Marine Management Organisation

Habitat Regulations Assessment for North East, North West, South East and South West Marine Plans: Appropriate Assessment Information Report, including Screening Report

MMO1188: Habitat Regulations Assessment for North East, North West, South East and South West Marine Plans: Appropriate Assessment Information Report including Screening Report

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Executive Summary

The marine planning process is legally required to avoid any adverse effects on the ability of internationally important wildlife sites to achieve their conservation objectives. AECOM was appointed by the MMO to assist in undertaking the Habitat Regulations Assessment (HRA) for seven marine plan areas; the north east inshore and offshore, north west inshore and offshore, south east inshore and south west inshore and offshore marine plan areas (herein north east, north west, south east and south west marine plan areas).

A database was created to determine which internationally important wildlife sites were in proximity to the marine plan areas. In line with established precedent from other marine plans, this automatically included all European sites[1] within 100km of the marine plan areas. However, the process was adjusted to include consideration of sites more than 100km from a marine plan area that were designated for certain long-distance foraging birds (fulmar, storm petrel, kittiwake, lesser black-backed gull, puffin, Manx shearwater and gannet) based on either published summary data or the Royal Society for the Protection of Birds (RSPB)'s Future of the Atlantic Marine Environment (FAME) and Seabird Tracking and Research (STAR) projects, marine mammals (grey seal, common seal, harbour porpoise and bottlenose dolphin), migratory fish and freshwater pearl mussel.

This was followed by an exercise to determine if plan policies have any potential for adverse effect (likely significant effect) on the interest features of those sites. The next step involved determining whether any policies in any marine plan posed potential for an effect on European sites. The following policies are those which were screened in, and the marine plan area to which the policies relate:

- TR-4 – present in the North West Marine Plan only
- HAB-1 present in the South West Marine Plan only
- INF-3 – present in the South East Marine Plan only
- INF-2 – present in the North West and South West Marine Plans
- CCS-1 and CCS-2 – present in the North East and North West Marine Plans
- EMP-3 – present in the North East and South East Marine Plans
- INF-4 – present in the North West, South East and South West Marine Plans
- TR-1, TR-2, REN-1, PS-4, INF-1, FISH-3, EMP-2, DD-4, CAB-1, CAB-2, AQ-2, ACC-2, SOC-3, and WIND-2 – present in all marine plans.

The policies were grouped as follows:

- Enhanced public access (ACC-2, SOC-3, FISH-3, TR-1, TR-2 and TR-4);
- Provision of infrastructure, including for employment, sustainable fisheries, aquaculture and related industries (AQ-2, EMP-2, EMP-3, INF-1, INF-2, INF-3 and INF-4);
- Cable burial and future cable landfall (CAB-1 and CAB-2);
- Environmentally positive policies that may have negative effects (CCS-1, CCS-2 and HAB-1);
- New dredge disposal sites (DD-4);
- Renewable energy, including wind turbines (REN-1 and WIND-2); and,

[1] Special Areas of Conservation, Special Protection Areas, Sites of Community Importance, Ramsar sites and areas of habitat creation intended to compensate for existing adverse effects on the integrity of European sites

- Promotion of short sea shipping (PS-4)

Having considered the impact pathways that may arise from each policy category (and thus policy) and related those to the broad habitat or species groups that may be vulnerable, it was then necessary to go through every European site in the database and make a screening decision. A total of 555 UK European sites and 148 EU European sites (primarily French and Irish) are included within the database. The marine plans were considered not to result in likely significant effects on 281 of these sites. The reasons varied (and are given for each site in the filterable database) but the most common explanation was because the site in question lies outside any marine plan area, is inland and has qualifying features that are purely terrestrial and are not expected to be impacted by the policy categories of any marine plan. This process left 297 UK sites and 125 EU sites that have been screened in for appropriate assessment.

Those policies that may have potential for adverse effects were then subject to 'appropriate assessment' to determine whether an adverse effect on the ability of those sites to achieve their conservation objectives would arise and, if so, to propose mitigation to avoid such an effect. The first two stages were presented in the Pre-Screening Report (2016) and the Screening Report (2019) and consulted upon with the relevant statutory nature conservation bodies. This current report contains those two stages and builds upon them by presenting an Appropriate Assessment Information Report (AAIR) in Chapter 5.

Since the screening assessment was completed, some policies have been merged (such that some have been deleted following merger) while others have had wording changed. No entirely new policies have been created. The significant changes for the purposes of the AAIR are to policies that had previously been screened in, as follows:

- Screened in policy ACC-2 has been deleted and its text incorporated into ACC-1, so ACC-1 is now screened into the AAIR;
- Screened in policy FISH-3 has been deleted and its text incorporated into FISH-2, so FISH-2 is now screened into the AAIR;
- Screened in policy DD-4 (new dredge disposal sites) has been deleted and its text incorporated into policy DD-3, so DD-3 is now screened into the AAIR. Moreover, this policy now clarifies that new dredge disposal site proposals will only be supported if they 'are subject to best practice and guidance';
- Screened in policy TR-2 has been deleted and its text incorporated into screened in policy TR-1;
- Screened in policy EMP-3 has been deleted and merged into screened in policy EMP-2; and
- Screened in policies INF-2 and INF-4 have been deleted and merged into screened in Policy INF-1.

The updated list of policies taken forward to AAIR is therefore: ACC-1, SOC-3, FISH-2, TR-1, TR-4, AQ-2, EMP-2, INF-1, INF-3, CAB-1, CAB-2, CCS-1, CCS-2, HAB-1, DD-3, REN-1, WIND-2 and PS-4.

The purpose of the AAIR was to further explore the potential impacts and effects to determine whether a conclusion of no adverse effects on integrity can be drawn for any of the 'screened in' European sites designated for these receptors, based on the

limited information available at the plan level regarding the potential outcomes of these policies.

Since most of the 'screened in' policies have very limited spatial information the AAIR was based on the sensitivity of the interest features of relevant European sites, rather than on the likelihood of effect, since the latter requires knowledge not only of the vulnerability of the species but also of the likelihood of specific activities and impacts occurring within sensitive areas; a level of detail that does not exist at the plan level. Taking a precautionary approach, it was therefore assumed that exposure of sensitive interest features to these impact pathways would occur in the absence of mitigation.

For a minority of policies a greater level of spatial information does exist:

- Policy ACC-1 refers to *'enhanced and inclusive public access to and within the marine area'* with regard to services for tourism and recreation. While that could theoretically occur throughout all seven marine plan areas, such activities and proposals are more likely to occur in the inshore coastal environment in locations where existing populations and/or levels of recreational activity are high.
- Policy WIND-2 refers to '*areas of identified potential for offshore wind resource'*. The licencing of such areas is the responsibility of the Crown Estate rather than the Marine Management Organisation but since the locations of these areas are known they can be considered in the appropriate assessment. However, they cover a large proportion of each marine plan area, so only provide a limited amount of spatial resolution for the purposes of impact assessment. Note that these only denote areas of potential and do not indicate where in those areas of potential Crown Estate may ultimately choose to licence wind farms.
- The marine plans refer to '*potential sustainable aquaculture production areas'*. While new aquaculture infrastructure as per policy AQ-2 could theoretically be throughout all seven marine plan areas, aquaculture in the relevant marine plan areas is currently focussed on the west Cumbria coast between Morecambe Bay and the Solway Firth, the Devon and Cornwall coastline between Falmouth and Exeter and the Thames Estuary (particularly the coastline of Essex as well as Whitstable and Herne Bay in north Kent) (Defra, 2015). There are also a small number of aquaculture sites along the north Cornwall and Devon coastline and the Northumberland coast. The majority of these sites are shellfish production sites in shallow coastal waters; England has no marine finfish farms (Black and Hughes, 2017). Offshore Shellfish Limited has been pioneering offshore rope-based mussel production on three sites between 3 and 6 miles offshore in Lyme Bay, Devon (Offshore Shellfish Ltd, 2016).
- Policy PS-4 supports promotion of short-sea shipping and coastal shipping as an alternative to other transport methods. While this has no explicit spatial component, the likely areas for impacts associated with the expansion of short-sea shipping and coastal shipping are where existing ports exist and these coincide with the locations of Special Protection Areas and Ramsar sites designated for seabirds, waders and waterfowl. The key areas (the major ports rather than a comprehensive list) within the relevant marine plan areas are therefore:

- north east inshore marine plan area: the Port of Tyne, Port of Blyth and the Ports of Teesport and Hartlepool
- north west inshore marine plan area: the Port of Heysham and the Ports of Liverpool & Garston.
- south west inshore marine plan area: The Port of Bristol and the Port of Plymouth.
- south east inshore marine plan area: the Port of Dover and the major ports of the greater Thames Estuary: Medway, London and Harwich.

Given the large number of European sites screened into the AAIR, the considerable overlap between many of these sites with regard to impact pathways, and the limited opportunity for detailed analysis, the AAIR was organised by vulnerable receptor group (interest feature): birds, habitats, fish and invertebrates, mammals. For each group of interest features the potential adverse effects on their ability to achieve their conservation objectives (and thus the integrity of the sites for which they are designated) was discussed, related to the interventions that the screened-in marine plan policies could deliver.

For each European site in the searchable Microsoft Excel database accompanying this report, a column was then added determining whether a conclusion of no adverse effect on integrity can be drawn. In making the judgments regarding likely significant effects on European sites from one or more of the seven new marine plans, account has been taken of the potential for these effects to arise 'in combination' with other plans and projects even if they might not arise from the seven new marine plans alone. There were three groups of plans and projects from which 'in combination' effects have been identified:

1) Effects in combination with other marine plans;
2) Effects in combination with terrestrial plans on the coast; and
3) Effects in combination with other plans within the marine environment.

The policy framework in each marine plan achieves the avoidance of adverse effects on site integrity, first and foremost, through the inclusion of policy MPA-1 in all seven marine plans. Policy MPA-1 requires proposals to demonstrate that they will, firstly, avoid adverse impacts on the conservation objectives of marine protected areas. Where adverse impacts on the objectives cannot be avoided they must be mitigated. Proposals that cannot avoid or mitigate adverse impacts will not be supported. By complying with MPA-1 to avoid and mitigate adverse impacts on the features and conservation objectives of European sites, proposals will avoid adverse effects on site integrity.

All seven marine plans contain a suite of policies to control many of the impact pathways identified in this AAIR. Policies WQ-1, UWN-2, AIR-1, ML-1, ML-2 and NIS-1 to NIS-2 set a general consenting framework to ensure that European sites are protected from any harmful deterioration in water quality or increase in underwater noise, atmospheric pollution, marine litter or invasive non-native species as a result of schemes that may be consented under other plan policies. In addition, policies BIO-1, BIO-3, BIO-4 and BIO-5 also address protection of European sites as part of their general requirement to protect and enhance habitats and species in the marine and coastal environment, including a hierarchy of avoid, minimise or mitigate effects.

Despite this, it has not been possible to conclude no adverse effect on integrity without mitigation for a large number of European sites. Note that this is not due to a large number of adverse effects having been definitively identified but rather due to the very limited information available (by design) at the plan level regarding the proposals that may come forward in each marine plan area. This has meant that using the precautionary principle, adverse effects on integrity cannot be dismissed for most European sites until individual projects are devised and can be scrutinised in detail.

It is therefore necessary to introduce further mitigation measures into all seven marine plans before a conclusion of no adverse effect on integrity can be drawn. Given the limited information available on proposals, the 'mitigation' in the plans will need to consist of a policy framework that explicitly prevents proposals coming forward unless they are able to demonstrate that they can avoid adverse effects on the integrity of European sites. This is in line with advice from the European Court of Justice regarding the 'tiering' of HRAs where there are multiple levels of plan-making, recognising that the purpose of a high level plan is to set out broad policies and intentions without going into any detail. When the UK was first required to undertake HRA of plans, Advocate-General Kokott commented on the apparent tension between the requirements of the Habitats Directive and the intentionally vague nature of high level strategic plans. She responded that to address this apparent tension '*It would …hardly be proper to require a greater level of detail in preceding plans* [rather than lower tier plans or planning applications] *or the abolition of multi-stage planning and approval procedures so that the assessment of implications can be concentrated on one point in the procedure. Rather, adverse effects on areas of conservation must be assessed at every relevant stage of the procedure to the extent possible on the basis of the precision of the plan* [emphasis added]*. This assessment is to be updated with increasing specificity in subsequent stages of the procedure'* [i.e. for planning applications or lower tier plans] (Opinion of Advocate-General Kokott, 2005).

Having assessed the impacts on European sites to the fullest extent possible without further detail on projects that might be delivered under plan policies, the focus must now therefore be turned to the further policy mechanisms which must be enshrined in the plans to protect European sites. In considering this, it is important to note that this issue has already been identified and tackled to the satisfaction of statutory consultees in several other English marine plans (most recently the South Marine Plan). This has informed our advice.

Three key policy measures are proposed to provide the necessary assurances that the marine plans as a whole will have no adverse effect on the integrity of European and Ramsar sites either alone or in-combination with other plans or projects. These are as follows:

- Explicitly enshrining the requirement for project-level HRA in the marine plans – since it is not possible to rule out adverse effects on the integrity of many European sites due simply to the high level nature of the marine plan policies, 'down-the-line' assessment becomes essential. There thus needs to be an explicit policy framework for this incorporated into the marine plans to ensure that applicants and scheme promoters are aware of the need for HRA (even if

only to confirm no likely significant effects) for all schemes and that this must consider effects in combination with other plans and projects.

- Consideration of matters that cross the terrestrial/marine environment planning borders when determining the acceptability of schemes – with regard to the public access promotion policies in particular (ACC-1, SOC-3, FISH-2, TR-1, TR-2 and TR-4), there is a risk that issues which span the marine/coastal and terrestrial environment are overlooked because they fall between planning responsibilities. Examples have been given in this HRA of coastal and estuarine European sites within each marine plan area that are identified to be at risk from increased recreational pressure due to housing development and which have a mitigation strategy in place. The marine plans must allow for these strategies to be considered when promoting access to the coastal and marine environment to ensure no conflict between local authorities delivering measures to manage recreation and marine plan policies which promote improved coastal access. An existing mechanism to facilitate this collaboration is the Coastal Concordat for England(Defra, 2013). Although not all coastal local authorities are signatories to the Concordat, the implementation plan for the Concordat addresses this by stating that '*For projects that meet the criteria for the coastal concordat[2], but are in areas where the local authority has not yet implemented the concordat, officers should apply the concordat principles in partnership with the other concordat bodies as far as possible…'*. It is recommended that the supporting text for the access policies in all seven marine plans acknowledges the balance to be struck between supporting increased access to the coast and marine environment and potential conflicts with European site conservation objectives and that particularly close attention will be given to ensuring any access provision schemes are compatible with conservation objectives and any existing or future recreational pressure mitigation strategies devised by coastal local authorities.
- A monitoring and Iterative Plan Review (IPR) provision – monitoring is not mitigation; however, where there is a lack of detail over the precise effects of a plan (because, as in this case, the purpose of the plan is to set over-arching policy, not present specific proposals), an Iterative Plan Review process enables the delivery of development to be managed and the plan (and its HRA) to be updated in future reviews. It involves recognising the fact that development associated with policies in the plan will not be delivered all at once but piecemeal over the entire plan timetable. This process will involve a phased and iterative approach to plan-implementation which is linked to ongoing project developments and their associated monitoring work and with the findings from such project-level work feeding back into the next phases of plan-implementation. This is done so that results from monitoring data from consented projects and on-going research programmes can be fed into subsequent developments in order for lessons to be learnt and evidence gaps filled, thus reducing potential impacts to European sites.

[2] In other words, that the footprint of the proposed development (and any ancillary infrastructure) is both terrestrial and has elements that fall below Mean High Water Springs within an estuary or on the coast, that the development requires multiple consents including both a marine licence and a planning permission, and that there are no other coordination mechanisms in place, for example under the Planning Act 2008.

The first and last of these measures match recommendations made in the AAIR the South Marine Plan. The second has been introduced specifically for this AAIR.

With the inclusion of the identified policy changes it is considered that a policy framework exists that will ensure no adverse effects on the integrity of European sites arise in practice on any European sites, even though (by design) insufficient detail exists in the plans to enable individual proposals to be assessed against specific European sites, or allows project-specific mitigation measures to be discussed. This is entirely in line with advice from the European Court of Justice regarding the 'tiering' of HRAs where there are multiple levels of plan-making. It is, however, essential that individual projects and plans within the marine environment are subject to HRA such that the intentions of the protective policy framework are delivered in practice.

It should be noted, however, that this conclusion for the seven marine plans does not prejudge any conclusions for individual projects that may come forward. For some schemes the opportunities to mitigate adverse effects will potentially be very limited (as Natural England has already flagged for wind farm proposals in the southern North Sea for example). Moreover, a series of rulings from the European Court of Justice have emphasised that even small amounts of permanent loss of qualifying habitat within a European site could constitute an adverse effect on integrity. Therefore, the mitigation hierarchy must be followed (avoid, then mitigate) and scheme proponents should engage at a suitably early stage with the relevant statutory nature conservation bodies (SNCBs) and the relevant decision maker, such as the Marine Management Organisation to ensure that the deliverability of their scheme is examined at an early stage.

1. Introduction

1.1. Background of the project

In 2016 AECOM was appointed by the Marine Management Organisation (MMO) to undertake the Habitat Regulations Assessment (HRA) Pre-Screening for the North East Inshore and Offshore, North West Inshore and Offshore, South East Inshore and South West Inshore and Offshore Marine Plans (herein North East, North West, South East and South West Marine Plans or the seven marine plans) (illustrated in Annex A Figures 1 to 7 of the Pre-Screening Report (AECOM, 2016)).

In late 2018 AECOM were appointed to undertake the next stages of the process, namely the HRA Screening (determination of likely significant effects) and the Appropriate Assessment Information Report (AAIR). The final report determining likely significant effects was delivered in April 2019. A draft version of that report was circulated to Natural England, Scottish Natural Heritage, Natural Resources Wales, the Joint Nature Conservation Committee and the Northern Ireland Department of Agriculture, Environment and Rural Affairs. This report has been updated to take account of their comments.

Since that time an Appropriate Assessment Information Report has been produced, taking forward the assessment of the policies that could not be concluded to result in no likely significant effect on European sites.

Note that since the assessment of likely significant effects was completed some policies have been merged while others have been deleted or renumbered. The AAIR therefore uses the latest policies and numbering.

1.2. Legislation

The need for HRA is set out within Article 6 of the European Commission Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora 1992 (referred to as the Habitats Directive), and interpreted into English and Welsh law by the Conservation of Habitats & Species Regulations 2017 (as amended) and the Conservation of Offshore Marine Habitats and Species Regulations 2017 (as amended). The Habitats Directive is enacted by all other full members of the European Union by various pieces of country specific legislation. The ultimate aim of the Habitats Directive is to '*maintain or restore, at favourable conservation status, natural habitats and species of wild fauna and flora of Community interest'* (Habitats Directive, Article 2(2)). This aim relates to habitats and species, not the European sites themselves, although the sites have a significant role in delivering favourable conservation status. European sites (also called Natura 2000 sites) can be defined as actual or proposed/candidate Special Areas of Conservation (SAC), Special Protection Areas (SPA) or Sites of Community Importance (SCI). It is also government policy for sites designated under the Convention on Wetlands of International Importance (Ramsar sites) to be treated as having equivalent status to Natura 2000 sites.

The Habitats Directive applies the precautionary principle to protected areas. Plans and projects can only be permitted having ascertained that there will be no adverse effect on the integrity of the site(s) in question. In the case of the Habitats Directive, plans and projects may still be permitted if there are no alternatives to them and

there are Imperative Reasons of Overriding Public Interest (IROPI) as to why they should go ahead. In such cases, compensation would be necessary to ensure the overall integrity of the site network. In order to ascertain whether or not there is potential for site integrity to be affected, a HRA should be undertaken of the plan or project in question.

Habitats Directive 1992

Article 6 (3) states that:
"Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives."

Conservation of Habitats & Species Regulations 2017 (as amended)

The Regulations state that:
"*A competent authority, before deciding to … give any consent for a plan or project which is likely to have a significant effect on a European site … shall make an appropriate assessment of the implications for the site in view of that sites conservation objectives… The authority shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the European site*".

1.3. The north east, north west, south east and south west inshore and offshore marine plan areas

Available guidance indicates that the following European sites should be included in the scope of assessment:

- All European sites within a marine plan area boundary; and
- Other sites shown to be linked to development within the marine plan area boundary through a known 'pathway' (discussed below).

Briefly defined, pathways are routes by which a change in activity within the marine plan area can lead to an effect upon a European site.

In addition to sites that have a formal designation (SAC, SPA, Ramsar site etc.) the compilation of the European site database also covered areas that have been identified as providing 'compensation', within the meaning of the Habitats Directive, for adverse effects on integrity of European sites arising from existing consented projects and plans. These areas of compensation are intended, in the fullness of time, to form part of the Natura 2000 network and must therefore be protected to the same standard as candidate, proposed and designated European sites. The list of compensation areas was derived from a website hosted by ABPMer(OMREG, 2018). Natural England indicated that there were several additional areas of compensatory habitat that should be added to the list, particularly in the Thames Estuary. These have been added to the database.

