chapter 15, Marine and Coastal Physical Processes**). The significance of effect will be evaluated once the project design and construction methods have been finalised (anticipated in the second quarter of 2016).

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
Disturbance to the protected interest features of the MCZ caused by the presence of the breakwaters.	Unlikely	High	Medium	Major (Significant)	It is anticipated that the breakwaters will create a zone of calmer water in the vicinity of the MOLF and, therefore, modify the hydrodynamic/wave regime resulting in a change in morphology and substrate over time (see **Chapter 15, Marine and coastal physical processes**). The magnitude of change and associated probability of this occurring will be dependent upon the design of any breakwaters, in particular its size, shape, location and orientation. Localised modifications of tidal currents and sediment transport can have a knock-on effect on Cumbria Coast MCZ interest features such as the *Sabellaria* reefs, which are dependent on a steady supply of sediment as reef building material. The significance of effect will be re-evaluated using sediment transport modelling once the project design has been finalised (anticipated in the second quarter of 2016).
Disturbance and loss of intertidal habitats from the presence of the BLF	Likely	High	*	*	A BLF is currently proposed prior to the construction of the MOLF. Although it is anticipated to be a temporary structure, adverse effects may arise from changes in sediment transport due to the presence of the BLF and an increase in disturbance in other, adjacent intertidal habitats from vessel movements and propellers. Until further details are available on the location of the BLF, and therefore the sensitivity of affected habitats, it is not possible to conclude significance of effect.
Disturbance and damage to the interest features of the MCZ as a result of the	Likely	High	*	*	The thermal/chemical plume has the potential to adversely affect the interest features of the MCZ. Effects will be minimised by appropriate siting and

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
thermal/chemical plume from the operation of the CWS					design of the outfall and control of emissions. Following completion of hydrodynamic modelling (anticipated in the second quarter of 2016), the residual temperature reaching the MCZ will be assessed against the thermal tolerance of the species/habitat present and compliance of chemical contaminants with relevant EQS will be assessed. Therefore, the significance of effect will be determined once the project design has been finalised and thermal/contaminant plume modelling completed (anticipated in the second quarter of 2016).
Allonby Bay and West of Walney MCZ and Mudhole rMCZ					
Disturbance and damage to the interest features of the MCZs and rMCZ by the thermal/chemical plume	Unlikely	High	Very low	Minor (Not significant)	Effects of the thermal/contaminant plume on the MCZs and rMCZ will be informed by the thermal/contaminant plume modelling (anticipated in the second quarter of 2016), although it is expected there will be no significant effect as the MCZs and rMCZ lie outside the expected ZoI. In addition, the MCZs and rMCZs are designated for subtidal features/habitats and as the thermal/chemical plume is buoyant, it is anticipated that there will be no adverse effects on benthic habitats.
Ongoing disturbance to the interest features of the MCZs caused by the presence of the MOLF, breakwaters and CWS infrastructure (which includes the outfall/intake structures and any vertical shafts), e.g. through changes to the	Unlikely	High	Very Low	Minor (Not significant)	It is anticipated that the above MCZs will be scoped out of further assessment as they are designated for sessile features and are situated outside the ZoI, thereby removing the potential for interconnectivity and therefore for effects to arise.

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
sediment regime.					

Note: * Denotes where the assessment is incomplete and ongoing at this time and therefore the significance of the effects cannot be accurately predicted.

17.9 Preliminary assessment of the Moorside Project as a whole

17.9.1 As previously identified in **Section 17.1**, pathways of effects from the Moorside Project on marine ecology receptors have been identified as those originating from the construction and operation of the marine and coastal structures and activities of the Moorside Power Station (MPS), namely the Circulating Water System (CWS), Beach Landing Facility (BLF), Marine Off-Loading Facility (MOLF) and breakwaters. Consequently the assessment of effects for the Moorside Project as a whole are no greater than those presented in **Table 17.7** above.