Consideration was given to expanding the bulleted list above to include specific

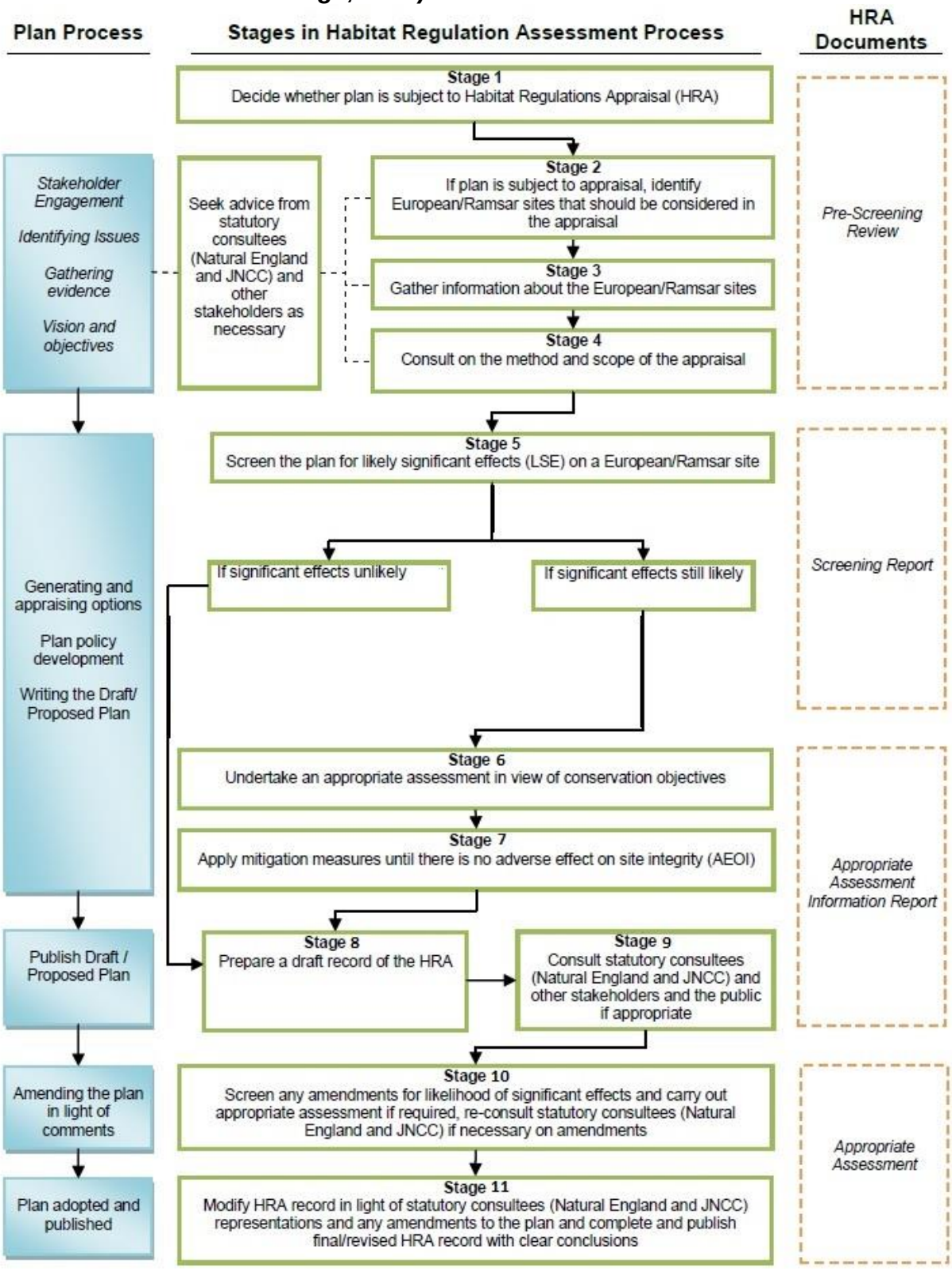
areas that may fall outside the boundary of a European site but which are known to constitute ‘functionally linked’ habitat that support, for example, a significant proportion (often defined as 1% or more of the European site population) of the species population for which a nearby European site was designated. However, it was ultimately decided that there weren’t any additional areas to add, firstly because the 100km buffer (or other zones regarding long-distance foraging birds, migratory fish and marine mammals) would already effectively capture most supporting habitat and secondly because the areas of supporting habitat that have been most clearly identified in research are inland fields used by SPA birds; these fields are unlikely to be affected by marine proposals.

There is considerable overlap between Ramsar sites and SACs/SPAs in terms of physical extent and interest features. It is recognised that a Ramsar site is an important separate designation but to avoid making the database unnecessarily long a separate row was not included for Ramsar sites except for the small number that do not physically overlap with an SPA and/or SAC designation. For all other Ramsar sites Column F of the database states whether the site also overlaps with a Ramsar designation. Ramsar citations do sometimes contain species or interest features that are not covered by the SAC or SPA designation. These features are primarily species of wetland plant and invertebrate, but also include natterjack toad (for the Ribble & Alt Estuaries, Upper Solway Flats and Marshes, Dee Estuary, Duddon Estuary and Humber Estuary) and grey seal (for the Humber Estuary). For reasons of space in the database it does not itemise those interest features of the overlapping Ramsar site that are not also on the SPA or SAC designation, with the exception of grey seal population of the Humber Estuary. That site/feature combination was the only one that contained a specific long-distance interest feature (marine mammals) that was not duplicated on the SAC citation. The authors are confident that these differences would not lead to any of the ‘scoped out’ European sites being ‘scoped in’. A link to all UK Ramsar site citations is provided in the database. For project-level HRAs that follow on from this plan-level HRA Ramsar sites may need to be discussed separately depending on the nature of the project and potential impact pathways.

2. Methodology

The methodology for the Habitats Regulations Assessment (HRA) follows that devised for Scottish Natural Heritage and which the MMO has adopted for its HRA work. The HRA process set out in that guidance is shown in Figure 1.

Figure 1: Stages of the HRA process for marine plans in England (adapted from Scottish Natural Heritage, 2015).



The guidance divides the whole plan-level HRA process into 13 distinct stages which provides a clear process that can be followed for plan-level HRAs. However, taking account of recent case law clarifying when mitigation can be taken into account in the HRA process, AECOM has revised the process to constitute 11 stages.

The Pre-Screening Report (2016) constituted a scoping exercise for the HRA proper and covered Stages 1 to 4 in the process set out in Figure 1. The screening assessment constituted Stage 5. The AAIR constitutes Stages 6 to 9.

Section 2.1 below sets out the Pre-Screening methodology that was followed in 2015 to arrive at the master list of European sites for consideration. This is relevant to reproduce because it set the parameters for the ecological scope of the HRA process. Section 2.2 then explains the amendments that were made to this methodology to update the European site list for this Screening report, given that several years had passed since Pre-Screening. The methodological changes were made in response to advice in January 2019 from the following statutory nature conservation bodies:

- Natural England (NE),
- Natural Resource Wales (NRW),
- Department of Agriculture, Environment and Rural Affairs (DAERA),
- Scottish Natural Heritage (SNH) and
- the Joint Nature Conservation Committee (JNCC).

2.1. Scoping the European sites for inclusion

For practicality the second and third stages in Scottish Natural Heritage (2015) were combined. These stages consist of identifying European sites that require consideration and collecting background information about them. It was necessary to potentially consider all the European sites that form part of the Natura 2000 network (Special Areas of Conservation, Special Protection Areas, Sites of Community Importance and proposed or candidate SPAs or SACs) within the broad area of influence of the plans.

However, there is recognised precedent set by the approach undertaken for adopted Marine Plans (the East Marine Plan and South Marine Plan) for constraining the list of European sites to be considered. For the Pre-Screening of other marine plans, a 100 kilometre (km) buffer zone was drawn around the marine plan areas, and the UK and Transnational designated European and Ramsar sites that lay within that buffer were scoped into the subsequent HRA process. This was because a 100km buffer was deemed to be a quantifiable and objective area that is likely to encompass many of the mobile species interest features within designated sites that could be indirectly affected by the marine plans; for example, most seabirds are known to forage within 100km of their breeding sites. AECOM therefore used a similar buffer for consistency in assembling the database.

It was recognised that for some species groups a 100km buffer would not capture all potentially affected European sites. These groups are:

- Diadromous (migratory) fish. There are European sites in the UK that are designated for the following species of migratory fish: Atlantic salmon (*Salmo salar*), twaite shad (*Alosa fallax*), allis shad (*Alosa alosa*), river lamprey

(*Lampetra fluviatilis*) and sea lamprey (*Petromyzon marinus*). These species are known to travel much further than 100km on migration;
- Freshwater pearl mussel (*Margaritifera margaritifera*). This species is dependent on anadromous fish (specifically Atlantic salmon but also brown trout) for part of its life cycle[3] (Skinner et al, 2003) and as such can be affected by works occurring more than 100km from SACs designated for the species, if those works affect fish migration;
- Migratory birds and long-distance foraging seabirds. Birds on migration will travel thousands of miles while seven species of seabird for which SPA/Ramsar sites are designated are known to regularly forage more than 100km from their nesting sites. These are kittiwake (*Rissa trydactyla*), fulmar (*Fulmarus glacialis*), storm petrel (*Hydrobates pelagicus*) lesser black-backed gull (*Larus fuscus*), puffin (*Fratercula arctica*), Manx shearwater (*Puffinus puffinus*) and gannet (*Morus bassanus*); and
- Marine mammals. The four species of marine mammal for which SACs are designated are known to potentially travel much further than 100km. These are common seal (*Phoca vitulina*), grey seal (*Halichoerus grypus*), harbour porpoise (*Phocoena phocoena*) and bottlenose dolphin (*Tursiops truncatus*).

To address these groups the Pre-Screening exercise was therefore amended from simply applying a 100km buffer as follows.

Migratory (diadromous) fish and freshwater pearl mussel

For previous marine plan HRAs, the fact that works within a marine plan area could affect SACs more than 100km distant if they disrupt fish migration was accounted for by dividing the seas around the UK into particular regions for migratory fish. These regions are based on work by ABPMer (2017) and are shown on Figure 6 of the Pre-Screening Report (2016). For consistency, this HRA Pre-Screening exercise therefore used the same region boundaries.

If a marine plan area overlapped with a particular region, then all European sites within that region for which diadromous fish are an interest feature were scoped into the HRA. Equally, if a major migratory route for an anadromous fish region passed through a marine plan area, then all European sites within that region for which for which anadromous fish are an interest feature were scoped into the HRA. This was on the basis that, with the level of detail currently available about the marine plans, potential disruption of migration could not be dismissed.

For example, the River Itchen SAC, which is designated for Atlantic salmon (and supports populations of river lamprey and sea lamprey), was scoped into the HRA for both the south west marine plan areas and the south east marine plan area on the basis that it is located within the south east marine plan area and migratory fish are likely to traverse the south west marine plan areas in order to reach the SAC.

As another example, the River Tweed SAC, which is designated for Atlantic salmon, river lamprey and sea lamprey, was scoped into the HRA for the south west, south east and north east marine plan areas (despite being located well over 100km from

[3] Glochidia attached to the gills of juvenile fish encyst, live and grow in the hyper-oxygenated environment until the following spring. They drop off in May and early June.

the first two) because, based on the information on migratory routes obtained from ABPMer (2017) and Malcolm et al (2010) fish migrating to the River Tweed may pass through the English Channel and up the east coast of England to reach the SAC. As such, works in any of these marine plan areas (including the east marine plan area which is not part of the scope of this project) could, pending further investigation, affect that SAC.

On the other hand, there are several SACs designated for migratory fish in north east Scotland which were scoped out on the basis that the mapping of main migratory routes and Malcolm et al (2010) suggests that the main migratory routes to these sites are from the north and thus would not involve passage through any of the marine plan areas.

Long distance foraging birds

For long-distance foraging birds, the mean maximum foraging distances as expressed in Thaxter et al (2012) were used as a scoping criterion in the Pre-Screening Report (2016). This was done in order to keep this Pre-Screening exercise consistent with that for other marine plans. However, consultation with Natural Resources Wales indicated that another published paper (Riteniece et al (2015)) established that storm petrel (*Hydrobates pelagicus)* should also be included in the list of long-distance foraging seabirds. As such all European Sites supporting storm petrels are assessed using this updated distance.

The 'mean maximum' foraging distances are defined as the maximum range reported by a series of individual studies, averaged across those studies (with the exception of storm petrel, the inclusion of which is based on a single study). These mean maximum foraging distances are as follows:

- Fulmar *Fulmarus glacialis* (400 km);
- Manx Shearwater *Puffinus puffinus* (330 km);
- Gannet *Morus bassanus* (229 km);
- Storm Petrel *Hydrobates pelagicus* (150km);
- Lesser Black-Backed Gull *Larus fuscus* (141 km); and
- Puffin *Fratercula arctica* (105 km).

With regard to continued use of the mean maximum foraging distances for seabirds included in Thaxter et al (2012), Natural England, Scottish Natural Heritage and JNCC (all the organisations that commented) agreed with the continued use. However JNCC also suggested that if more recent and comprehensive material than Thaxter et al (2012) is available for a given species, this should be included. For example, for some species, Thaxter has a very small sample size or very old reference. However, reasonable judgement should be used, and justifications given, for any use of data more recent than Thaxter. For example, where new data indicate a revised foraging range, but the sample size is very small, it may not be appropriate to use the latest figures. JNCC recommended approaching Royal Society for the Protection of Birds (RSPB) directly to get information on their latest estimates of mean maximum foraging ranges using this new database. Both JNCC and Natural England specifically directed the authors to the RSPB FAME (Future of the Atlantic Marine Environment) and STAR (Seabird Tracking and Research) projects.

The RSPB FAME and STAR project website (RSPB, 2019b) was examined along with the associated technical report(Cleasby *et al,* 2018) and journal article (Wakefield *et al,* 2017). The detailed analyses currently available cover only four species: kittiwakes, guillemots (also known as murres), razorbills and shags. RSPB was contacted to confirm whether processed data are available for other species but data on other species will become available in the future as the number of tracking studies increase. The data available indicate that the kittiwake routinely forage further than Thaxter *et al* (2012) suggest; for example the hotspot for foraging kittiwake associated with the Flamborough Head & Bempton Cliffs SPA/Ramsar site in the north east of England extends approximately 160km from the SPA/Ramsar site at its greatest extent, compared to a mean maximum foraging distance reported in Thaxter et al (2012) of 100km. That said, it should be noted that the 160km distance is the maximum extent of the hotspot and was only observed in one direction (towards the south-east); in other directions from the SPA/Ramsar site the extent of the hotspot was much smaller. In this case, the data do not change the Pre-Screening database because this SPA/Ramsar site was already screened in due to being located within the north east marine plan area. The data indicate that this SPA/Ramsar site, Farne Islands SPA/Ramsar site and Skomer, Skokholm & the Seas of Pembrokeshire SPA/Ramsar site in Wales (for the latter two of which kittiwake is part of the breeding assemblage) are the only ones with a hotspot that overlaps with one of the marine plan areas in this assessment. These three SPA/Ramsar sites were therefore included in the Screening exercise and AAIR as the available hotspot data for this species is more detailed than the mean maximum foraging distance metric.

During the Pre-Screening exercise Scottish Natural Heritage cited monitoring data that indicate that the razorbill *Alca torda* population of Fair Isle SPA/Ramsar site forage more than 100km from the SPA/Ramsar site. However, that particular SPA/Ramsar site is remote from the marine plan areas in the assessment (376km away) and the FAME and STAR data on razorbills, guillemots and shags indicates that no razorbill SPAs that are located more than 100km from the marine plan areas have hotspots that overlap with the marine plan areas. As such, the relevant SPA/Ramsar sites for razorbill were assessed using a 100km buffer.

For each marine plan area in this assessment, European sites were scoped into the HRA if at least one of these species were among the interest features of the site and that marine plan area lay within the mean maximum foraging distance for that species. The decision to scope a European site into the HRA for a marine plan area was based on the bird with the greatest mean maximum foraging distance. It should be noted that all sites within 100km of a marine plan area were automatically scoped into assessment. It should also be noted that in order to scope sites into the assessment the full bird assemblage (i.e. the species list associated with the wetland of international importance criterion available under Article 4.2 of the Birds Directive) was examined for the presence of these species.

Although this process meant that SPA/Ramsar sites up to 400km from a marine plan area could be scoped into the HRA, this was tempered by consideration of the fact that these species generally do not travel for long distances over land in order to reach their foraging areas. For consistency with other marine plan HRAs (such as the South Marine Plan HRA (Marine Management Organisation, 2016),‘Long

distances' was defined as 50km or more. Therefore, any SPA/Ramsar site that had more than 50km of land intervening between it and the nearest marine plan area, and which did not lie within the mean maximum foraging distance to the closest marine plan area if tracing a pathway around the coast, was scoped out even if it was designated for one of the five long distance foraging bird species. In practice this meant that a large number of SPA/Ramsar sites on the west coast of Ireland were scoped out of the HRA despite being designated for these species. No UK SPA/Ramsar sites were entirely scoped out through application of this rule.

Note that to be precautionary, the mean maximum foraging distances were applied to all sites for which fulmar, gannet, kittiwake, storm petrel, lesser black-backed gull, puffin and Manx shearwater are qualifying features, rather than applying them only to those SPA/Ramsar sites designated for breeding populations of these species.

Migratory birds

During the Pre-Screening work both Natural England and Natural Resources Wales commented that migratory seabirds, waterfowl and waders will travel considerably further than 100km (or 400km) when on migration.

All European sites that support migratory bird species and are located within 100km of the marine plan areas are automatically included in the database. Due to the number of marine plan areas involved and the large combined size of the marine plan areas and their 100km buffers this effectively means that all SPA/Ramsar sites in Great Britain and along the east coast of Northern Ireland which contain migratory birds as either qualifying features or part of the assemblage are included in the database up to a diagonal line from approximately Ayr on the west coast of Scotland to Montrose on the east coast of Scotland. Migratory birds associated with SPA/Ramsar sites north of this line are unlikely to migrate south across England.

For the AAIR a detailed examination was undertaken of migratory routes for relevant species (i.e. those for which SPA/Ramsar sites are designated anywhere in the UK) and their intersection with locations for offshore wind turbine arrays. In order to do this JNCC recommended reviewing any publications on non-breeding season movements from recent advances on tracking technologies. They also directed us to a number of publications looking at the migration of specific species e.g. www.divertracking.com and to two tools that JNCC are aware of to inform analysis and provide information on identifying key migratory routes:

- The Strategic Ornithological Support Services Migration Assessment Tool (SOSSMAT) tool published under the SOSS Project https://www.bto.org/science/wetland-and-marine/soss/projects), associated with the report SOSS-05: Assessing the risk of offshore wind farm development to migratory birds designated as features of UK Special Protection Areas (and other Annex 1 species). This project reviewed available information on over-sea migration routes, timings and the flight heights of migrating seabirds, waterbirds and terrestrial birds that are features of UK Special Protection Areas, and how these vary, for example in response to weather conditions
- The Natural England Population sizes for Biologically Defined Minimum Population Scales (BDMPS) report (http://publications.naturalengland.org.uk/publication/6427568802627584),

which for example discusses the movements of relevant bird species such as fulmar on migration, including maps of key movement directions
- The Seabird Mapping and Sensitivity Tool (SeaMAST) GIS tool that can be requested from NE's GIS website, an overview here - *https://www.wwtconsulting.co.uk/new-tool-to-identify-areas-sensitive-to-seabirds-for-offshore-wind-farm-development/*.
- Furness, R.W. 2015. Non-breeding season populations of seabirds in UK waters: Population sizes for Biologically Defined Minimum Population Scales (BDMPS). Natural England Commissioned Reports, Number 164
- Publications that indicate that the southern North Sea and English Channel 'bottleneck' is an important route for North Sea breeding seabirds, notably Steinen et al (2007).

AECOM has made use of these data in conjunction with peer-reviewed journals and research when undertaking the AAIR of the European sites that may be affected by policies on offshore wind arrays (WIND-2), these being the only spatially specific policies in the seven marine plans that identify where development will be delivered rather than protecting a particular sector from conflicting developments. However, the areas identified as being potentially suitable for wind farms are large and complex and cover a large amount of each marine plan area. As such, the data available has not enabled a particularly detailed assessment of impacts.

In responding to the Screening Report, JNCC commented that it may not be appropriate to screen in entirely marine SPAs (as opposed to partially marine/coastal sites) into the assessment on the same basis as terrestrial SPA/Ramsar sites for breeding seabirds (i.e. using a 100km threshold). The conservation objectives for many features of marine SPAs relate to avoidance of mortality or disturbance within the site and maintenance of supporting habitat within the site. Therefore, they would not necessarily be screened in based on foraging ranges or large buffers designed to reflect the foraging range of breeding birds from colony location. In particular, the Irish Sea Front SPA, which is entirely offshore, includes conservation objectives relating to avoidance of mortality and disturbance within the site and maintenance of supporting habitat within the site, and for safe passage between breeding colonies and the site during breeding season. The JNCC has therefore advised that plan areas either within a small buffer of the site (they suggested approximately 10km may be appropriate) and/or directly between significant breeding colonies and the site, would be screened in. Since the Irish Seafront SPA is located 90km from the nearest marine plan area (the north west inshore) at its closest, AECOM concurs with JNCC that adverse effect would not occur to this SPA from any activities in any of the seven marine plan areas.

With regard to other European sites, AECOM is mindful of the emphasis that recent European Court of Justice rulings have placed on considering the impacts on interest features of European sites even when outside the European site in question. This is most notably clarified by the court in the Holohan et al vs. An Bord Pleanála (C-461/17) case. As a result AECOM has been intentionally cautious in screening sites into and out of assessment with regard to the potential for development well outside that site to nonetheless affect highly mobile interest features.

Marine mammals

Disturbance and mortality (particularly due to underwater noise) are particularly significant considerations for marine mammals under HRA given the standard conservation objective for Natura 2000 sites with these species as qualifying features: to avoid, in the Special Areas of Conservation, disturbance of the species. For example, as a result of disturbance, harbour porpoise density is significantly reduced for several kilometres away from seismic surveys and impact pile driving (e.g. Thompson et al (2013), Brandt et al (2011) and Dahne et al (2013)).

In order to capture all SACs for marine mammals that may be affected by works within a given marine plan area a 100km buffer was not used since this would be effectively arbitrary. Rather, reference was made to the Management Units identified for these species in work undertaken for the UK Inter-Agency Marine Mammals Working Group in 2013 (IAMMWG 2013), updated for cetaceans in 2015 (IAMMWG 2015). These Management Units are shown on Figures 5a to 5c of the Pre-Screening Report along with UK SACs designated for cetaceans. Note that not all of these SACs have been scoped into the further stages of HRA. The basis for scoping sites out is as follows.

The original intention was that where a marine plan area overlapped with a marine mammal Management Unit, all European sites within that Management Unit that were designated for the relevant marine mammal would be scoped into the HRA irrespective of distance. However, following consultation on the Pre-Screening methodology, JNCC commented that '*JNCC currently advise a buffer around porpoise pSACs of 50km for pile driving and a minimum of 15km for seismic surveys. JNCC advises that there is no potential for the Marine Plans to result in likely significant effects on sites with marine mammal qualifying features that are located further away than the 50km buffer recommended'*[4].

Consultation responses identified that no changes are required to the distances used for marine mammals, with the exceptions of Welsh and Irish sites. DAERA recommended that for Northern Irish sites designated for grey seal, a distance of 135km should be used for screening, rather than 50km.

Natural Resources Wales confirmed that they would expect the following sites designated for marine mammals to be screened into assessment irrespective of the fact that several lie more than 50km from any marine plan area: North Anglesey Marine, West Wales Marine, Bristol Channel Approaches, Lleyn Peninsula & The Sarnau, Cardigan Bay and Pembrokeshire Marine. All of these SACs are already included in the Pre-Screening database. However, North Anglesey Marine, West Wales Marine and Lleyn Peninsula & The Sarnau were scoped out of the HRA process for marine mammals as they were more than 50km from any marine plan area. That decision has therefore been revised for the Screening exercise. Natural Resources Wales also provided some detailed advice to aid judgments in the appropriate assessment stage. These have been taken into account in the AAIR.

[4] Email from JNCC Offshore Industries Advisor to AECOM dated 27th September 2016

Approach to terrestrial sites and freshwater sites

Sites with wholly terrestrial or freshwater interest features have been included within the database if they are located within 100km of a marine plan area or if they have an interaction with the marine environment (i.e. freshwater pearl mussel, migratory fish and sites supporting migratory birds).

It is recognised that there is potential for terrestrial and freshwater European and Ramsar sites located on the coast beyond the mean high water spring tide boundary to be affected by developments and activities associated with Marine Plan policy, such as cable/pipeline landfall locations, landside infrastructure and activities linked to construction and maintenance. Effects on terrestrial and freshwater sites could also result from developments and activities which change sediment dynamics (e.g. affecting sand dunes) or implement coastal realignment. This has been considered in making screening decisions. For example Penhale Dunes SAC and Godrevy Head to St Agnes SAC in Cornwall have both been screened in because they are immediately landwards of the south west marine plan area and there is thus potential for impacts from infrastructure.

In common with other marine plan HRAs, European sites within 100km of a given marine plan area that are designated for otter have been scoped into the HRA where the European site lies within 10km of the coast. This is on the basis otters will forage in coastal waters and could therefore potentially be affected by works in a marine plan area.

Accounting for hydrodynamics

It is mportant to recognise that activities within the geographic areas under review could indirectly affect habitats and species just outside their boundaries, not only through long-distance pathways such as noise, but because the sea is not a static environment but consists of moving packages of water. At this Screening stage a highly precautionary approach has been taken and any marine or coastal European site within 100km of a marine plan area has been screened in to trigger further consideration of hydrodynamic and sediment process changes.

For the AAIR however, this will be scrutinised more closely. As a general rule, impacts from hydrodynamic changes (i.e. erosion), sediment disturbance and sediment transport at any designated site that lies more than the distance of one tidal ellipse[5] away from a marine plan area boundary are unlikely to arise in practice. This is based on evidence from plume studies that even fine particles mobilised from the sea bed settle out again to a large extent within the distance of one tidal excursion. The average distance over which there could be a potential indirect effect, as defined by an average tidal ellipse, is around 10-15km. In the AAIR we have therefore used this as a typical indicator of potential water quality/sediment impacts outside each marine plan area.

2.2. Changes made to the European site list since Pre-Screening

The list of European sites contained in the Pre-Screening database continues to be valid. However, it has been identified by AECOM in consultation with the statutory

[5] Elliptical packages of water will move to and fro over one tidal cycle, typically along a dominant axis, returning to almost the same position. These are ‘tidal ellipses’.

nature conservation bodies that the following European sites have now progressed to full SPA designation:

- North Cardigan Bay;
- Northumberland Marine;
- Greater Wash;
- Falmouth Bay;
- Teesmouth and Cleveland Coast Extension (now subsumed into the Teesmouth and Cleveland Coast SPA)
- Liverpool Bay Extension (now subsumed into the Liverpool Bay SPA);
- Outer Thames Estuary Extension (now subsumed into the Outer Thames Estuary SPA); and
- Skomer, Skokholm and Seas off Pembrokeshire, which replaces and extends Skokholm & Skomer SPA.

In addition, the Irish Sea Front SPA was designated in January 2017, since the Pre-Screening database was completed. This site lies 90km from the north west marine plan areas at their closest and is designated for Manx Shearwater. It was therefore added to the database and considered at the screening stage. The Upper Solway Flats and Marshes SPA/Ramsar site is currently under the process of a new designation into a larger site called the Solway Firth potential Special Protection Area (pSPA). The extension is to encompass habitat for non-breeding red-throated diver, common scoter & goosander. In addition, non-breeding lapwing (*Vanellus vanellus*), ringed plover (*Charadrius hiaticula*), cormorant (*Phalacrocorax carbo*), common gull (*Larus canus*), black-headed gull (*Chroicocephalus ridibundus*) and herring gull (*Larus argentatus*) have been added to the existing SPA as part of the 2001 SPA review. The new site boundary proposed includes the marine waters west of the existing SPA/Ramsar site at Whitehaven (England) and Wigtown Bay (Scotland)(Scottish Natural Heritage, 2016).

The JNCC mentioned two new pSPA (Pentland Firth pSPA and Seas off St Kilda pSPA) and advised consideration of whether they are located within 400km of any of the marine plan areas and are designated for long-distance foraging seabirds[6]. Seas off St Kilda pSPA is over 400km from any marine plan area. While Pentland Firth pSPA is located within 400km of the north east offshore marine plan area (being 260km distant), it is proposed as an SPA because it regularly supports more than 1,000 breeding arctic tern pairs and that species does not appear on the list of long-distance foraging seabirds. The pSPA is also designated for its breeding seabird assemblage but examination of the SPA Site Selection Document indicates this is primarily due to its populations of common guillemot and arctic skua, neither of which is on the list of long-distance foraging seabirds. Therefore, Pentland Firth pSPA does not need to be added to the database.

AECOM has also identified that the following additional area of compensatory habitat needs adding to the database:

- Natural England directed AECOM to reports that identified six areas of compensatory habitat associated with the Thames Gateway Port and

[6] Those with a mean maximum foraging distance of more than 100km around their breeding sites.

Thames Estuary 2100 project and these also need adding to the database of compensatory habitat areas as they all lie within 100km of the south east marine plan area. These have been added to the database and taken into account during Screening.

2.3. Determining of Likely Significant Effects

The screening methodology was based on that devised and used for the East Marine Plans and the South Marine Plans, and Stages 5 to 7 of HRA set out in Scottish Natural Heritage (2015) guidance, but has been adapted to take into account recent (spring 2018) case law. The screening stages were:

- Stage 5: Screen the plan for likely significant effects on a European site.

This accounts for the fact that in spring 2018 the European Court of Justice made a ruling in the case People Over Wind and Sweetman v Coillte Teoranta (C-323/17) which clarified that 'measures to avoid or reduce' the effects of a plan or project can only legally be taken into account during the appropriate assessment stage of HRA, not during the screening (likely significant effects) stage.

Therefore, the HRA Screening does not take account of any measures to avoid or reduce the effects of the seven plans (i.e. mitigation) in the screening assessments and Stages 6 and 7 will be deferred to the appropriate assessment. An exception may be made for measures which are introduced to ensure compliance with other legislative requirements but which convey an incidental level of protection to European sites.

Since a key part of the Screening work undertaken for previous marine plans has in this case already been completed for the Pre-Screening Report (albeit some refinement was required as outlined in Section 2.2), and consideration of mitigation is not now legally permissible until the appropriate assessment, the Screening assessment determining Likely Significant Effects has comprised two steps, which both form part of Stage 5 of the SNH guidance:

- Policy Screening; and
- Ecological Screening.

Policy Screening

The policy screening was a simple sequential process aimed at 'screening out' those policies that could be identified early as having no likely significant effect, because they were environmentally positive, lacked any development promotion element, or have already been subject to HRA at another level which already fully covers the issues. Based on previously agreed principles adopted for the East and South Marine Plans HRAs policies that simply set out development control criteria (rather than promoting or supporting development) were deemed not to pose a likely significant effect. The same was true for policies that merely 'safeguarded' existing resources (i.e. existing minerals sites or dredge disposal sites) by preventing other incompatible development.

To do this, three criteria were used in order to screen out policies as follows:

- **Criterion 1:** Is the policy general, or does not promote development, such that is has no specific spatially definable implications for activities (i.e. it does

not direct, influence or clarify the nature and location of activities) with the marine plan area?

- **Criterion 2:** If likely significant effects can't be dismissed due to Criterion 1, has the policy been subject to a previous HRA and did that HRA fully explore the issue and is that HRA still valid (i.e. has there been a further change to proposals as originally assessed).
- **Criterion 3:** Does the policy change what was assessed in the previous HRA or bring greater clarity to sectoral plan elements? If it does, then it should still be taken forward for appropriate assessment.

If the response to Criterion 1 was 'Yes' the policy was immediately screened out from further assessment. For those that were not screened out after consideration of Criterion 1, Criteria 2 and 3 were looked at in conjunction to make an assessment as to the policy's potential to create a likely significant effect. Although they are included in the standard process for consistency with the HRA of adopted English marine plans (the East Marine Plans and South Marine Plans), **it can be confirmed that in practice no policies were screened out because of Criteria 2 and 3.**

It was noted that those policies that could not be screened out had broad aspects in common which enabled them to be grouped into categories at this Screening stage. For example, policies ACC-1, FISH-3 and TR-1 were all associated with enhanced public access and therefore could be grouped. The policies that could not be screened out were therefore grouped into one of seven policy categories that shared similar characteristics and likely impacts.

Having identified these categories, it was necessary to clarify the specific activity-based impact pathways that were relevant. A tabulated list of relevant generic impact pathways was produced. This follows the format, and where relevant the content of the impact matrixes which were created for previous plan-level HRAs (for example, ABPmer, 2013; ABPmer, 2014). According to these previously applied methods the pathways were separated into the standard 'categories of operations which may cause deterioration or disturbance'. These categories are used because they are identical to those devised for the HRAs of other English marine plans and were agreed with the consultees (including Natural England) when consulted on the HRA methodology:

- Physical Loss (of habitats) from removal or smothering.
- Physical Damage (of habitats and species) from siltation, erosion or physical injury/death.
- Non-Physical (indirect) Disturbance from noise or visual presence and reduced availability or displacement of species (including prey).
- Toxic Contamination from the introduction of synthetic compounds, introduction of non-synthetic contaminants.
- Non-Toxic Contamination from nutrient enrichment, organic enrichment, changes in suspended sediment and turbidity, changes in salinity or changes to the thermal regime.
- Biological Disturbance from introduction of microbial pathogens, the introduction of invasive non-native species and translocation, or from selective extraction of selected species.

Having identified the relevant generic impact pathways, the next stage was to review the individual activities that might affect designated sites and their interest features. The activities and the relevant environmental changes arising from them across each

of the categories were reviewed, and relevant interest feature groups that are sensitive to these changes were indicated. The results were presented again in a single tabular/matrix format in which the generic pathways were highlighted and grouped under the relevant standard 'categories of operations which may cause deterioration or disturbance'.

Ecological Screening

For this screening stage, there was a need to consider which of the sites included in the database will be affected by activities associated with the screened in policy categories.

Taking into account the interest features of the European sites, the impact distances discussed in Section 2.2, the physical location of the site in relation to each marine plan area, the conservation objectives for that site and the vulnerability of the interest features to the impacts associated with each policy category, a screening decision was made for each European site as to whether a likely significant effect from the activities within each 'screened in' policy category. Since the purpose of screening is to constitute an initial sift without undertaking detailed technical analyses, the assessment erred on the site of caution and screened in likely significant effects on sites unless there was a high degree of confidence they could be dismissed.

2.4. Appropriate Assessment Information Report (AAIR)

The purpose of the AAIR is to further explore the potential impacts and effects to determine whether a conclusion of no adverse effects on integrity can be drawn for any of the 'screened in' European sites designated for these receptors, based on the limited information available at the plan level regarding the potential outcomes of these policies.

Since most of the 'screened in' policies have very limited spatial information the AAIR is based on the sensitivity of the interest features of relevant European sites, rather than on the likelihood of effect, since the latter requires knowledge not only of the vulnerability of the species but also of the likelihood of specific activities and impacts occurring within sensitive areas; a level of detail that does not exist at the plan level. Taking a precautionary approach, it is therefore assumed that exposure of sensitive interest features to these impact pathways would occur in the absence of mitigation.

For a minority of policies (ACC-1, WIND-2, AQ-2 and PS-4) a greater level of spatial information does exist in as much as existing concentrations of such activities (public access, aquaculture sites, focal ports for short-sea shipping) are in known locations, or (in the case of WIND-2) there are maps showing broad locations within each marine plan area which may be suitable. However, even for these policies the level of spatial detail is intentionally limited and the purpose of policies AQ-2 and PS-4 in particular is to promote aquaculture and short-sea shipping wherever it is suitable, rather than just at existing locations. Nonetheless, this level of spatial information has been considered in the discussion in the AAIR.

Given the large number of European sites screened into the AAIR, the considerable overlap between many of these sites with regard to impact pathways, and the limited opportunity for detailed analysis, the AAIR is organised by vulnerable receptor group

(interest feature): birds, habitats, fish and invertebrates, mammals. For each group of interest features the potential adverse effects on their ability to achieve their conservation objectives (and thus the integrity of the sites for which they are designated) is discussed, related to the interventions that the screened-in marine plan policies could deliver.

For each European site in the searchable Microsoft Excel database accompanying this report, a column has then been added determining whether a conclusion of no adverse effect on integrity can be drawn.

Since it has not been possible to conclude no adverse effect on integrity without mitigation for a large number of European sites due to the limited information available at the plan level, the report concludes by discussing the mitigation measures that must be included in the seven marine plans to enable a conclusion of no adverse effect on integrity to be drawn. This is entirely in line with advice from the European Court of Justice regarding the 'tiering' of HRAs where there are multiple levels of plan-making. When the UK was first required to undertake HRA of plans, Advocate-General Kokott commented that '*It would …hardly be proper to require a greater level of detail in preceding plans* [rather than lower tier plans or planning applications] *or the abolition of multi-stage planning and approval procedures so that the assessment of implications can be concentrated on one point in the procedure. Rather, adverse effects on areas of conservation must be assessed at every relevant stage of the procedure <u>to the extent possible on the basis of the precision of the plan</u>* [emphasis added]*. This assessment is to be updated with increasing specificity in subsequent stages of the procedure*' (Opinion of Advocate-General Kokott, 2005).

3. Screening Results

3.1. Policy Screening Results

Table 1 below lists the policies for each marine plan and shows the results of the policy screening exercise. The table comprises the full list of policies within the seven marine plans against the three screening criteria in section 2 and highlights the reasons for screening the policy out (i.e. concluding no potential for likely significant effects (LSE)) or screening it in for appropriate assessment.

In summary the following policies were those which were screened in following the initial screening exercise, and the marine plan area to which the policies relate:

- TR-4 – North West Marine Plan only
- HAB-1 - South West Marine Plan only
- INF-3 – South East Marine Plan only
- INF-2 – North West and South West Marine Plans
- CCS-1 and CCS-2 – North East and North West Marine Plans
- EMP-3 – North East and South East Marine Plans
- INF-4 – North West, South East and South West Marine Plans
- TR-1, TR-2, REN-1, PS-4, INF-1, FISH-3, EMP-2, DD-4, CAB-1, CAB-2, AQ-2, ACC-2, SOC-3 and WIND-2 – apply to all seven Marine Plans.

Note that since that screening exercise was undertaken some policies have been deleted or merged and policy numbers have changed. This is discussed in the AAIR section of this report.