17.10 Preliminary assessment of cumulative effects

Scope of the assessment

17.10.1 As outlined in **Section 3.4**, an exercise has been undertaken to determine which other (non-Moorside) developments should be considered in the context of their ability to result in cumulative adverse environmental effects with the Moorside Project.

17.10.2 Of the other developments described in **Section 3.4**, listed in **Table 3.4** and considered in the context of **Table 3.9** in terms of effects on marine ecology, it is considered appropriate at this stage not to consider the following projects on the basis that they are located outwith the Zone of Influence (**Figure 17.1**):

- Sellafield Site decommissioning (Nuclear Decommissioning Authority);
- Upgrade of BAE Systems' Barrow Site (BAE Systems);
- Low Level Waste Repository Drigg (Nuclear Decommissioning Authority);
- Ulverston Biopharmaceutical Manufacturing Facility (GSK);
- North West Coast Connections (National Grid);
- West Cumbria Mining Project (coal mine) (West Cumbria Mining);
- West Cumbria Water Supply Pipeline (United Utilities); and
- Heysham New Nuclear Power Station (EDF Energy).

17.10.3 However, it should be noted that the situation with respect to the above sites will be kept under review during the preparation of the EIA, pending the availability of information from the respective developers regarding their own marine ecology ZoIs.

17.10.4 Of the remaining other developments considered in **Table 3.4**, the following have potential cumulative effects with the Moorside Site marine ecology receptors.

- Walney Extension Offshore Wind Farm (Dong Energy); and
- West Cumbria Tidal Lagoon (Tidal Lagoon Power).

17.10.5 It is difficult to determine whether the two development listed in **Paragraph 17.9.4** will have cumulative effects on the marine ecology receptors from the Moorside Site as the two developments are outwith the ZoI. However, there is the possibility of indirect effects arising from the following:

- changes in hydrodynamics, geomorphology and sediment movement; and
- cumulative adverse effects on migratory mammals and migratory fish.

17.10.6 At this stage, there is insufficient information available at this time with respect to spatial, temporal or implementation details for either of these proposed developments to be able to undertake any meaningful assessment of potential cumulative effects with the Moorside Project. If further information on either of these two projects becomes available prior to the Moorside Project ES being completed, this information will be reviewed and a cumulative effects assessment undertaken if necessary. If not, and if either, or both, of these projects were to proceed it would be appropriate for their EIAs to consider the Moorside Project as part of their cumulative effects assessments at that time.

17.11 Consideration of additional mitigation

17.11.1 At this stage, all of the mitigation measures, which are anticipated will be required, are incorporated into the development proposals and are considered in the assessment of effects outlined in **Section 17.6**. However, if it emerges during the preparation of the ES that additional, non-incorporated measures need to be considered, the relevant details will be presented in the ES.