Table 1 Summary table of policy screening exercise based on screening Criterion 1, 2 and 3

Theme	Policy code: Policy Text	Potential for Likely Significant Effects?	Screening Criterion			Potential LSE?	Screened in for Test of Likely Significant Effects in marine plan area			
			1	2	3		North East	North West	South East	South West
Social	ACC-1: Proposals, including in relation to tourism and recreation, should demonstrate that they will, in order of preference: a) avoid, b) minimise, c) mitigate significant adverse impacts on public access.	This policy is criteria based and seeks to ensure proposals in the marine plan areas do not adversely affect existing public access. It does not promote or allocate tourism development within the marine plan areas.	Y	N/A	N/A	N				
Social	ACC-2: Proposals demonstrating appropriate enhanced and inclusive public access to and within the marine area, and that consider the future provision of services for tourism and recreation activities, will be supported.	This policy supports proposals for tourism and recreational services. As such, there is a possibility that issues relating to recreational pressure could pose a likely significant effect to European Sites located within the marine plan areas.	N	N	N/A	Y	✓	✓	✓	✓
Economy	AGG-1: Proposals in areas where a licence for extraction of aggregates has been granted or formally applied for should not be authorised, unless it is demonstrated that the other development or activity is compatible with aggregate extraction.	This policy is criteria based and seeks to ensure that aggregate resources are not sterilised through other conflicting development. It does not promote or allocate aggregate extraction/development within the marine plan areas.	Y	N/A	N/A	N				
Economy	AGG-2: Proposals within an area subject to an Exploration and Option	This policy is criteria based and seeks to ensure that development that is incompatible with Exploration	Y	N/A	N/A	N				

Theme	Policy code: Policy Text	Potential for Likely Significant Effects?	Screening Criterion			Potential LSE?	Screened in for Test of Likely Significant Effects in marine plan area			
			1	2	3		North East	North West	South East	South West
	Agreement with The Crown Estate should not be supported unless it is demonstrated that the other development or activity is compatible with aggregate extraction.	and Option Agreements does not occur in those areas. It does not promote aggregate extraction.								
Economy	AGG-3: Proposals in areas where high potential aggregate resource occurs should demonstrate that they will, in order of preference: a) avoid, b) minimise, c) mitigate significant adverse impacts on aggregate extraction, d) if it is not possible to mitigate significant adverse impacts, proposals should state the case for proceeding.	This policy is criteria based and seeks to ensure that aggregate resources are not sterilised through other conflicting development. It does not promote or allocate aggregate extraction/development within the marine plan areas.	Y	N/A	N/A	N				
Economy	AGG-4: Proposals requiring marine aggregates should give preference to the use of marine aggregates sourced from the South West marine plan areas. Where aggregates sourced from the South West marine plan areas are not appropriate, proposals should state the case for	This is a positive policy that does not promote aggregate extraction (which is controlled by the Crown Estate) but is aimed at maximising sustainable aggregate use in the south west marine plan area by requiring aggregate users in that area to prioritise aggregate from the same area rather than from more distant locations.	Y	N/A	N/A	N				

Theme	Policy code: Policy Text	Potential for Likely Significant Effects?	Screening Criterion			Potential LSE?	Screened in for Test of Likely Significant Effects in marine plan area			
			1	2	3		North East	North West	South East	South West
	proceeding without such locally sourced aggregates.									
Environment	AIR-1: Proposals that support a reduction in air pollution will be supported. Proposals must consider their contribution to air pollution, both direct and cumulative. Where developments are likely to result in or facilitate increased air pollution, proposals should demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate air pollution.	This is a positive policy aimed to reduce air pollution. This is criteria based and does not promote or allocate developments to reduced air quality within the marine plan areas.	Y	N/A	N/A	N				
Economy	AQ-1: Proposals in existing or within potential sustainable aquaculture production areas must demonstrate consideration of and compatibility with sustainable aquaculture production. Where compatibility is not possible, proposals must demonstrate that they will, in order of preference: a) avoid, b) minimise,	This policy is criteria based policy and is intended to ensure existing or potential aquaculture production areas are not sterilised by inappropriate alternative development. It does not promote or allocate aquaculture development within the marine plan areas.	Y	N/A	N/A	N				

Theme	Policy code: Policy Text	Potential for Likely Significant Effects?	Screening Criterion			Potential LSE?	Screened in for Test of Likely Significant Effects in marine plan area			
			1	2	3		North East	North West	South East	South West
	c) mitigate significant adverse impacts on sustainable aquaculture, d) if it is not possible to mitigate significant adverse impacts, proposals should state the case for proceeding.									
Economy	AQ-2: Proposals enabling the provision of appropriate infrastructure for sustainable fisheries, aquaculture and related industries will be supported.	This policy supports proposals for the infrastructure that enables fisheries, aquaculture and related industries. As such, there is the possibility that issues associated with such infrastructure would cause likely significant effects to European Sites located within catchment of the marine plan areas.	N	N	N/A	Y	✓	✓	✓	✓
Environment	BIO-1: Proposals that enhance or facilitate native habitat and species adaptation or connectivity, species migration or net environmental gain will be supported. Proposals that may have significant adverse impacts on species adaptation or connectivity, species migration or net environmental gain must	This is a positive policy aimed to enhance and facilitate marine and intertidal habitats and species. This is criteria based and does not promote or allocate developments that are expected to have significant adverse impacts within the marine plan areas.	Y	N/A	N/A	N				

Theme	Policy code: Policy Text	Potential for Likely Significant Effects?	Screening Criterion			Potential LSE?	Screened in for Test of Likely Significant Effects in marine plan area			
			1	2	3		North East	North West	South East	South West
	demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate significant adverse impacts on species adaptation or migration, native habitat connectivity or net environmental gain.									
Environment	BIO-3: Proposals that enhance coastal habitats where important in their own right and / or for ecosystem functioning and provision of ecosystem services will be supported. Proposals must take account of the space required for coastal habitats where important in their own right and / or for ecosystem functioning and provision of ecosystem services, and demonstrate that they will, in order of preference: a) avoid, b) minimise, c) mitigate for net loss of coastal habitats.	This is a positive policy intended to enhance and facilitate marine and intertidal habitats and species. This is criteria based and does not promote or allocate developments that are expected to have significant adverse impacts within the marine plan areas.	Y	N/A	N/A	N				
Environment	BIO-4: Proposals that enhance the distribution and net extent of priority	This is a positive policy intended to enhance the distribution of protected species and priority	Y	N/A	N/A	N				

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			1	2	3		North East	North West	South East	South West
	habitats and distribution of priority species in the North East marine plan area will be supported. Proposals must avoid reducing the distribution and net extent of priority habitats and other habitats priority species rely on.	habitats. This is criteria based and does not promote or allocate developments that are expected to have significant adverse impacts within the marine plan areas.								
Environment	BIO-5: Proposals must demonstrate that they will, in order of preference: a) avoid, b) minimise, c) mitigate significant adverse effects on marine or coastal natural capital assets, or d) if it not possible to mitigate significant adverse effects on marine or coastal natural capital assets proposals should state the case for proceeding. Proposals should seek to enhance marine or coastal natural capital assets where possible.	This is a positive policy aimed to safeguard marine and coastal natural capital assets. This is criteria based and does not promote or allocated development within the marine plan areas.	Y	N/A	N/A	N				
Environment	BIO-6: Public authorities with functions capable of affecting the North East marine plan areas should take measures to: a) avoid	This is a positive policy aimed to safeguard marine and coastal natural capital assets. This is criteria based and does not promote or allocated development within the marine plan areas.	Y	N/A	N/A	N				

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			1	2	3		North East	North West	South East	South West
	b) minimise c) mitigate significant adverse impacts on marine or coastal natural capital assets and should seek to enhance marine or coastal natural capital assets where possible.									
Environment	BIO-9: Proposals affecting the Severn Estuary must a) avoid, b) minimise, c) mitigate significant adverse impacts to the wide diversity of habitats and species in the Severn Estuary, including those which are not protected by designations. If significant adverse impacts cannot be mitigated, proposals must state their case for proceeding. Proposals within the Severn Estuary that integrate measures to protect and support habitat diversity and associated species, including those not protected by designations, will be supported.	This is a positive policy that safeguards the Severn Estuary from adverse impacts of any proposals within the marine plan areas. As such, this policy is not expected to pose as a likely significant effect to the integrity of European Sites.	Y	N/A	N/A	N				

Theme	Policy code: Policy Text	Potential for Likely Significant Effects?	Screening Criterion			Potential LSE?	Screened in for Test of Likely Significant Effects in marine plan area			
			1	2	3		North East	North West	South East	South West
Economy	CAB-1: Proposals which demonstrate due account to the potential for cable burial, interaction and coexistence with other users of the sea will be supported. Where burial is not achievable, decisions should take account of protection measures for the cable that may be proposed by the applicant. Where burial or protection measures are not appropriate, proposals should state the case for proceeding without those measures.	This policy supports proposals for cable burial. As such, there is the possibility that issues relating to disturbance due to construction could pose as a likely significant effect to European Sites and support features located within catchment of the marine plan areas.	N	N	N/A	Y	✓	✓	✓	✓
Economy	CAB-2: Proposals demonstrating compatibility with existing landfall sites and incorporating measures to enable development of future landfall opportunities should be supported. Where this is not possible proposals will, in order of preference: a) avoid b) minimise, c) mitigate significant adverse impacts, d) if it is not possible to	This proposal supports measures enabling the future development of landfall sites. At present it is not known what these measures entail, and so potential impact to European protected sites cannot be screened out.	N	N	N/A	Y	✓	✓	✓	✓

Theme	Policy code: Policy Text	Potential for Likely Significant Effects?	Screening Criterion			Potential LSE?	Screened in for Test of Likely Significant Effects in marine plan area			
			1	2	3		North East	North West	South East	South West
	mitigate significant adverse impacts, proposals should state the case for proceeding.									
Economy	CAB-3: Where seeking to co-locate to existing sub-sea cables, proposals should demonstrate how ongoing function, maintenance and decommissioning activities of the cable will be facilitated.	This policy is criteria based and does not promote or allocate sub-sea cables within the marine plan areas.	Y	N/A	N/A	N				
Environment	CC-1: Proposals must demonstrate that they will, in order of preference: a) avoid, b) minimise, c) mitigate consequences on other activities from unintended greenhouse gas emissions.	This is a positive policy aimed avoid and/ or minimise the emissions of greenhouse gases. This is criteria based and does not promote or allocate development within the marineplan areas.	Y	N/A	N/A	N				
Environment	CC-2: Proposals should demonstrate for the lifetime of the proposal that they: 1) are resilient to the effects of climate change and coastal change 2) will not have a significant adverse impact upon climate change adaptation measures elsewhere.	This is a positive policy aimed avoid and/ or minimise contributions to climate change. This is criteria based and does not promote or allocate development within the marine plan areas.	Y	N/A	N/A	N				

Theme	Policy code: Policy Text	Potential for Likely Significant Effects?	Screening Criterion			Potential LSE?	Screened in for Test of Likely Significant Effects in marine plan area			
			1	2	3		North East	North West	South East	South West
	In respect of 2) proposals should demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate the significant adverse impacts upon these climate change adaptation measures									
Environment	CC-3: Proposals in the North East marine plan areas and adjacent marine plan areas that are likely to have a significant adverse impact on coastal change should not be supported.	This is a positive policy aimed to prevent and safeguard the current conditions of the coast. This is criteria based and does not promote or allocate development within the marine plan areas.	Y	N/A	N/A	N				
Environment	CC-4: Proposals that enhance habitats that provide a flood defence or carbon sequestration will be supported. Proposals that may have a significant adverse impact on habitats that provide a flood defence or carbon sequestration ecosystem service must demonstrate that they will, in order of preference: a) avoid b) minimise	This is a positive policy aimed to enhance marine and costal habitats and to provide flood defence and carbon sequestration. This is criteria based and does not promote or allocate development within the marine plan areas.	Y	N/A	N/A	N				

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			1	2	3		North East	North West	South East	South West
	c) mitigate significant adverse impacts.									
Environment	CC-5: Public authorities with functions capable of affecting the marine area should: 1. consider long-term climate change projections and associated effects, including, but not limited to, the space required for the redistribution of priority habitats and species 2. consider support for people, infrastructure and components of the marine ecosystem that generate natural capital in adapting to change during their lifetime 3. not result in greenhouse gas emissions caused by unintended consequences on other activities 4. not lead to unnecessary increased demand for coastal protection in the future.	This is a positive policy encouraging public authorities to safeguard marine and costal habitats. This is a criteria based and does not promote or allocate development within the marine plan areas.	Y	N/A	N/A	N				
Environment	CC-6: Proposals that reduce or buffer carbon dioxide concentrations in	This is a positive policy that supports proposals that reduce or buffer carbon dioxide concentrations. This is criteria	Y	N/A	N/A	N				

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			1	2	3		North East	North West	South East	South West
	seawater should be supported.	based and does not promote or allocate development within the marine plan areas.								
Economy	CCS-1:Carbon Capture Usage and Storage proposals incorporating the re-use of existing oil and gas infrastructure will be supported.	This policy supports the re-use of existing infrastructure, which is positive, but without further details such reuse has the potential for impact to European protected sites.	N	N	N/A	Y	✓	✓	N/A	N/A
Economy	CCS-2: During the decommissioning phase of oil and gas facilities the potential for re-use of infrastructure in particular for Carbon Capture Usage and Storage should be considered.	This policy supports the re-use of existing infrastructure, which is positive, but without further details such reuse has the potential for impact to European protected sites.	N	N	N/A	Y	✓	✓	N/A	N/A
Environment	CE-1: Proposals which may have cumulative or in-combination effects with other existing or authorised developments or activities must demonstrate that they will, in order of preference, a) avoid, b) minimise, c) mitigate significant cumulative or in-combination effects.	This is a positive policy that ensures proposals are assessed in-combination with other plans and projects across the marine plan areas. This is criteria bases and does not promote or allocate development within the marine plan areas.	Y	N/A	N/A	N				
Environment	CE-2: Proposals should provide information to address the cumulative effects arising from the	This is a positive policy that ensures that the cumulative effects of proposals are assessed before granting permission. This is criteria	Y	N/A	N/A	N				

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			1	2	3		North East	North West	South East	South West
	proposed project upon the environment within and adjacent to the marine plan area.	bases and does not promote or allocate development within the marine plan areas.								
Governance	CO-1: Proposals should demonstrate that they will optimise the use of space and consider opportunities for co-existence and co-operation with existing activities, providing benefits to existing activities where appropriate. If proposals cannot avoid significant adverse impacts of their activity (including displacement) on existing activities in the marine plan areas they must, in order of preference: a) minimise, b) mitigate significant adverse impacts or c) if it is not possible to mitigate significant adverse impacts, proposals should state the case for proceeding.	This policy seeks to minimise the footprint for development and does not promote or allocate development within the marine plan areas.	Y	N/A	N/A	N				
Governance	DD-1: In areas of authorised dredging activity, including those subject to navigational dredging, proposals for other activities will not be	This policy is criteria based and is intended to ensure authorised dredging areas are not sterilised by inappropriate development. It does not promote or allocate dredging	Y	N/A	N/A	N				

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			1	2	3		North East	North West	South East	South West
	supported unless they are compatible with the dredging activity.	activity within the marine plan areas.								
Governance	DD-2: Proposals that cause significant adverse impacts on licensed disposal areas should not be supported. Proposals that cannot avoid such impacts must, in order of preference (a) minimise, (b) mitigate or (c) if it is not possible to mitigate the significant adverse impacts, proposals must state the case for proceeding.	This policy is criteria based and does not promote or allocate licensed development within the marine plan areas.	Y	N/A	N/A	N				
Governance	DD-3: Proposals for the disposal of dredged material must demonstrate that they have been assessed against the waste hierarchy. If creation of waste from dredging cannot be prevented, where practicable, dredged material must be put to alternative use.	This is a positive policy that ensures the disposal of dredged material is correctly managed. This is a criteria policy and does not allocate areas for disposal within the marine plan areas.	Y	N/A	N/A	N				
Governance	DD-4: Proposals identifying new dredge disposal sites which are subject to best practice and guidance from previous studies should be supported. Proposals will	This policy supports proposals for new dredge disposal sites. As such, there is the possibility of issues relating to the spread of invasive, noise, pollution and disturbance. These impact pathways could pose	N	N	N/A	Y	✓	✓	✓	✓

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			1	2	3		North East	North West	South East	South West
	include an adequate characterisation study, be assessed against the waste hierarchy and must be informed by consultation with all relevant stakeholders.	as likely significant effects to European Sites located within catchment of the marine plan areas.								
Social	DEF-1: Proposals in or affecting Ministry of Defence areas should only be authorised with agreement from the Ministry.	This policy does not promote or allocate development within the marine plan areas.	Y	N/A	N/A	N				
Environment	DIST-1: Proposals within the North East marine plan areas and adjacent plan areas must demonstrate that they will, in order of preference: a) avoid, b) minimise, c) mitigate significant disturbance to, or displacement of, highly mobile species.	This policy is criteria based and does not promote or allocate development within the marine plan areas.	Y	N/A	N/A	N				
Environment	DIST-3: Proposals, including those that increase access to the North East marine plan areas, must demonstrate that they will, in order of preference: a) avoid b) minimise	This policy is criteria based and does not promote or allocate development within the marine plan areas.	Y	N/A	N/A	N				

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			1	2	3		North East	North West	South East	South West
	c) mitigate adverse impacts on priority habitats.									
Social	EMP-1: Proposals that develop skills related to marine activities, particularly in line with local skills strategies, will be supported.	Promotion of skills will not necessarily result in any increased use or increased development of the marine environment but is more associated with ensuring training is available so certain trades don't die out (for example). This policy is concerned only with developing skills and does not promote or allocate development within the marine plan areas.	Y	N/A	N/A	N				
Social	EMP-2: Proposals resulting in a net increase to marine related employment will be supported, particularly in areas identified as the most deprived and /or where the proposals are in line with the skills available in and adjacent to the North East marine plan areas.	This policy supports proposals that increase employment opportunities related to the marine industry. As such, there is a possibility of likely significant effects on European Sites.	N	N	N/A	Y	✓	✓	✓	✓
Social	EMP-3: Proposals that promote employment, diversity of opportunities, implementation of new technologies and promote skills related to marine activities, particularly in line	This policy supports proposals that increase employment opportunities and new technologies related to the marine industry. As such, there is the possibility of likely significant effects arising to European Sites located within the marine plan areas.	N	N	N/A	Y	✓	N/A	✓	N/A

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			1	2	3		North East	North West	South East	South West
	with local skills strategies, will be supported.									
Social	EMP-4: Public authority functions related to employment and skills development must take account of current and future marine activities.	This policy simply identifies that marine activities must be taken into account, so will not have any impact on European protected sites.	Y	N/A	N/A	N				
Social	FISH-1: Proposals supporting a sustainable fishing industry, including the industry's diversification and or enhanced resilience to the effects of climate change, should be supported.	This policy supports the improvement of current fishing practices to ensure the industry is sustainable. By definition a 'sustainable' fishing industry is one that will not adversely affect internationally important wildlife sites.	Y	N/A	N/A	N				
Social	FISH-2: Proposals that may have significant adverse impacts on access to or within aquaculture sites, or fishing activities, must demonstrate that they will, in order of preference: a) avoid, b) minimise, c) mitigate significant adverse impacts, d) if it is not possible to mitigate the significant adverse impacts, proposals should state the case for proceeding.	The policy does not promote activities outside of that which are already occurring and exists to protect current fishing and aquaculture activity.	Y	N/A	N/A	N				
Social	FISH-3: Proposals that enhance access to or within	This policy promotes access within areas subject to aquaculture and	N	N	N/A	Y	✓	✓	✓	✓

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			1	2	3		North East	North West	South East	South West
	aquaculture sites, or fishing activities, should be supported.	fishing activities so there is potential for significant effects to European protected sites.								
Social	FISH-4: Proposals enhancing essential fish habitat, including spawning, nursery and feeding grounds, and migratory routes should be supported. If proposals cannot enhance essential fish habitat, they must demonstrate that they will, in order of preference: a) avoid, b) minimise, c) mitigate significant adverse impact on essential fish habitat, including spawning, nursery and feeding grounds, and migration routes.	This policy promotes the enhancement of fish habitat, and so no adverse impacts to European protected areas would be expected.	Y	N/A	N/A	N				
Governance	GOV-1: Proposals that consider transboundary impacts throughout the lifetime of the proposed activity will be supported. Proposals that impact upon one or more marine plan areas or marine proposals that impact upon terrestrial environments must show	This policy promotes improving the assessment of potential impacts associated with activities, and so no adverse impacts to European protected areas would be expected.	Y	N/A	N/A	N				

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			1	2	3		North East	North West	South East	South West
	evidence of the relevant public authorities (including other countries) being consulted.									
Environment	HAB-1: Proposals which incorporate measures to support the resilience of deep sea habitats will be supported. Proposals which may have significant adverse impacts on deep sea habitats must demonstrate that they will, in order of preference, a) avoid, b) minimise c) mitigate significant adverse impacts on deep sea habitats.	This policy promotes activity of potential benefit to deep sea habitats. However, depending on the details of how those proposals may be delivered there could still be negative effects on European sites	N	N	N/A	Y	✓	✓	✓	✓
Social	HER-1: Proposals that demonstrate they will enhance elements contributing to the significance of heritage assets will be supported. Proposals unable to enhance elements contributing to the significance of heritage assets will only be supported if they	This policy is not closely related to activities with potential to have an adverse impact on European protected areas.	Y	N/A	N/A	N				

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			1	2	3		North East	North West	South East	South West
	demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate harm to the enhance elements contributing to the significance of heritage assets d) if it is not possible, to minimise or mitigate, then the public benefits for proceeding with the proposal must outweigh the harm to the significance of heritage assets.									
Governance	INF-1: Appropriate land based infrastructure which facilitates marine activity (and vice versa) should be supported.	This proposal supports the development of infrastructure, which could have a significant effect on European protected areas.	N	N	N/A	Y	✓	✓	✓	✓
Governance	INF-2: Proposals for appropriate infrastructure that facilitates the diversification or regeneration of marine industries should be supported.	This proposal supports the development of infrastructure and industry, which could have a significant effect on European protected areas.	N	N	N/A	Y	N/A	✓	N/A	✓
Governance	INF-3: Proposals for alternative development at existing landing facilities will not be supported unless	Whilst this policy does not directly propose new development, it does suggest that under certain circumstances development of new	N	N	N/A	Y	N/A	N/A	✓	N/A

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	that facility is no longer viable or capable of being made viable for waterborne transport. Proposals adjacent and opposite existing landing facilities, including safeguarded wharves, must demonstrate that they will in order of preference: a) avoid, b) minimise c) mitigate significant adverse impacts on existing facilities.	facilities will be supported. This may have potential to impact upon European protected sites.								
Governance	INF-4: Public authorities with functions capable of affecting the marine area should ensure provision for appropriate land-based infrastructure that facilitate marine activity.	This proposal supports the development of infrastructure for the purpose of facilitating marine activity, which could have a significant effect on European protected areas.	N	N	N/A	Y	N/A	✓	✓	✓
Environment	ML-1: Public authorities with functions capable of releasing litter into the marine area must provide adequate provision and waste management for the prevention, re-use, recycling, recovery and disposal of waste.	This policy does not specify any further developments to activities that currently take place, and focuses on improving systems already in place.	Y	N/A	N/A	N				

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			1	2	3		North East	North West	South East	South West
Environment	ML-2: Public authorities with waste management functions capable of affecting the marine area must provide adequate provision for the prevention and removal of marine litter.	This policy promotes improvement to marine environments, and so no significant effects are likely.	Y	N/A	N/A	N				
Environment	ML-3: Proposals that facilitate waste re-use or recycling, or that reduce marine and coastal litter will be supported. Proposals that could potentially increase the amount of marine litter that is discharged into the marine area, either intentionally or accidentally, must include measures to: a) avoid b) minimise or c) mitigate the discharges.	This policy promotes improvement to marine environments, and so no significant effects are likely.	Y	N/A	N/A	N				
Environment	MPA-1: Proposals that support the objectives of marine protected areas and the ecological coherence of the marine protected area network will be supported. Proposals that may have adverse impacts on the objectives of marine	This policy promotes improvement to marine environments, and so no significant effects are likely.	Y	N/A	N/A	N				

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			1	2	3		North East	North West	South East	South West
	protected areas must demonstrate that they will, in order of preference: a) avoid, b) minimise, c) mitigate adverse impacts, with due regard given to statutory advice on an ecologically coherent network.									
Environment	MPA-2: Proposals that enhance a marine protected area's ability to adapt to climate change, enhancing the resilience of the marine protected area network will be supported. Proposals that may have adverse impacts on an individual marine protected area's ability to adapt to the effects of climate change and so reduce the resilience of the marine protected area network, must demonstrate that they will, in order of preference: a) avoid, b) minimise, c) mitigate adverse impacts.	Improved resilience of marine protected areas to climate change is promoted by this policy, and so no significant effects are likely	Y	N/A	N/A	N				
Environment	MPA-3: Where statutory advice states that a marine protected area site	Improved resilience of marine protected areas to climate change	Y	N/A	N/A	N				

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			1	2	3		North East	North West	South East	South West
	condition is deteriorating or that features are moving or changing due to climate change, a suitable boundary change to ensure continued protection of the site and coherence of the overall network should be considered.	is promoted by this policy, and so no significant effects are likely.								
Environment	MPA-4: Until the ecological coherence of the marine protected area network is confirmed, proposals should demonstrate that they will, in order of preference: a) avoid, b) minimise, c) mitigate adverse impacts on features that may be required to complete the network, d) if it is not possible to mitigate adverse impacts, proposals should state the case for proceeding.	This policy does not promote increased activity or development within marine protected areas or within the marine environment in general, and so no significant effects are likely.	Y	N/A	N/A	N				
Environment	MPA-6: Proposals must demonstrate that they will, in order of preference: a) avoid b) minimise	This policy does not promote increased activity or development, and so no significant effects are likely.	Y	N/A	N/A	N				

Theme	Policy code: Policy Text	Potential for Likely Significant Effects?	Screening Criterion			Potential LSE?	Screened in for Test of Likely Significant Effects in marine plan area			
			1	2	3		North East	North West	South East	South West
	c) mitigate significant adverse impacts on designated geodiversity.									
Environment	NIS-1: Proposals that reduce the risk of spread and/or introduction of non-native invasive species within the marine plan areas and adjacent plan areas should be supported. Proposals must put in place appropriate measures to avoid or minimise significant adverse impacts that would arise through the introduction and transport of non-native invasive species, particularly when: 1) moving equipment, boats or livestock (for example fish or shellfish) from one water body to another 2) introducing structures suitable for settlement of non-native invasive species, or the spread of non-native invasive species known to exist in the area.	This policy proposes measures that will reduce negative impacts to the marine environment, and so no significant effect is likely.	Y	N/A	N/A	N				
Environment	NIS-2: Public authorities with functions to manage activities that could	This policy promotes measures that will reduce negative impacts to the	Y	N/A	N/A	N				

Theme	Policy code: Policy Text	Potential for Likely Significant Effects?	Screening Criterion			Potential LSE?	Screened in for Test of Likely Significant Effects in marine plan area			
			1	2	3		North East	North West	South East	South West
	potentially introduce, transport or spread non-native invasive species in the marine plan areas should implement adequate biosecurity measures to avoid or minimise the risk of introducing, transporting or spreading non-native invasive species.	marine environment, and so no significant effect is likely.								
Economy	OG-1: Proposals demonstrating compatibility with oil and gas activities in areas where a licence for oil and gas has been granted or formally applied for should be supported.	This policy promotes measures to ensure activity is compatible with oil and gas activities, but does not specifically propose any additional development/activity in itself and so no significant effects are foreseeable.	Y	N/A	N/A	N				
Economy	OG-2: Proposals within geological oil and gas extraction potential areas demonstrating compatibility with future extraction activity will be supported.	This policy promotes measures to ensure activity is compatible with future oil and gas activities, but does not specifically propose any additional development/activity in itself and so no significant effects are foreseeable.	Y	N/A	N/A	N				
Economy	PS-1: Proposals demonstrating compatibility with current activity and future opportunity for expansion of port and harbour activities will be supported. Proposals that may have a significant	This policy promotes measures to ensure activity is compatible with current and future port activities and expansion, but does not specifically propose any additional development/activity in itself and so no significant effects are foreseeable	Y	N/A	N/A	N				

Theme	Policy code: Policy Text	Potential for Likely Significant Effects?	Screening Criterion			Potential LSE?	Screened in for Test of Likely Significant Effects in marine plan area			
			1	2	3		North East	North West	South East	South West
	impact upon current activity and future opportunity for expansion of port and harbour activities should demonstrate that they will, in order of preference: a) avoid, b) minimise, c) mitigate significant adverse impacts, d) if it is not possible to mitigate significant adverse impacts, proposals should state the case for proceeding.									
Economy	PS-2: Proposals that require static sea surface infrastructure or that significantly reduce under-keel clearance must not be authorised within International Maritime Organization routeing systems unless there are exceptional circumstances.	This policy does not promote any activity/development with potential significant effects on European protected sites.	Y	N/A	N/A	N				
Economy	PS-3: Proposals that require static sea surface infrastructure or that significantly reduce under-keel clearance which encroaches upon high density navigation routes, or that pose a risk to the viability of passenger	This policy does not promote any activity/development with potential significant effects on European protected sites.	Y	N/A	N/A	N				

Theme	Policy code: Policy Text	Potential for Likely Significant Effects?	Screening Criterion			Potential LSE?	Screened in for Test of Likely Significant Effects in marine plan area			
			1	2	3		North East	North West	South East	South West
	services, must not be authorised unless there are exceptional circumstances.									
Economy	PS-4: Proposals promoting short sea shipping as an alternative to road or rail transport will be supported	This policy encourages an increase in short sea shipping that could potentially have a significant effect on European protected sites.	N	N	N/A	Y	✓	✓	✓	✓
Economy	REN-1: Proposals that enable the provision of emerging renewable energy technologies and associated supply chains, will be supported.	This policy encourages renewable energy and supply chain developments that could potentially have a significant effect on European protected sites.	N	N	N/A	Y	✓	✓	✓	✓
Economy	REN-2: Proposals that are in or could affect sites held under a lease or an agreement for lease for renewable energy generation (wind, wave or tidal) should demonstrate that they will in order of preference: a) avoid, b) minimise, c) mitigate adverse impacts.	This policy promotes measures to ensure that sites held under lease for renewable energy generation are not negatively impacted by additional development/activity within the same area.	Y	N/A	N/A	N				
Social	SCP-1: Proposals should demonstrate how the significant adverse impacts of a development on the seascape and landscape of an area has been considered. The proposal will only be supported if	This policy does not in itself promote any specific activity/development, but provides guidance on how proposals should demonstrate any significant adverse impacts are being mitigated.	Y	N/A	N/A	N				

Theme	Policy code: Policy Text	Potential for Likely Significant Effects?	Screening Criterion			Potential LSE?	Screened in for Test of Likely Significant Effects in marine plan area			
			1	2	3		North East	North West	South East	South West
	they demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate d) if it is not possible to mitigate, the public benefits for proceeding with the proposal that outweigh significant adverse impacts to the seascape and landscape of an area and its significance. Where possible, proposals should demonstrate that they have considered how highly the seascape and landscapes of an area is valued, its quality, and the areas potential for change. In addition, the scale and design of the proposal should be compatible with its surroundings, and not have a significant adverse impact on the seascape and landscapes of an area or the wider landscape.									
Social	SOC-1: Proposals that enhance or promote social benefits should be supported.	This policy does not specify any activity/development that could potentially have an adverse impact on European protected sites.	Y	N/A	N/A	N				

Theme	Policy code: Policy Text	Potential for Likely Significant Effects?	Screening Criterion			Potential LSE?	Screened in for Test of Likely Significant Effects in marine plan area			
			1	2	3		North East	North West	South East	South West
	Proposals unable to enhance or promote social benefits should demonstrate that they will, in order of preference: a) minimise, or b) mitigate adverse impacts which result in the displacement of other existing or authorised (but yet to be implemented) activities that generate social benefits.									
Social	SOC-3: Proposals that increase the understanding and enjoyment of the marine environment (including the natural, historic and social value) for the promotion of conservation management and increased education, and skills, should be supported.	This policy does not specify any activity that could potentially have an adverse impact on European protected sites. However, in consultation Natural England suggested that schemes to promote increased education and enjoyment of the marine environment could still have adverse effects.	N	N/A	N/A	Y	✓	✓	✓	✓
Social	TR-1: Proposals supporting, promoting or facilitating sustainable tourism and recreation activities, or where this creates appropriate additional utilisation of related facilities beyond	This policy promotes activities that could potentially have a significant effect on European protected sites. Whilst the word 'sustainable' used, this does not rule out potential significant effects.	N	N	N/A	Y	✓	✓	✓	✓

Theme	Policy code: Policy Text	Potential for Likely Significant Effects?	Screening Criterion			Potential LSE?	Screened in for Test of Likely Significant Effects in marine plan area			
			1	2	3		North East	North West	South East	South West
	typical usage patterns, should be supported.									
Social	TR-2: Proposals supporting, promoting or facilitating sustainable tourism and recreation activities, or where this creates appropriate additional utilisation of related facilities beyond typical usage patterns, should be supported.	This policy promotes activities that could potentially have a significant effect on European protected sites. Whilst the word 'sustainable' used, this does not rule out potential significant effects.	N	N/A	N/A	Y	✓	✓	✓	✓
Social	TR-4: Proposals promoting inclusive and accessible recreational use of the area by residents should be supported.	This policy promotes access of areas to local residents, which could have a significant impact on European protected sites.	N	N	N/A	Y	N/A	✓	N/A	N/A
Environment	UWN-1: Proposals generating impulsive sound, must contribute data to the UK Marine Noise Registry as per any currently agreed requirements. Public authorities must take account of any currently agreed targets under the UK Marine Strategy part one descriptor 11.	This policy does not promote additional activity that generates impulsive sound, but sets out guidelines for data contribution.	Y	N/A	N/A	N				
Environment	UWN-2: Proposals that generate impulsive or non-impulsive noise must	This policy does not promote additional activity that generates underwater noise, but provides	Y	N/A	N/A	N				

Theme	Policy code: Policy Text	Potential for Likely Significant Effects?	Screening Criterion			Potential LSE?	Screened in for Test of Likely Significant Effects in marine plan area			
			1	2	3		North East	North West	South East	South West
	demonstrate that they will, in order of preference: a) avoid, b) minimise, c) mitigate significant adverse impacts on highly mobile species, d) if it is not possible to mitigate significant adverse impacts, proposals must state the case for proceeding.	guidelines on how any such activities must show they are not having an adverse impact on mobile species.								
Economy	WIND-2: Preference will be given to proposals for offshore wind farms inside areas of identified potential for offshore wind resource, including relevant enabling projects and infrastructure, will be supported	This policy supports an activity that may have significant effects on European protected sites.	N	N	N/A	Y	✓	✓	✓	✓
Environment	WQ-1: Proposals that may have significant adverse impacts upon water quality, including upon habitats and species beneficial to water quality must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate significant adverse impacts.	This policy does not specifically promote any activity/development with potential significant effects to European protected sites, but provides guidance on how potential impacts should be addressed.	Y	N/A	N/A	N				
Environment	WQ-2: Proposals delivering improvements to water	This policy promotes improvement to environmental features, and so	Y	N/A	N/A	N				

Theme	Policy code: Policy Text	Potential for Likely Significant Effects?	Screening Criterion			Potential LSE?	Screened in for Test of Likely Significant Effects in marine plan area			
			1	2	3		North East	North West	South East	South West
	quality, or enhancing habitats and species which can be of benefit to water quality should be supported.	no negative impact to European protected sites is foreseeable.								
Environment	WQ-3: Public authorities with functions capable of affecting water quality in the marine area should seek to enhance water quality where possible. Public authorities with functions capable of affecting water quality in the marine area (including river catchments) must build in measures to, in order of preference: a) avoid b) minimise or c) mitigate significant adverse impacts to water quality in the marine area.	This policy promotes improvement to environmental features, and so no negative impact to European protected sites is foreseeable.	Y	N/A	N/A	N				

Those policies that were concluded to pose as a likely significant effect were grouped as follows:

- Enhanced public access (ACC-2, SOC-3, FISH-3, TR-1, TR-2 and TR-4);
- Provision of infrastructure, including for employment, sustainable fisheries, aquaculture and related industries (AQ-2, EMP-2, EMP-3, INF-1, INF-2, INF-3 and INF-4);
- Cable burial and future cable landfall (CAB-1 and CAB-2);
- Environmentally positive policies that may have negative effects (CCS-1, CCS-2 and HAB-1);
- New dredge disposal sites (DD-4);
- Renewable energy, including wind turbines (REN-1 and WIND-2); and,
- Promotion of short sea shipping (PS-4)

Policy categories were then considered against generic impact pathways. The results of this stage are shown in Table 2 below.

Table 2 Generic impact pathways associated with policies likely to have a significant effect on European protected sites.

Pathway Ref no.	Potential Sensitivity Category		Impact Pathway Description	Policy categories						
	Categories of deterioration or disturbance*	Code		1. Enhanced public access (ACC-2, SOC-3, FISH-3, TR-1 and TR-4)	2. Provision of infrastructure and employment, including for sustainable fisheries, aquaculture and related industries (AQ-2, EMP-2, EMP-3, INF-1, INF-2, INF-3 and INF-4)	3. Cable burial and future cable landfall (CAB-1 and CAB-2)	4. Environmentally positive policies that may have negative effects (CCS-1, CCS-2 and HAB-1)	5. New dredge disposal sites (DD-4)	6. Renewable energy, including wind turbines (REN-1 and WIND-2)	7. Promotion of short sea shipping (PS-4)
1	Physical Loss/Gain of Habitat (loss of habitat in development footprint)	PLG	Loss of habitat under the footprint of structures, erosion of the coastline and the deposition of rock and other materials, light and noise pollution, and the short-term loss of underlying habitats during construction works.		✓	✓	✓	✓	✓	
2	Physical Damage (direct and temporary damage to habitat)	PD	Changes to habitat as a result of damage from baseline surveys; from equipment use causing abrasion, erosion, light and noise pollution, damage or smothering during installation and operation; from vessels mooring/anchoring.	✓	✓	✓	✓	✓	✓	✓
3	Physical Damage	PLG	Change in quality of foraging areas from		✓	✓	✓	✓	✓	

Pathway Ref no.	Potential Sensitivity Category		Impact Pathway Description	Policy categories						
	Categories of deterioration or disturbance*	Code		1. Enhanced public access (ACC-2, SOC-3, FISH-3, TR-1 and TR-4)	2. Provision of infrastructure and employment, including for sustainable fisheries, aquaculture and related industries (AQ-2, EMP-2, EMP-3, INF-1, INF-2, INF-3 and INF-4)	3. Cable burial and future cable landfall (CAB-1 and CAB-2)	4. Environmentally positive policies that may have negative effects (CCS-1, CCS-2 and HAB-1)	5. New dredge disposal sites (DD-4)	6. Renewable energy, including wind turbines (REN-1 and WIND-2)	7. Promotion of short sea shipping (PS-4)
	(indirect change to habitat)		equipment use causing light and noise pollution, abrasion, damage or smothering; from hydrodynamic and/or sediment transport regime change (including erosion); or from presence of structures on seabed resulting in changes to prey and species behaviour (e.g. acting as FAD (Fish Aggregating Device), artificial reef or bird roost).							
4	Physical Damage (indirect and temporary damage to habitat)	PD	Changes to coastal and offshore habitat as a result of alterations to the hydrodynamic (wave and tide) erosion and rock and sediment transport regime from the presence of structures (i.e. wind		✓	✓	✓	✓	✓	

Pathway Ref no.	Potential Sensitivity Category		Impact Pathway Description	Policy categories						
	Categories of deterioration or disturbance*	Code		1. Enhanced public access (ACC-2, SOC-3, FISH-3, TR-1 and TR-4)	2. Provision of infrastructure and employment, including for sustainable fisheries, aquaculture and related industries (AQ-2, EMP-2, EMP-3, INF-1, INF-2, INF-3 and INF-4)	3. Cable burial and future cable landfall (CAB-1 and CAB-2)	4. Environmentally positive policies that may have negative effects (CCS-1, CCS-2 and HAB-1)	5. New dredge disposal sites (DD-4)	6. Renewable energy, including wind turbines (REN-1 and WIND-2)	7. Promotion of short sea shipping (PS-4)
			turbines) or altered morphology.							
5	Physical Damage (direct damage to seal haul out habitat)	PD	Damage to seal haul out locations from equipment use causing abrasion, light and noise pollution, erosion, damage or smothering during construction/decommissioning and operation.		✓	✓			✓	
6	Physical Damage (direct damage to species from collision risk)	PD	Collision risk and possible mortality of species due to wind turbines, light and noise pollution, and vessels/dredgers travelling to and from the site or due to the presence of other offshore infrastructure such as wind turbines. Tidal arrays may also involve collision risk but	✓	✓	✓	✓	✓	✓	✓

Pathway Ref no.	Potential Sensitivity Category		Impact Pathway Description	Policy categories						
	Categories of deterioration or disturbance*	Code		1. Enhanced public access (ACC-2, SOC-3, FISH-3, TR-1 and TR-4)	2. Provision of infrastructure and employment, including for sustainable fisheries, aquaculture and related industries (AQ-2, EMP-2, EMP-3, INF-1, INF-2, INF-3 and INF-4)	3. Cable burial and future cable landfall (CAB-1 and CAB-2)	4. Environmentally positive policies that may have negative effects (CCS-1, CCS-2 and HAB-1)	5. New dredge disposal sites (DD-4)	6. Renewable energy, including wind turbines (REN-1 and WIND-2)	7. Promotion of short sea shipping (PS-4)
			are not proposed under any marine plan policy.							
7	Physical Damage (direct damage to species from marine litter)	PD	Damage to marine species through ingestion, entanglement, sub-lethal effects that affect reproductive success, and smothering from marine litter.	✓	✓	✓	✓	✓	✓	✓
8	Non-Physical Disturbance (barrier to species movement)	NPD	Presence of sub-surface structures (and disturbance (visual) associated with suspended or cage production) may present a barrier to movement and block migratory pathways or access to feeding grounds depending on design.		✓	✓	✓		✓	
9	Non-Physical Disturbance	NPD	Visual disturbance and exclusion from areas as a result of surveying;	✓	✓	✓	✓	✓	✓	✓

Pathway Ref no.	Potential Sensitivity Category		Impact Pathway Description	Policy categories						
	Categories of deterioration or disturbance*	Code		1. Enhanced public access (ACC-2, SOC-3, FISH-3, TR-1 and TR-4)	2. Provision of infrastructure and employment, including for sustainable fisheries, aquaculture and related industries (AQ-2, EMP-2, EMP-3, INF-1, INF-2, INF-3 and INF-4)	3. Cable burial and future cable landfall (CAB-1 and CAB-2)	4. Environmentally positive policies that may have negative effects (CCS-1, CCS-2 and HAB-1)	5. New dredge disposal sites (DD-4)	6. Renewable energy, including wind turbines (REN-1 and WIND-2)	7. Promotion of short sea shipping (PS-4)
	(disturbance to species)		construction/decommissioning and operational activities (including movements of vessels and associate light pollution from nocturnal activities).							
10	Physical Disturbance (disturbance and injury to species)	PD	Noise/vibration disturbance, or even injury regarding fish and mammals, and exclusion from areas as a result of underwater construction noise, movements of dredgers, wind turbines, vessels and/or bulldozers; the placement of sediment; or the use of acoustic deterrents in finfish aquaculture or to deter marine mammals from entering piling injury zones. Potential killing of marine mammals	✓	✓	✓	✓	✓	✓	✓

Pathway Ref no.	Potential Sensitivity Category		Impact Pathway Description	Policy categories						
	Categories of deterioration or disturbance*	Code		1. Enhanced public access (ACC-2, SOC-3, FISH-3, TR-1 and TR-4)	2. Provision of infrastructure and employment, including for sustainable fisheries, aquaculture and related industries (AQ-2, EMP-2, EMP-3, INF-1, INF-2, INF-3 and INF-4)	3. Cable burial and future cable landfall (CAB-1 and CAB-2)	4. Environmentally positive policies that may have negative effects (CCS-1, CCS-2 and HAB-1)	5. New dredge disposal sites (DD-4)	6. Renewable energy, including wind turbines (REN-1 and WIND-2)	7. Promotion of short sea shipping (PS-4)
			from unexploded ordnance. Tidal arrays may also lead to disturbance but are not proposed under any marine plan policy.							
11	Toxic Contamination (reduction in water quality)	TC	Spillage of fluids, fuels and/or construction materials and the loss/ reduction in sediment quality during survey/maintenance, construction/decommissioning or operation.		✓	✓	✓	✓	✓	✓
12	Toxic Contamination (reduction in water quality)	TC	Release of contaminants associated with the dispersion of suspended sediments and the reduction in sediment quality		✓	✓	✓	✓	✓	
13	Toxic Contamination	TC	Organic enrichment of sediments and water column as a result of the		✓	✓	✓	✓	✓	