17.12 References

1. Department for Communities and Local Government (DCLG), (2012). National Planning Policy Framework. ISBN 978-1-4098-3413-7.
2. Chartered Institute of Ecology and Environmental Management (2006). Guidelines for Ecological Impact Assessment in the United Kingdom.
3. Chartered Institute of Ecology and Environmental Management (2010). Guidelines for Ecological Impact Assessment in Britain and Ireland – Marine and Coastal.
4. Chartered Institute of Ecology and Environmental Management (2016). Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal, second edition.
5. Wyn, G., Brazier, D. P. and McMath, A. J. (2000). CCW handbook for marine intertidal Phase 1 survey and mapping. CCW Marine Sciences Report: 00/06/01.
6. Davies, J., Baxter, J., Bradley, M., Connor, D., Khan, J., Murray, E., Sanderson, W., Turnbull, C. & Vincent, M., (2001), Marine Monitoring Handbook. 405 pp, ISBN 1 85716 550 0.
7. UKTAG (2014). Macroalgae – Intertidal Rocky Shore Macroalgal Index. ISBN: 978-1-906934-39-2.
8. Wells, E. (2005). A Field Guide to the British Seaweeds. As required for assistance in the classification of water bodies under the Water Framework Directive. 112pp.
9. UKTAG (2014). Angiosperms – Saltmarsh Tool. ISBN: 978-1-906934-40-8.
10. UKTAG (2014). Benthic Invertebrate Fauna – Infaunal Quality Index. ISBN: 978-1-906934-34-7.
11. Popper, A.N., Hawkins, A.D., Fay, R.R., Mann, D.A., Bartol, S., Carlson, T.J., Cooms, S., Ellison, W.T., Gentry, R.L., Halvorsen, M.B., Løkkeborg, S., Rogers, P.H., Southall, B.L., Zeddies, D.G., and Tavolga, W.N. (2014) *Sound Exposure Guidelines for Fishes and Sea Turtles*. A Technical Report prepared by ANSI-Accredited Standards Committee S3/SC1 and registered with ANSI. ASA S3/SC1.4 TR-2014.
12. Southall, B.L., Bowles, A.E., Ellison, W.T., Finneran, J.J., Gentry, R.L., Greene Jr, C.R., Kastak, D., Ketten, D.R., Miller, J.H., Nachtigall, P.E., Richardson, W.J., Thomas, J.A., and Tyack, P.L. (2007). Marine Mammal Noise Exposure Criteria: Initial Scientific Recommendations. *Aquatic Mammals*, Volume 33, Number 4.
13. Robinson, S.P., Lepper, P.A. and Hazelwood, R.A. (2014) *Good Practice Guide for Underwater Noise Measurement*, National Measurement Office, Marine Scotland, The Crown Estate. NPL Good Practice Guide No. 133, ISSN: 1368-6550
14. National Oceanic and Atmospheric Administration (2015). *Draft Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing. Underwater Acoustic Threshold Levels for Onset of Permanent and Temporary Threshold Shifts*. Revised version for Second Public Comment Period.
15. Ware, S.J. and Kenny, A.J. (2011). *Guidelines for the Conduct of Benthic Studies at Marine Aggregate Extraction Sites (2nd Edition)*. Marine Aggregate Levy Sustainability Fund, 80 pp. ISBN: 978 0 907545 70 5
16. Cook, E.J., Macleod, A., Payne, R.D., and Brown, S. (2014) edited by Natural England and Natural Resources Wales (2015). *Marine Biosecurity Planning* -

Guidance for producing site and operation-based plans for preventing the introduction and spread of non-native species in England and Wales.
17. Gowen, R. J., & Stewart, B. M. (2005). The Irish Sea: Nutrient status and phytoplankton. Journal of Sea Research, 54(1 SPEC. ISS.), 36–50. doi:10.1016/j.seares.2005.02.003.
18. Commission of the European Community (CEC). (2007). The Interpretation Manual of European Union Habitats – EUR27. [Online]. Brussels: European Commission DG Environment. Available from: http://ec.europa.eu/environment/nature/legislation/habitatsdirective/index_en.htm [Accessed September, 2015].
19. Ellis, J.R., Milligan, S.P., Readdy, L., Taylor, N. & Brown, M.J. (2012). Spawning and nursery grounds of selected fish species in UK waters. Sci. Ser. Tech. Rep., Cefas Lowestoft, 147:56pp.
20. JNCC. (2010) *JNCC guidelines for minimising the risk of injury and disturbance to marine mammals from seismic surveys*. JNCC Marine Advice, Aberdeen.
21. Reid, J.B., Evans, P.G.H., & Northridge, S.P., (2003), Atlas of Cetacean distribution in north-west European waters, 76 pp. ISBN 1 86107 550 2.
22. Cunningham, P.N., Hawkins, S.J., Jones, H.D. and Burrows, M.T. (1984). The geographical distribution of *Sabellaria alveolata* (L.) in England, Wales and Scotland, with investigations into the community structure of and the effects of trampling on *Sabellaria alveolata* colonies. *Nature Conservancy Council, Peterborough, Contract Report* no. HF3/11/22. University of Manchester, Department of Zoology.
23. Qian, P.Y. (1999). Larval settlement of polychaetes. *Reproductive Strategies and Developmental Patterns in Annelids*. Springer Netherlands. pp. 239-253.