Pathway Ref no.	Potential Sensitivity Category		Impact Pathway Description	Policy categories						
	Categories of deterioration or disturbance*	Code		1. Enhanced public access (ACC-2, SOC-3, FISH-3, TR-1 and TR-4)	2. Provision of infrastructure and employment, including for sustainable fisheries, aquaculture and related industries (AQ-2, EMP-2, EMP-3, INF-1, INF-2, INF-3 and INF-4)	3. Cable burial and future cable landfall (CAB-1 and CAB-2)	4. Environmentally positive policies that may have negative effects (CCS-1, CCS-2 and HAB-1)	5. New dredge disposal sites (DD-4)	6. Renewable energy, including wind turbines (REN-1 and WIND-2)	7. Promotion of short sea shipping (PS-4)
	(reduction in water quality)		breakdown of organic matter from disturbed sediments (i.e. reduced sediment quality).							
14	Non-Toxic Contamination (elevated turbidity)	NTC	Increase in turbidity (and possibly reduced dissolved oxygen) associated with aquaculture (e.g. fish faeces) and activities that disturb sediments and sediment quality.		✓	✓	✓	✓	✓	
15	Biological Disturbance (direct introduction of non-native species)	BD	Introduction of non-native species as a result of the cultivation of these species (e.g. slipper limpet and Pacific oyster).		✓					
16	Biological Disturbance (translocation of native species)	BD	Translocation of indigenous species (e.g. native oyster, Atlantic salmon) resulting in genetic modification and changes to the		✓					

Pathway Ref no.	Potential Sensitivity Category		Impact Pathway Description	Policy categories						
	Categories of deterioration or disturbance*	Code		1. Enhanced public access (ACC-2, SOC-3, FISH-3, TR-1 and TR-4)	2. Provision of infrastructure and employment, including for sustainable fisheries, aquaculture and related industries (AQ-2, EMP-2, EMP-3, INF-1, INF-2, INF-3 and INF-4)	3. Cable burial and future cable landfall (CAB-1 and CAB-2)	4. Environmentally positive policies that may have negative effects (CCS-1, CCS-2 and HAB-1)	5. New dredge disposal sites (DD-4)	6. Renewable energy, including wind turbines (REN-1 and WIND-2)	7. Promotion of short sea shipping (PS-4)
			community structure and distribution of natural populations.							
17	Biological Disturbance (indirect introduction of non-native species)	BD	Introduction of new structures (e.g. cages, trestles) on the seabed facilitating the colonisation and ingress of invasive non-native species.		✓	✓	✓		✓	
18	Biological Disturbance (direct introduction of non-native species)	BD	Introduction and ingress of invasive non-native species as biofouling species on the surfaces of vessels or construction plant.	✓	✓	✓	✓	✓	✓	✓
19	Biological Disturbance (introduction/transfer of parasites/ pathogens)	BD	Introduction/transfer of parasites/pathogens as a result of aquaculture activities.	✓	✓					
* As derived from the standard ‘categories of operations which may cause deterioration or disturbance’ (UK Marine SAC project, 2001).										

Having identified the impacts most likely to be associated with each policy group, it was necessary to identify which habitat and species groups were most likely to be affected by each impact. This exercise is contained in Table 3.

Table 3 Impact-activity-feature matrix for all policy categories

Project Phase	Activity	Change	Potential Sensitivity Category	Impact Pathway Description	Pathway Ref no. (refers to Table 2)	Interest feature group				
						Habitats	Birds	Marine mammals	Fish & freshwater pearl mussel	Otters
Baseline surveys	Sampling during environmental baseline surveys	Permanent or temporary removal of, or change to, species or habitat features	Physical Damage (direct and temporary damage to habitat)	Changes to coastal and offshore habitat as a result of damage from baseline surveys (e.g. trawls, grabs); from equipment use causing abrasion, damage or smothering during installation and operation; from vessels mooring/anchoring.	2	✓				
	Increased vessel activity during baseline surveys	Elevated collision risk for marine species especially marine mammals	Physical Damage (direct damage to species from collision risk)	Collision risk and possible mortality of species due to wind turbines and vessels/dredgers travelling to and from the site; risk of entanglement following a collision with mooring elements or anti-predator nets.	6		✓	✓	✓	✓
	Increased vessel activity during baseline surveys	Visual or noise disturbance of species	Non-Physical Disturbance (disturbance to species)	Visual disturbance and exclusion from areas as a result of surveying; surveyors, noise caused by geophysical equipment construction/decommissioning and operational activities	9		✓	✓	✓	✓

Project Phase	Activity	Change	Potential Sensitivity Category	Impact Pathway Description	Pathway Ref no. (refers to Table 2)	Interest feature group				
						Habitats	Birds	Marine mammals	Fish & freshwater pearl mussel	Otters
				(including movements of vessels).						
	Increased vessel activity during baseline surveys	Increased vessel activity causing elevated noise	Non-Physical Disturbance (disturbance to species)	Noise/vibration disturbance and exclusion from areas as a result of movements of surveyors, geophysical equipment, dredgers, vessels and/or bulldozers; the placement of sediment (e.g. pumping, spraying); or the use of acoustic deterrents in finfish aquaculture.	10		✓	✓	✓	✓
	Increased vessel activity during baseline surveys	Elevated risk of spillages/ releases of oil or other contaminants & toxic effects on marine species	Toxic Contamination (reduction in water quality and sediment quality)	Spillage of fluids, fuels and/or construction materials (including from surface coatings/treatments) during survey/maintenance, construction/decommissioning or operation.	11	✓	✓	✓	✓	✓
	Increased vessel activity during baseline surveys	Elevated risk of introducing non-native species as biofouling on the surfaces of vessels	Biological Disturbance (direct introduction of non-native species)	Introduction and ingress of invasive non-native species as biofouling species on the surfaces of vessels or construction plant.	18	✓			✓	
Construction and decommissioning	Placement of material and/or structures	Loss of seabed habitat and species from the placement	Physical Loss/Gain of Habitat (loss of habitat in	Loss of coastal and offshore habitat under the footprint of cultivation sites, stabilisation material, cage fixtures, any	1	✓	✓	✓	✓	✓

Project Phase	Activity	Change	Potential Sensitivity Category	Impact Pathway Description	Pathway Ref no. (refers to Table 2)	Interest feature group				
						Habitats	Birds	Marine mammals	Fish & freshwater pearl mussel	Otters
		of material and/or structures	development footprint)	sediment retaining structures and the short-term loss of underlying habitats during beach nourishment and mud recharge works.						
	Activities associated with the placement of material and installation/removal of structures	Damage to habitats from construction activities including abrasion from equipment and smothering of habitats	Non-physical damage	Changes to coastal and offshore habitat as a result of damage from baseline surveys; from equipment use causing abrasion, damage or smothering during installation and operation; from vessels mooring/ anchoring.	2	✓	✓	✓	✓	✓
	Activities associated with the placement of material and installation/removal of structures	Where significant losses occur to intertidal or subtidal habitats	Physical damage	Change in quality of foraging areas from equipment use causing abrasion, damage or smothering; from hydrodynamic and/or sediment transport regime change; or from presence of structure on seabed resulting in changes to prey and species behaviour.	3	✓	✓	✓	✓	✓
	Activities associated with the placement of material and installation/removal of structures	Permanent damage to seal haul out location during installation and decommissioning processes	Physical damage	Damage to seal haul out locations from equipment use causing abrasion, damage or smothering during construction/ decommissioning and operation.	5			✓		

Project Phase	Activity	Change	Potential Sensitivity Category	Impact Pathway Description	Pathway Ref no. (refers to Table 2)	Interest feature group				
						Habitats	Birds	Marine mammals	Fish & freshwater pearl mussel	Otters
	Increased vessel activity during construction/decommissioning	Elevated collision risk for marine species especially marine mammals	Physical damage	Collision risk and possible mortality of species due to wind turbines and vessels/dredgers travelling to and from the site; risk of entanglement following a collision with mooring elements or anti-predator nets.	6		✓	✓	✓	✓
	Increased vessel activity during construction/decommissioning	Visual disturbance of species	Non-physical disturbance	Visual disturbance and exclusion from areas as a result of surveying; construction/decommissioning and operational activities (including movements of vessels).	9		✓	✓	✓	✓
	Increased vessel and vehicle activity during construction/decommissioning	Noise pollution form increased vessel activity	Non-physical disturbance	Noise/vibration disturbance and exclusion from areas as a result of movements of dredgers, vessels and/or bulldozers; the placement of sediment (e.g. pumping, spraying); or the use of acoustic deterrents in finfish aquaculture	10		✓	✓	✓	✓
	Activities associated with the placement of material	Noise and vibration generated by placement of material	Non-physical disturbance	Noise/vibration disturbance and exclusion from areas as a result of movements of dredgers, vessels and/or	10		✓	✓	✓	✓

Project Phase	Activity	Change	Potential Sensitivity Category	Impact Pathway Description	Pathway Ref no. (refers to Table 2)	Interest feature group				
						Habitats	Birds	Marine mammals	Fish & freshwater pearl mussel	Otters
				bulldozers; the placement of sediment (e.g. pumping, spraying); or the use of acoustic deterrents in finfish aquaculture						
	Increased vessel activity during construction/decommissioning	Elevated risk of spillages/releases of oil or other contaminants & toxic effects on marine species	Toxic Contamination	Spillage of fluids, fuels and/or construction materials (including from surface coatings/treatments) during survey/maintenance, construction/decommissioning or operation	11	✓	✓	✓	✓	✓
	Increase in suspended sediments with associated contaminant from placement and removal of material	Toxic effects on marine species	Toxic Contamination	Release of contaminants associated with the dispersion of suspended sediments during aquaculture harvesting (dredging), beach nourishment works and intertidal recharge	12	✓	✓	✓	✓	✓
	Increase in suspended sediments with associated organic material from placement of material	Toxic effects on marine species	Toxic Contamination	Organic enrichment of sediments and water column as a result of the breakdown of organic matter from sediments released during aquaculture activities, beach nourishment works and intertidal recharge.	14	✓	✓	✓	✓	✓

Project Phase	Activity	Change	Potential Sensitivity Category	Impact Pathway Description	Pathway Ref no. (refers to Table 2)	Interest feature group				
						Habitats	Birds	Marine mammals	Fish & freshwater pearl mussel	Otters
	Increase in suspended sediments from placement of material	Adverse effects on marine species	Non-toxic Contamination	Increase in turbidity (and possibly reduced dissolved oxygen) associated with the release of particulate waste (e.g. fish faeces) during aquaculture cultivation, and the release of sediments during aquaculture harvesting (dredging), beach nourishment works and intertidal recharge.	15	✓	✓	✓	✓	✓
	Increased vessel activity during construction/decommissioning	Elevated risk of introducing non-native species as biofouling on the surfaces of vessels	Biological disturbance	Introduction and ingress of invasive non-native species as biofouling species on the surfaces of vessels or construction plant.	18	✓			✓	
Operation	Permanent presence of structures	Loss of seabed habitat and species from the presence of structures	Physical Loss/Gain of Habitat	Loss of coastal and offshore habitat under the footprint of cultivation sites, cage fixtures, any sediment retaining structures and the short-term loss of underlying habitats during beach nourishment and mud recharge works.	1	✓	✓	✓	✓	✓
	Harvesting of species at aquaculture sites	The removal of surface substratum and associated seabed benthos leading to damage but followed by a	Physical damage	Changes to coastal and offshore habitat as a result of damage from baseline surveys; from equipment use causing abrasion, damage or smothering during installation	2	✓				

Project Phase	Activity	Change	Potential Sensitivity Category	Impact Pathway Description	Pathway Ref no. (refers to Table 2)	Interest feature group				
						Habitats	Birds	Marine mammals	Fish & freshwater pearl mussel	Otters
		process of re-colonisation and recovery		and operation; from vessels mooring/ anchoring.						
	Activities associated with the maintenance of structures	Damage to habitats from maintenance activities including abrasion from equipment and smothering of habitats	Physical damage	Changes to coastal and offshore habitat as a result of damage from baseline surveys; from equipment use causing abrasion, damage or smothering during installation and operation; from vessels mooring/ anchoring.	15	✓		✓		
	Permanent presence of structures	Change to habitat composition and resulting changes to prey availability and species behaviour (e.g. fish aggregation, artificial reef or bird roosting)	Physical damage	Changes in quality of foraging areas from equipment use causing abrasion, damage or smothering; from hydrodynamic and/or sediment transport regime change; or from presence of structures on seabed resulting in changes to prey and species behaviour.	3	✓	✓	✓	✓	✓
	Harvesting of species at aquaculture sites	Where significant changes occur to intertidal or subtidal habitats leading to impacts to species' food resources	Physical damage	Changes in quality of foraging areas from equipment use causing abrasion, damage or smothering; from hydrodynamic and/or sediment transport regime change; or from presence of structures on	3	✓	✓	✓	✓	✓

Project Phase	Activity	Change	Potential Sensitivity Category	Impact Pathway Description	Pathway Ref no. (refers to Table 2)	Interest feature group				
						Habitats	Birds	Marine mammals	Fish & freshwater pearl mussel	Otters
				seabed resulting in changes to prey and species behaviour.						
	Presence and operation of structures or changes to the seabed bathymetry	Changes to the hydrodynamics causing seabed disturbance through local scour and more distant erosion and smothering by re-deposition of mobilised sediment	Physical damage	Changes to coastal and offshore habitat as a result of alterations to the hydrodynamic (wave and tide) and sediment transport regime from the presence of structures (e.g. shellfish trestles, finfish cages) or altered morphology (e.g. steepened beach profile).	4	✓				
	Presence of structures on intertidal habitats	Impacts to seal haul out locations where any structures remain permanently present across intertidal areas	Physical damage	Damage to seal haul out locations from equipment use causing abrasion, damage or smothering during construction/ decommissioning and operation.	5			✓		
	Permanent presence of structures	Entanglement risk with mooring elements or anti-predator nets	Physical damage	Collision risk and possible mortality of species due to wind turbines and vessels/dredgers travelling to and from the site; risk of entanglement following a collision with mooring elements or anti-predator nets.	6	✓	✓	✓	✓	✓

Project Phase	Activity	Change	Potential Sensitivity Category	Impact Pathway Description	Pathway Ref no. (refers to Table 2)	Interest feature group				
						Habitats	Birds	Marine mammals	Fish & freshwater pearl mussel	Otters
	Increased vessel maintenance activity	Elevated collision risk for marine species especially marine mammals	Physical damage	Collision risk and possible mortality of species due to wind turbines and vessels/dredgers travelling to and from the site; risk of entanglement following a collision with mooring elements or anti-predator nets.	6	✓	✓	✓	✓	✓
	Abandoned, lost, broken or discarded aquaculture gear	Marine litter resulting in damage to marine species	Physical damage	Damage to marine species through ingestion, entanglement and smothering of marine litter.	7	✓	✓	✓	✓	✓
	Permanent presence of structures	Barrier to movement of marine species	Non-physical disturbance	Presence of sub-surface structures and disturbance (visual) associated with suspended or cage production may present a barrier to movement and block migratory pathways or access to feeding grounds depending on design.	8		✓	✓	✓	
	Increased vessel maintenance activity	Visual disturbance to species	Non-physical disturbance	Visual disturbance and exclusion from areas as a result of surveying; construction/decommissioning and operational activities.	9		✓	✓	✓	✓
	Harvesting of species at aquaculture sites	Dredger activity causing elevated noise	Non-physical disturbance	Noise/vibration disturbance and exclusion from areas as a result of movements of	10		✓	✓	✓	✓

Project Phase	Activity	Change	Potential Sensitivity Category	Impact Pathway Description	Pathway Ref no. (refers to Table 2)	Interest feature group				
						Habitats	Birds	Marine mammals	Fish & freshwater pearl mussel	Otters
				dredgers, vessels and/or bulldozers; the placement of sediment (e.g. pumping, spraying); or the use of acoustic deterrentsacoustic deterrents in finfish aquaculture.						
	Increased vessel maintenance activity	Increased vessel activity causing elevated noise	Non-physical disturbance	Noise/vibration disturbance and exclusion from areas as a result of movements of dredgers, vessels and/or bulldozers; impact piling, the placement of sediment (e.g. pumping, spraying); or the use of acoustic deterrents in finfish aquaculture.	10		✓	✓	✓	✓
	Construction activity	Noise and vibration disturbance and mortality from underwater piling	Physical disturbance	Noise/vibration from piling, acoustic deterrent devices associated with construction or unexploded ordnance resulting in direct mortality	10			✓	✓	
	Use of acoustic deterrents in finfish aquaculture	Noise and vibration disturbance from seal scarers	Non-physical disturbance	Noise/vibration disturbance and exclusion from areas as a result of movements of dredgers, vessels and/or bulldozers; the placement of sediment (e.g. pumping, spraying); or the use of	10		✓	✓	✓	✓

Project Phase	Activity	Change	Potential Sensitivity Category	Impact Pathway Description	Pathway Ref no. (refers to Table 2)	Interest feature group				
						Habitats	Birds	Marine mammals	Fish & freshwater pearl mussel	Otters
				acoustic deterrents in finfish aquaculture.						
	Increased vessel maintenance activity	Elevated risk of spillages/releases of oil or other contaminants & toxic effects on marine species	Toxic contamination	Spillage of fluids, fuels and/or construction materials (including from surface coatings/treatments) during survey/maintenance, construction/decommissioning or operation.	11	✓	✓	✓	✓	✓
	Increase in suspended sediments with associated contaminant during aquaculture harvesting (dredging)	Toxic effects on marine species	Toxic contamination	Release of contaminants associated with the dispersion of suspended sediments during aquaculture harvesting, beach nourishment works and intertidal recharge.	12	✓	✓	✓	✓	✓
	Increase in contamination during operation of finfish cages	Adverse effects on marine species	Toxic contamination	Introduction of non-synthetic compounds and synthetic compounds as a result of cage production	13	✓	✓	✓	✓	✓
	Increase in suspended sediments with associated organic material during aquaculture harvesting	Toxic effects on marine species	Toxic contamination	Organic enrichment of sediments and water column as a result of the breakdown of organic matter from sediments released during aquaculture activities, beach nourishment works and intertidal recharge.	14		✓	✓	✓	✓

Project Phase	Activity	Change	Potential Sensitivity Category	Impact Pathway Description	Pathway Ref no. (refers to Table 2)	Interest feature group				
						Habitats	Birds	Marine mammals	Fish & freshwater pearl mussel	Otters
	Increase in siltation as a result of an increase in particulate organic waste from aquaculture sites	Adverse effects on marine species	Non-toxic contamination	Increase in turbidity (and possibly reduced dissolved oxygen) associated with the release of particulate waste (e.g. fish faeces) during aquaculture cultivation, and the release of sediments during aquaculture harvesting (dredging), beach nourishment works and intertidal recharge.	15	✓	✓	✓	✓	✓
	Increase in suspended sediments during aquaculture harvesting (dredging)	Adverse effects on marine species	Non-toxic contamination	Increase in turbidity (and possibly reduced dissolved oxygen) associated with the release of particulate waste (e.g. fish faeces) during aquaculture cultivation, and the release of sediments during aquaculture harvesting (dredging), beach nourishment works and intertidal recharge.	15	✓	✓	✓	✓	✓
	Cultivation of aquaculture species	Introduction of non-native species as a result of their cultivation	Biological disturbance	Introduction of non-native species as a result of the cultivation of these species (e.g. slipper limpet and Pacific oyster).	16	✓				
	Cultivation of aquaculture species	Translocation of cultivated species	Biological disturbance	Translocation of indigenous species (e.g. native oyster, Atlantic salmon) resulting in	17					

Project Phase	Activity	Change	Potential Sensitivity Category	Impact Pathway Description	Pathway Ref no. (refers to Table 2)	Interest feature group				
						Habitats	Birds	Marine mammals	Fish & freshwater pearl mussel	Otters
				genetic modification and changes to the community structure and distribution of natural populations.						
	Cultivation of aquaculture species	Escape of cultivated species as a result of accidents or storm damage to structures	Biological disturbance	Translocation of indigenous species (e.g. native oyster, Atlantic salmon) resulting in genetic modification and changes to the community structure and distribution of natural populations	17				✓	
	Permanent (operational period) presence of structures	Introduction and colonisation of invasive non-native species on introduced hard substrata	Biological disturbance	Introduction of new structures (e.g. cages, trestles) on the seabed facilitating the colonisation and ingress of invasive non-native species.	18					
	Increased vessel maintenance activity	Elevated risk of introducing non-native species as biofouling on the surfaces of vessels	Biological disturbance	Introduction and ingress of invasive non-native species as biofouling species on the surfaces of vessels or construction plant.	18					
	Cultivation of aquaculture species	Introduction of parasites/pathogens	Biological disturbance	Introduction/transfer of parasites/pathogens as a result of aquaculture activities.	19					

4. Ecological screening

4.1. Summary results

Having considered the impact pathways that may arise from each policy category (and thus policy) and related those to the broad habitat or species groups that may be vulnerable, it was then necessary to go through every European site in the database and make a screening decision.

A total of 555 UK European sites and 148 EU European sites (primarily French and Irish) are included within the database. The seven marine plans were considered not to result in likely significant effects on 281 of these sites. The reasons varied (and are given for each site in the filterable database) but the most common explanation was because the site in question lies outside any marine plan area, is inland and has qualifying features that are purely terrestrial and are not expected to be impacted by the policy categories of any Marine Plan. Other sites were screened out because they were English, Scottish or EU SACs designated for marine mammals that lie over 50km from any marine plan area within the scope of this HRA.

This process left 297 UK sites and 125 EU sites that have been screened in for appropriate assessment. Note, however, that being screened in does not mean that an adverse effect is expected (even in the absence of mitigation), it simply means that further examination of the plan proposals and the linkages to the European site are required before a conclusion is reached. It is expected that during the appropriate assessment a conclusion of no adverse effect on integrity is likely to be possible for a number of screened-in sites, even in the absence of mitigation. For example, although all sites designated for migratory birds have been screened in because of potential conflicts with windfarm arrays (Policy WIN-2) some of these sites are designated for small, highly manoeuvrable birds that are at low risk of bird strike, such as nightjar and woodlark. Equally, all coastal and marine sites within 100km of any marine plan area have been screened in for appropriate assessment as a precaution due to potential impacts through hydrodynamic pathways and coastal processes. In practice, however, such sites are unlikely to experience an adverse effect on integrity through these pathways if they are more than one tidal ellipse from a marine plan area. This will result in a conclusion of no adverse effect on integrity for many sites.

There are, however, expected to remain sites for which an adverse effect on integrity is a credible threat without mitigation. This will relate primarily to sites located within, adjacent to, or within one tidal ellipse of, a marine plan area but will also include some SACs designated for marine mammals and migratory fish (or freshwater pearl mussel) and a large number of SPA/Ramsar sites designated for seabirds and larger migratory birds. These will be explored further in the appropriate assessment as will mitigation solutions.

4.2. Conclusion

The conclusion of the Screening exercise is that none of the seven marine plans can be screened out as posing no likely significant effects on European sites either alone or in combination with other plans and projects. However, the potential effects stem from a relatively small number of policies (ACC-2, SOC-3, FISH-3, TR-1, TR,-2, TR-4, AQ-2, EMP-2, EMP-3, INF-1, INF-2, INF-3, INF-4, CAB-1, CAB-2, CCS-1, CCS-2, HAB-1, DD-4, REN-1, WIND-2 and PS-4).

5. Appropriate Assessment Information Report

Since the Screening assessment was completed, some policies have been merged (such that some have been deleted following merger) while others have had wording changed. No entirely new policies have been created. The significant changes for the purposes of the AAIR are those made to policies that had been screened in, as follows:

- Screened in policy ACC-2 has been deleted and its text incorporated into ACC-1, so ACC-1 is now screened into the AAIR;
- Screened in policy FISH-3 has been deleted and its text incorporated into FISH-2, so FISH-2 is now screened into the AAIR;
- Screened in policy DD-4 (new dredge disposal sites) has been deleted and its text incorporated into policy DD-3, so DD-3 is now screened into the AAIR. Moreover, this policy now clarifies that new dredge disposal site proposals will only be supported if they 'are subject to best practice and guidance';
- Screened in policy TR-2 has been deleted and its text incorporated into screened in policy TR-1;
- Screened in policy EMP-3 has been deleted and merged into screened in policy EMP-2; and
- Screened in policies INF-2 and INF-4 have been deleted and merged into screened in Policy INF-1.

The updated list of policies taken forward to AAIR is therefore: ACC-1, FISH-2, TR-1, TR-4, AQ-2, EMP-2, INF-1, INF-3, CAB-1, CAB-2, CCS-1, CCS-2, HAB-1, DD-3, REN-1, SOC-3, WIND-2 and PS-4. The final list of policies for each Marine Plan is presented overleaf in Table 4.

Table 4 Final list of policies in rach marine Plan

Plan Area	Full Policy Code	Final Wording
North East	NE-ACC-1	Proposals demonstrating appropriate enhanced and inclusive public access to and within the marine area, and also demonstrate the future provision of services for tourism and recreation activities, will be supported. Where enhanced public access cannot be provided, proposals should demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate significant adverse impacts on public access.
North East	NE-AGG-1	Proposals in areas where a licence for extraction of aggregates has been granted or formally applied for should not be authorised, unless it is demonstrated that the other or activity is compatible with aggregate extraction.
North East	NE-AGG-2	Proposals within an area subject to an Exploration and Option Agreement with The Crown Estate should not be supported unless it is demonstrated that the other development or activity is compatible with aggregate extraction.
North East	NE-AGG-3	Proposals in areas where high potential aggregate resource occurs should demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate significant adverse impacts on aggregate extraction, d) if it is not possible to mitigate significant adverse impacts, proposals should state the case for proceeding.
North East	NE-AIR-1	Proposals must assess their direct and indirect impacts upon air quality and greenhouse gas emissions. Where proposals are likely to result in air pollution or increased greenhouse gas emissions, they must demonstrate that they will, in order of preference: a) avoid b) minimise

Plan Area	Full Policy Code	Final Wording
		c) mitigate air pollution and or greenhouse gas emissions in line with current national or local air quality objectives.
North East	NE-AQ-1	Proposals within existing or potential strategic areas of sustainable aquaculture production must demonstrate consideration of and compatibility with sustainable aquaculture production. Where compatibility is not possible, proposals must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate significant adverse impacts on sustainable aquaculture production d) if it is not possible to mitigate significant adverse impacts, proposals should state the case for proceeding.
North East	NE-AQ-2	Proposals enabling the provision of infrastructure for sustainable aquaculture and related industries will be supported.
North East	NE-BIO-1	Proposals that enhance or facilitate native species or habitat adaptation or connectivity or native species migration will be supported. Proposals that may cause significant adverse impacts on native species or habitat adaptation or connectivity or native species migration must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate d) compensate for significant adverse impacts.
North East	NE-BIO-3	Proposals that deliver environmental net gain for coastal habitats where important in their own right and/or for ecosystem functioning and provision of ecosystem services will be supported. Proposals must take account of the space required for coastal habitats where important in their own right and/or for ecosystem functioning and provision of ecosystem services, and demonstrate that they will in order of preference: a) avoid

Plan Area	Full Policy Code	Final Wording
		b) minimise c) mitigate d) compensate for net habitat loss and deliver environmental net gain.
North East	NE-BIO-4	Proposals that enhance the distribution of priority habitats of priority species will be supported. Proposals that may have significant adverse impacts on the distribution of priority habitats and priority species must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate d) compensate for significant adverse impacts.
North East	NE-BIO-5	Proposals should deliver environmental net gain for components of marine or coastal natural capital. Proposals that may have significant adverse impacts on components of marine and coastal natural capital must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate d) compensate for significant adverse impacts and deliver environmental net gain.
North East	NE-CAB-1	Preference should be given to proposals for cable installation where the method of installation is burial. Where burial is not achievable, decisions should take account of protection measures for the cable that may be proposed by the applicant. Where burial or protection measures are not appropriate, proposals should state the case for proceeding without those measures.
North East	NE-CAB-2	Proposals demonstrating compatibility with existing landfall sites and incorporating measures to enable development of future landfall opportunities should be supported. Where this is not possible proposals will, in order of preference: a) avoid b) minimise

Plan Area	Full Policy Code	Final Wording
		c) mitigate significant adverse impacts on new and existing landfall sites d) if it is not possible to mitigate significant adverse impacts, proposals should state the case for proceeding.
North East	NE-CAB-3	Where seeking to locate close to existing sub-sea cables, proposals should demonstrate compatibility with ongoing function, maintenance and decommissioning activities of the cable.
North East	NE-CC-2	Proposals in the north east marine plan areas should demonstrate for the lifetime of the project that they are resilient to the impacts of climate change and coastal change.
North East	NE-CC-3	Proposals in the north east marine plan areas and adjacent marine plan areas that are likely to have significant adverse impacts on coastal change should not be supported. Proposals that may have significant adverse impacts on climate change adaptation measures outside of the proposed project area must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate the significant adverse impacts upon these climate change adaptation measures.
North East	NE-CC-4	Proposals which enhance habitats that provide a flood defence or carbon sequestration will be supported. Proposals that may have significant adverse impacts on habitats that provide a flood defence or carbon sequestration ecosystem service must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate significant adverse impacts, or, as a last resort d) compensate and deliver net gains in line with and where required in current legislation and policy.
North East	NE-CCS-1	Carbon Capture Usage and Storage proposals incorporating the re-use of existing oil and gas infrastructure will be supported.
North East	NE-CCS-2	Decommissioning Programmes for oil and gas facilities should demonstrate the potential for re-use of infrastructure in particular for Carbon Capture Usage and Storage.

Plan Area	Full Policy Code	Final Wording
North East	NE-CE-1	Proposals which may have adverse cumulative effects with other existing, authorised or reasonably foreseeable proposals must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate significant adverse cumulative and/or in-combination effects.
North East	NE-CO-1	Proposals that optimise the use of space and incorporate opportunities for co-existence and co-operation with existing activities will be supported. Where potential conflicts with existing activities are likely (including displacement) proposals must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate significant adverse impacts on existing activities (including displacement) d) if it is not possible to mitigate significant adverse impacts on existing activities (including displacement), proposals should state the case for proceeding.
North East	NE-DD-1	In areas of authorised dredging activity, including those subject to navigational dredging, proposals for other activities will not be supported unless they are compatible with the dredging activity.
North East	NE-DD-2	Proposals that cause significant adverse impacts on licensed disposal areas should not be supported. Proposals that cannot avoid such impacts must, in order of preference a) minimise b) mitigate c) if it is not possible to mitigate the significant adverse impacts, proposals must state the case for proceeding.
North East	NE-DD-3	Proposals for the disposal of dredged material must demonstrate that they have been assessed against the waste hierarchy. Where there is the need to identify new dredge disposal sites, proposals should be supported which are subject to best practice and guidance.
North East	NE-DEF-1	Proposals in or affecting Ministry of Defence areas should only be authorised with agreement from the Ministry of Defence.

Plan Area	Full Policy Code	Final Wording
North East	NE-DIST-1	Proposals that may have significant adverse impacts on highly mobile species through disturbance or displacement must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate significant adverse impacts.
North East	NE-EMP-2	Proposals that result in a net increase to marine related employment will be supported, particularly where they meet one of more of the following: i) are created in areas identified as the most deprived or; ii) are in line with local skills strategies and the skills available in and adjacent to the north east marine plan area or; iii) create a diversity of opportunities or; iv) implement new technologies.
North East	NE-FISH-1	Proposals supporting a sustainable fishing industry, including the industry's diversification, should be supported.
North East	NE-FISH-2	Proposals that enhance access for fishing activities should be supported. Proposals that may have significant adverse impacts on access for fishing activities, must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate significant adverse impacts d) if it is not possible to mitigate the significant adverse impacts, proposals should state the case for proceeding.
North East	NE-FISH-4	Proposals enhancing essential fish habitat, including spawning, nursery and feeding grounds, and migratory routes should be supported. if proposals cannot enhance essential fish habitat, they must demonstrate that they will, in order of preference: a) avoid b) minimise

Plan Area	Full Policy Code	Final Wording
		c) mitigate significant adverse impact on essential fish habitat, including spawning, nursery and feeding grounds, and migration routes.
North East	NE-GOV-1	Proposals must consider transboundary impacts throughout the lifetime of the proposed activity (including decommissioning). Proposals that impact upon one or more marine plan areas or impact upon terrestrial environments must show evidence of the relevant public authorities (including other countries) being consulted and responses considered.
North East	NE-HER-1	Proposals that demonstrate they will enhance elements contributing to the significance of heritage assets will be supported. Proposals unable to enhance elements contributing to the significance of heritage assets will only be supported if they demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate harm to those elements contributing to the significance of heritage assets d) if it is not possible to mitigate, then the public benefits for proceeding with the proposal must outweigh the harm to the significance of heritage assets.
North East	NE-INF-1	Appropriate land-based infrastructure which facilitates marine activity (and vice versa) should be supported.
North East	NE-ML-1	Public authorities must make adequate provision for the prevention, re-use, recycling and disposal of waste to reduce and prevent marine litter. Public authorities should aspire to undertake measures to remove marine litter within their jurisdiction.
North East	NE-ML-3	Proposals that facilitate waste re-use or recycling to reduce or remove marine litter will be supported. Proposals that could potentially increase the amount of marine litter in the marine plan area, must include measures to:

Plan Area	Full Policy Code	Final Wording
		a) avoid b) minimise c) mitigate waste entering the marine environment.
North East	NE-MPA-1	Proposals that support the objectives of marine protected areas and the ecological coherence of the marine protected area network will be supported. Proposals that may have adverse impacts on the objectives of marine protected areas must demonstrate that they will, in order of preference: a) avoid, b) minimise, c) mitigate adverse impacts, with due regard given to statutory advice on an ecologically coherent network.
North East	NE-MPA-2	Proposals that enhance a marine protected area's ability to adapt to climate change, enhancing the resilience of the marine protected area network will be supported. Proposals that may have adverse impacts on an individual marine protected area's ability to adapt to the effects of climate change and so reduce the resilience of the marine protected area network, must demonstrate that they will, in order of preference: a) avoid, b) minimise, c) mitigate adverse impacts.
North East	NE-MPA-3	Where statutory advice states that a marine protected area site condition is deteriorating or that features are moving or changing due to climate change, a suitable boundary change to ensure continued protection of the site and coherence of the overall network should be considered.
North East	NE-MPA-6	Proposals must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate significant adverse impacts on designated geodiversity.
North East	NE-NIS-1	Proposals that reduce the risk of spread and/or introduction of non-native invasive species should be supported. Proposals must put in place appropriate measures to avoid or minimise significant adverse

Plan Area	Full Policy Code	Final Wording
		impacts that would arise through the introduction and transport of non-native invasive species, particularly when: 1) moving equipment, boats or livestock (for example fish or shellfish) from one water body to another 2) introducing structures suitable for settlement of non-native invasive species, or the spread of non-native invasive species known to exist in the area.
North East	NE-NIS-2	Public authorities with functions to manage activities that could potentially introduce, transport or spread non-native invasive species should implement adequate biosecurity measures to avoid or minimise the risk of introducing, transporting or spreading non-native invasive species.
North East	NE-OG-1	Proposals in areas where a licence for oil and gas has been granted or formally applied for should not be authorised unless it is demonstrated that the other development or activity is compatible with the oil and gas activity.
North East	NE-OG-2	Proposals within areas of geological oil and gas extraction potential demonstrating compatibility with future extraction activity will be supported.
North East	NE-PS-1	Only proposals demonstrating compatibility with current activity and future opportunity for sustainable expansion of port and harbour activities will be supported. Proposals that may have a significant adverse impact upon current activity and future opportunity for expansion of port and harbour activities must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate significant adverse impacts d) if it is not possible to mitigate significant adverse impacts, proposals should state the case for proceeding.
North East	NE-PS-2	Proposals that require static sea surface infrastructure or that significantly reduce under-keel clearance must not be authorised within or encroaching upon International Maritime Organization routeing systems unless there are exceptional circumstances.
North East	NE-PS-3	Proposals that require static sea surface infrastructure or that significantly reduce under-keel clearance which encroaches upon high density navigation routes, strategically important navigation routes, or that pose a risk to the viability of passenger services, must not be authorised unless there are exceptional circumstances.
North East	NE-PS-4	Proposals promoting or facilitating sustainable coastal and/or short sea shipping as an alternative to road, rail or air transport will be supported where appropriate.

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North East	NE-REN-1	Proposals that enable the provision of renewable energy technologies and associated supply chains, will be supported.
North East	NE-REN-2	Proposals in areas held under a lease or an agreement for lease for renewable energy generation should not be supported, unless it is demonstrated that the proposed development or activity will not reduce the ability to construct, operate or decommission the existing or planned energy generation project.
North East	NE-SCP-1	Proposals that may have a significant adverse impact upon the seascape and landscape of an area should only be supported if they demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate d) if it is not possible to mitigate, the public benefits for proceeding with the proposal must outweigh significant adverse impacts to the seascape and landscape of an area and its significance. Where possible, proposals should demonstrate that they have considered how highly the seascape and landscapes of an area is valued, its quality, and the areas potential for change. In addition, the scale and design of the proposal should be compatible with its surroundings, and not have a significant adverse impact on the seascape and landscapes of an area.
North East	NE-SOC-3	Those bringing forward proposals are encouraged to consider and enhance public knowledge, understanding, appreciation and enjoyment of the marine environment as part of (the design of) the proposal.
North East	NE-TR-1	Proposals that promote or facilitate sustainable tourism and recreation activities, or that create appropriate opportunities to expand or diversify the current use of facilities, should be supported. Where proposals may have a significant adverse impact on tourism and recreation activities they must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate that impact.

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North East	NE-UWN-1	Proposals that result in the generation of impulsive sound must contribute data to the UK Marine Noise Registry as per any currently agreed requirements. Public authorities must take account of any currently agreed targets under the UK Marine Strategy part one descriptor 11.
North East	NE-UWN-2	Proposals that result in the generation of impulsive or non-impulsive noise must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate significant adverse impacts on highly mobile species d) if it is not possible to mitigate significant adverse impacts, proposals must state the case for proceeding.
North East	NE-WIND-2	Proposals for offshore wind inside areas of identified potential will be supported.
North East	NE-WQ-1	Proposals that enhance and restore water quality will be supported. Proposals that cause deterioration of water quality must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate deterioration of water quality in the marine environment.
North West	NW-ACC-1	Proposals demonstrating appropriate enhanced and inclusive public access to and within the marine area, and also demonstrate the future provision of services for tourism and recreation activities, will be supported. Where enhanced public access cannot be provided, proposals should demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate significant adverse impacts on public access.
North West	NW-AGG-1	Proposals in areas where a licence for extraction of aggregates has been granted or formally applied for should not be authorised, unless it is demonstrated that the other development or activity is compatible with aggregate extraction.

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North West	NW-AGG-2	Proposals within an area subject to an Exploration and Option Agreement with The Crown Estate should not be supported unless it is demonstrated that the other development or activity is compatible with aggregate extraction.
North West	NW-AGG-3	Proposals in areas where high potential aggregate resource occurs should demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate significant adverse impacts on aggregate extraction d) if it is not possible to mitigate significant adverse impacts, proposals should state the case for proceeding.
North West	NW-AIR-1	Proposals must assess their direct and indirect impacts upon air quality and greenhouse gas emissions. Where proposals are likely to result in air pollution or increased greenhouse gas emissions, they must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate air pollution and or greenhouse gas emissions in line with current national or local air quality objectives.
North West	NW-AQ-1	Proposals within existing or potential strategic areas of sustainable aquaculture production must demonstrate consideration of and compatibility with sustainable aquaculture production. Where compatibility is not possible, proposals must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate significant adverse impacts on sustainable aquaculture production d) if it is not possible to mitigate significant adverse impacts, proposals should state the case for proceeding.

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North West	NW-AQ-2	Proposals enabling the provision of infrastructure for sustainable aquaculture and related industries will be supported.
North West	NW-BIO-1	Proposals that enhance or facilitate native species or habitat adaptation or connectivity or native species migration will be supported. Proposals that may cause significant adverse impacts on native species or habitat adaptation or connectivity or native species migration must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate d) compensate for significant adverse impacts.
North West	NW-BIO-3	Proposals that deliver environmental net gain for coastal habitats where important in their own right and/or for ecosystem functioning and provision of ecosystem services will be supported. Proposals must take account of the space required for coastal habitats where important in their own right and/or for ecosystem functioning and provision of ecosystem services, and demonstrate that they will in order of preference: a) avoid b) minimise c) mitigate d) compensate for net habitat loss and deliver environmental net gain.
North West	NW-BIO-4	Proposals that enhance the distribution of priority habitats of priority species will be supported. Proposals that may have significant adverse impacts on the distribution of priority habitats and priority species must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate d) compensate for significant adverse impacts.

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North West	NW-BIO-5	Proposals should deliver environmental net gain for components of marine or coastal natural capital. Proposals that may have significant adverse impacts on components of marine and coastal natural capital must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate d) compensate for significant adverse impacts and deliver environmental net gain.
North West	NW-CAB-1	Preference should be given to proposals for cable installation where the method of installation is burial. Where burial is not achievable, decisions should take account of protection measures for the cable that may be proposed by the applicant. Where burial or protection measures are not appropriate, proposals should state the case for proceeding without those measures.
North West	NW-CAB-2	Proposals demonstrating compatibility with existing landfall sites and incorporating measures to enable development of future landfall opportunities should be supported. Where this is not possible proposals will, in order of preference: a) avoid b) minimise c) mitigate significant adverse impacts on new and existing landfall sites d) if it is not possible to mitigate significant adverse impacts, proposals should state the case for proceeding.
North West	NW-CAB-3	Where seeking to locate close to existing sub-sea cables, proposals should demonstrate compatibility with ongoing function, maintenance and decommissioning activities of the cable.
North West	NW-CC-2	Proposals in the north west marine plan areas should demonstrate for the lifetime of the project that they are resilient to the impacts of climate change and coastal change.
North West	NW-CC-3	Proposals in the north west marine plan areas and adjacent marine plan areas that are likely to have significant adverse impacts on coastal change should not be supported. Proposals that may have significant adverse impacts on climate change adaptation measures outside of the proposed project area must demonstrate that they will, in order of preference:

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		a) avoid b) minimise c) mitigate the significant adverse impacts upon these climate change adaptation measures.
North West	NW-CC-4	Proposals which enhance habitats that provide a flood defence or carbon sequestration will be supported. Proposals that may have significant adverse impacts on habitats that provide a flood defence or carbon sequestration ecosystem service must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate significant adverse impacts, or, as a last resort, d) compensate and deliver net gains in line with and where required in current legislation and policy.
North West	NW-CCS-1	Carbon Capture Usage and Storage proposals incorporating the re-use of existing oil and gas infrastructure will be supported.
North West	NW-CCS-2	Decommissioning Programmes for oil and gas facilities should demonstrate the potential for re-use of infrastructure in particular for Carbon Capture Usage and Storage.
North West	NW-CE-1	Proposals which may have adverse cumulative effects with other existing, authorised or reasonably foreseeable proposals must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate significant adverse cumulative and/or in-combination effects.
North West	NW-CO-1	Proposals that optimise the use of space and incorporate opportunities for co-existence and co-operation with existing activities will be supported. Where potential conflicts with existing activities are likely (including displacement) proposals must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate significant adverse impacts on existing activities (including displacement)

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		d) if it is not possible to mitigate significant adverse impacts on existing activities (including displacement), proposals should state the case for proceeding.
North West	NW-DD-1	In areas of authorised dredging activity, including those subject to navigational dredging, proposals for other activities will not be supported unless they are compatible with the dredging activity.
North West	NW-DD-2	Proposals that cause significant adverse impacts on licensed disposal areas should not be supported. Proposals that cannot avoid such impacts must, in order of preference a) minimise b) mitigate c) if it is not possible to mitigate the significant adverse impacts, proposals must state the case for proceeding.
North West	NW-DD-3	Proposals for the disposal of dredged material must demonstrate that they have been assessed against the waste hierarchy. Where there is the need to identify new dredge disposal sites, proposals should be supported which are subject to best practice and guidance.
North West	NW-DEF-1	Proposals in or affecting Ministry of Defence areas should only be authorised with agreement from the Ministry of Defence
North West	NW-DIST-1	Proposals that may have significant adverse impacts on highly mobile species through disturbance or displacement must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate significant adverse impacts
North West	NW-EMP-2	Proposals that result in a net increase to marine related employment will be supported, particularly where they meet one of more of the following: i) are created in areas identified as the most deprived or; ii) are in line with local skills strategies and the skills available in and adjacent to the north west marine plan area or; iii) create a diversity of opportunities or; iv) implement new technologies.

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North West	NW-FISH-1	Proposals supporting a sustainable fishing industry, including the industry's diversification, should be supported.
North West	NW-FISH-2	Proposals that enhance access for fishing activities should be supported. Proposals that may have significant adverse impacts on access for fishing activities, must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate significant adverse impacts d) if it is not possible to mitigate the significant adverse impacts, proposals should state the case for proceeding.
North West	NW-FISH-4	Proposals enhancing essential fish habitat, including spawning, nursery and feeding grounds, and migratory routes should be supported. If proposals cannot enhance essential fish habitat, they must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate significant adverse impact on essential fish habitat, including spawning, nursery and feeding grounds, and migration routes.
North West	NW-GOV-1	Proposals must consider transboundary impacts throughout the lifetime of the proposed activity (including decommissioning). Proposals that impact upon one or more marine plan areas or impact upon terrestrial environments must show evidence of the relevant public authorities (including other countries) being consulted and responses considered.
North West	NW-HER-1	Proposals that demonstrate they will enhance elements contributing to the significance of heritage assets will be supported. Proposals unable to enhance elements contributing to the significance of heritage assets will only be supported if they demonstrate that they will, in order of preference: a) avoid

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		b) minimise c) mitigate harm to those elements contributing to the significance of heritage assets d) if it is not possible to mitigate, then the public benefits for proceeding with the proposal must outweigh the harm to the significance of heritage assets.
North West	NW-INF-1	Appropriate land-based infrastructure which facilitates marine activity (and vice versa), including the diversification or regeneration of marine industries, should be supported.
North West	NW-ML-1	Public authorities must make adequate provision for the prevention, re-use, recycling and disposal of waste to reduce and prevent marine litter. Public authorities should aspire to undertake measures to remove marine litter within their jurisdiction.
North West	NW-ML-3	Proposals that facilitate waste re-use or recycling to reduce or remove marine litter will be supported. Proposals that could potentially increase the amount of marine litter in the marine plan area, must include measures to: a) avoid b) minimise c) mitigate waste entering the marine environment.
North West	NW-MPA-1	Proposals that support the objectives of marine protected areas and the ecological coherence of the marine protected area network will be supported. Proposals that may have adverse impacts on the objectives of marine protected areas must demonstrate that they will, in order of preference: a) avoid, b) minimise, c) mitigate adverse impacts, with due regard given to statutory advice on an ecologically coherent network.
North West	NW-MPA-2	Proposals that enhance a marine protected area's ability to adapt to climate change, enhancing the resilience of the marine protected area network will be supported.

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		Proposals that may have adverse impacts on an individual marine protected area's ability to adapt to the effects of climate change and so reduce the resilience of the marine protected area network, must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate adverse impacts.
North West	NW-MPA-3	Where statutory advice states that a marine protected area site condition is deteriorating or that features are moving or changing due to climate change, a suitable boundary change to ensure continued protection of the site and coherence of the overall network should be considered.
North West	NW-MPA-6	Proposals must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate significant adverse impacts on designated geodiversity.
North West	NW-NIS-1	Proposals that reduce the risk of spread and/or introduction of non-native invasive species should be supported. Proposals must put in place appropriate measures to avoid or minimise significant adverse impacts that would arise through the introduction and transport of non-native invasive species, particularly when: 1) moving equipment, boats or livestock (for example fish or shellfish) from one water body to another 2) introducing structures suitable for settlement of non-native invasive species, or the spread of non-native invasive species known to exist in the area.
North West	NW-NIS-2	Public authorities with functions to manage activities that could potentially introduce, transport or spread non-native invasive species should implement adequate biosecurity measures to avoid or minimise the risk of introducing, transporting or spreading non-native invasive species.
North West	NW-OG-1	Proposals in areas where a licence for oil and gas has been granted or formally applied for should not be authorised unless it is demonstrated that the other development or activity is compatible with the oil and gas activity.
North West	NW-OG-2	Proposals within areas of geological oil and gas extraction potential demonstrating compatibility with future extraction activity will be supported.

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North West	NW-PS-1	Only proposals demonstrating compatibility with current activity and future opportunity for sustainable expansion of port and harbour activities will be supported. Proposals that may have a significant adverse impact upon current activity and future opportunity for expansion of port and harbour activities must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate significant adverse impacts d) if it is not possible to mitigate significant adverse impacts, proposals should state the case for proceeding.
North West	NW-PS-2	Proposals that require static sea surface infrastructure or that significantly reduce under-keel clearance must not be authorised within or encroaching upon International Maritime Organization routeing systems unless there are exceptional circumstances.
North West	NW-PS-3	Proposals that require static sea surface infrastructure or that significantly reduce under-keel clearance which encroaches upon high density navigation routes, strategically important navigation routes, or that pose a risk to the viability of passenger services, must not be authorised unless there are exceptional circumstances.
North West	NW-PS-4	Proposals promoting or facilitating sustainable coastal and/or short sea shipping as an alternative to road, rail or air transport will be supported where appropriate.
North West	NW-REN-1	Proposals that enable the provision of renewable energy technologies and associated supply chains, will be supported.
North West	NW-REN-2	Proposals in areas held under a lease or an agreement for lease for renewable energy generation should not be supported, unless it is demonstrated that the proposed development or activity will not reduce the ability to construct, operate or decommission the existing or planned energy generation project.
North West	NW-SCP-1	Proposals that may have a significant adverse impact upon the seascape and landscape of an area should only be supported if they demonstrate that they will, in order of preference: a) avoid b) minimise

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		c) mitigate d) if it is not possible to mitigate, the public benefits for proceeding with the proposal must outweigh significant adverse impacts to the seascape and landscape of an area and its significance. Where possible, proposals should demonstrate that they have considered how highly the seascape and landscapes of an area is valued, its quality, and the areas potential for change. In addition, the scale and design of the proposal should be compatible with its surroundings, and not have a significant adverse impact on the seascape and landscapes of an area
North West	NW-SOC-3	Those bringing forward proposals are encouraged to consider and enhance public knowledge, understanding, appreciation and enjoyment of the marine environment as part of (the design of) the proposal.
North West	NW-TR-1	Proposals that promote or facilitate sustainable tourism and recreation activities, or that create appropriate opportunities to expand or diversify the current use of facilities, should be supported. Where proposals may have a significant adverse impact on tourism and recreation activities they must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate that impact.
North West	NW-UWN-1	Proposals that result in the generation of impulsive sound must contribute data to the UK Marine Noise Registry as per any currently agreed requirements. Public authorities must take account of any currently agreed targets under the UK Marine Strategy part one descriptor 11.
North West	NW-UWN-2	Proposals that result in the generation of impulsive or non-impulsive noise must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate significant adverse impacts on highly mobile species d) if it is not possible to mitigate significant adverse impacts, proposals must state the case for proceeding.

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North West	NW-WIND-2	Proposals for offshore wind inside areas of identified potential will be supported.
North West	NW-WQ-1	Proposals that enhance and restore water quality will be supported. Proposals that cause deterioration of water quality must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate deterioration of water quality in the marine environment.
South East	SE-ACC-1	Proposals demonstrating appropriate enhanced and inclusive public access to and within the marine area, and also demonstrate the future provision of services for tourism and recreation activities, will be supported. Where enhanced public access cannot be provided, proposals should demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate significant adverse impacts on public access.
South East	SE-AGG-1	Proposals in areas where a licence for extraction of aggregates has been granted or formally applied for should not be authorised, unless it is demonstrated that the other development or activity is compatible with aggregate extraction
South East	SE-AGG-2	Proposals within an area subject to an Exploration and Option Agreement with The Crown Estate should not be supported unless it is demonstrated that the other development or activity is compatible with aggregate extraction.
South East	SE-AGG-3	Proposals in areas where high potential aggregate resource occurs should demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate significant adverse impacts on aggregate extraction d) if it is not possible to mitigate significant adverse impacts, proposals should state the case for proceeding.

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South East	SE-AIR-1	Proposals must assess their direct and indirect impacts upon air quality and greenhouse gas emissions. Where proposals are likely to result in air pollution or increased greenhouse gas emissions, they must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate air pollution and or greenhouse gas emissions in line with current national or local air quality objectives.
South East	SE-AQ-1	Proposals within existing or potential strategic areas of sustainable aquaculture production must demonstrate consideration of and compatibility with sustainable aquaculture production. Where compatibility is not possible, proposals must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate significant adverse impacts on sustainable aquaculture production d) if it is not possible to mitigate significant adverse impacts, proposals should state the case for proceeding.
South East	SE-AQ-2	Proposals enabling the provision of infrastructure for sustainable aquaculture and related industries will be supported.
South East	SE-BIO-1	Proposals that enhance or facilitate native species or habitat adaptation or connectivity or native species migration will be supported. Proposals that may cause significant adverse impacts on native species or habitat adaptation or connectivity or native species migration must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate d) compensate for significant adverse impacts.

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South East	SE-BIO-3	Proposals that deliver environmental net gain for coastal habitats where important in their own right and/or for ecosystem functioning and provision of ecosystem services will be supported. Proposals must take account of the space required for coastal habitats where important in their own right and/or for ecosystem functioning and provision of ecosystem services, and demonstrate that they will in order of preference: a) avoid b) minimise c) mitigate d) compensate for net habitat loss and deliver environmental net gain.
South East	SE-BIO-4	Proposals that enhance the distribution of priority habitats of priority species will be supported. Proposals that may have significant adverse impacts on the distribution of priority habitats and priority species must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate d) compensate for significant adverse impacts.
South East	SE-BIO-5	Proposals should deliver environmental net gain for components of marine or coastal natural capital. Proposals that may have significant adverse impacts on components of marine and coastal natural capital must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate d) compensate for significant adverse impacts and deliver environmental net gain.
South East	SE-CAB-1	Preference should be given to proposals for cable installation where the method of installation is burial. Where burial is not achievable, decisions should take account of protection measures for

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		the cable that may be proposed by the applicant. Where burial or protection measures are not appropriate, proposals should state the case for proceeding without those measures.
South East	SE-CAB-2	Proposals demonstrating compatibility with existing landfall sites and incorporating measures to enable development of future landfall opportunities should be supported. Where this is not possible proposals will, in order of preference: a) avoid b) minimise c) mitigate significant adverse impacts on new and existing landfall sites d) if it is not possible to mitigate significant adverse impacts, proposals should state the case for proceeding.
South East	SE-CAB-3	Where seeking to locate close to existing sub-sea cables, proposals should demonstrate compatibility with ongoing function, maintenance and decommissioning activities of the cable.
South East	SE-CC-2	Proposals in the south east marine plan area should demonstrate for the lifetime of the project that they are resilient to the impacts of climate change and coastal change.
South East	SE-CC-3	Proposals in the south east marine plan area and adjacent marine plan areas that are likely to have significant adverse impacts on coastal change should not be supported. Proposals that may have significant adverse impacts on climate change adaptation measures outside of the proposed project area must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate the significant adverse impacts upon these climate change adaptation measures.
South East	SE-CC-4	Proposals which enhance habitats that provide a flood defence or carbon sequestration will be supported. Proposals that may have significant adverse impacts on habitats that provide a flood defence or carbon sequestration ecosystem service must demonstrate that they will, in order of preference: a) avoid b) minimise

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		c) mitigate significant adverse impacts, or, as a last resort d) compensate and deliver net gains in line with and where required in current legislation and policy.
South East	SE-CCS-2	Decommissioning Programmes for oil and gas facilities should demonstrate the potential for re-use of infrastructure in particular for Carbon Capture Usage and Storage.
South East	SE-CE-1	Proposals which may have adverse cumulative effects with other existing, authorised or reasonably foreseeable proposals must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate significant adverse cumulative and/or in-combination effects.
South East	SE-CO-1	Proposals that optimise the use of space and incorporate opportunities for co-existence and co-operation with existing activities will be supported. Where potential conflicts with existing activities are likely (including displacement) proposals must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate significant adverse impacts on existing activities (including displacement) d) if it is not possible to mitigate significant adverse impacts on existing activities (including displacement), proposals should state the case for proceeding.
South East	SE-DD-1	In areas of authorised dredging activity, including those subject to navigational dredging, proposals for other activities will not be supported unless they are compatible with the dredging activity.
South East	SE-DD-2	Proposals that cause significant adverse impacts on licensed disposal areas should not be supported. Proposals that cannot avoid such impacts must, in order of preference a) minimise b) mitigate

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		c) if it is not possible to mitigate the significant adverse impacts, proposals must state the case for proceeding.
South East	SE-DD-3	Proposals for the disposal of dredged material must demonstrate that they have been assessed against the waste hierarchy. Where there is the need to identify new dredge disposal sites, proposals should be supported which are subject to best practice and guidance.
South East	SE-DEF-1	Proposals in or affecting Ministry of Defence areas should only be authorised with agreement from the Ministry of Defence.
South East	SE-DIST-1	Proposals that may have significant adverse impacts on highly mobile species through disturbance or displacement must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate significant adverse impacts
South East	SE-EMP-2	Proposals that result in a net increase to marine related employment will be supported, particularly where they meet one of more of the following: i) are created in areas identified as the most deprived or; ii) are in line with local skills strategies and the skills available in and adjacent to the south east marine plan area or; iii) create a diversity of opportunities or; iv) implement new technologies.
South East	SE-FISH-1	Proposals supporting a sustainable fishing industry, including the industry's diversification, should be supported.
South East	SE-FISH-2	Proposals that enhance access for fishing activities should be supported. Proposals that may have significant adverse impacts on access for fishing activities, must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate significant adverse impacts d) if it is not possible to mitigate the significant adverse impacts, proposals should state the case for proceeding.

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South East	SE-FISH-4	Proposals enhancing essential fish habitat, including spawning, nursery and feeding grounds, and migratory routes should be supported. If proposals cannot enhance essential fish habitat, they must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate significant adverse impact on essential fish habitat, including spawning, nursery and feeding grounds, and migration routes.
South East	SE-GOV-1	Proposals must consider transboundary impacts throughout the lifetime of the proposed activity (including decommissioning). Proposals that impact upon one or more marine plan areas or impact upon terrestrial environments must show evidence of the relevant public authorities (including other countries) being consulted and responses considered.
South East	SE-HER-1	Proposals that demonstrate they will enhance elements contributing to the significance of heritage assets will be supported. Proposals unable to enhance elements contributing to the significance of heritage assets will only be supported if they demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate harm to those elements contributing to the significance of heritage assets d) if it is not possible to mitigate, then the public benefits for proceeding with the proposal must outweigh the harm to the significance of heritage assets.
South East	SE-INF-1	Appropriate land-based infrastructure which facilitates marine activity (and vice versa) should be supported.
South East	SE-INF-3	(1) Proposals for alternative development at existing safeguarded landing facilities will not be supported. (2) Proposals adjacent and opposite existing safeguarded landing facilities, must demonstrate that they avoid significant adverse impacts on existing safeguarded landing facilities. (3) Proposals for alternative development at existing landing facilities (excluding safeguarded

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		sites) should not be supported unless that facility is no longer viable or capable of being made viable for waterborne transport. (4) Proposals adjacent and opposite existing landing facilities (excluding safeguarded sites) should demonstrate that they will in order of preference: a) avoid, b) minimise c) mitigate significant adverse impacts on existing landing facilities.
South East	SE-ML-1	Public authorities must make adequate provision for the prevention, re-use, recycling and disposal of waste to reduce and prevent marine litter. Public authorities should aspire to undertake measures to remove marine litter within their jurisdiction.
South East	SE-ML-3	Proposals that facilitate waste re-use or recycling to reduce or remove marine litter will be supported. Proposals that could potentially increase the amount of marine litter in the marine plan area, must include measures to: a) avoid b) minimise c) mitigate waste entering the marine environment.
South East	SE-MPA-1	Proposals that support the objectives of marine protected areas and the ecological coherence of the marine protected area network will be supported. Proposals that may have adverse impacts on the objectives of marine protected areas must demonstrate that they will, in order of preference: a)avoid b)minimise c)mitigate adverse impacts, with due regard given to statutory advice on an ecologically coherent network.
South East	SE-MPA-2	Proposals that enhance a marine protected area's ability to adapt to climate change, enhancing the resilience of the marine protected area network will be supported. Proposals that may have adverse impacts on an individual marine protected area's ability to

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		adapt to the effects of climate change and so reduce the resilience of the marine protected area network, must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate adverse impacts.
South East	SE-MPA-3	Where statutory advice states that a marine protected area site condition is deteriorating or that features are moving or changing due to climate change, a suitable boundary change to ensure continued protection of the site and coherence of the overall network should be considered.
South East	SE-MPA-6	Proposals must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate significant adverse impacts on designated geodiversity.
South East	SE-NIS-1	Proposals that reduce the risk of spread and/or introduction of non-native invasive species should be supported. Proposals must put in place appropriate measures to avoid or minimise significant adverse impacts that would arise through the introduction and transport of non-native invasive species, particularly when: 1) moving equipment, boats or livestock (for example fish or shellfish) from one water body to another 2) introducing structures suitable for settlement of non-native invasive species, or the spread of non-native invasive species known to exist in the area.
South East	SE-NIS-2	Public authorities with functions to manage activities that could potentially introduce, transport or spread non-native invasive species should implement adequate biosecurity measures to avoid or minimise the risk of introducing, transporting or spreading non-native invasive species.
South East	SE-OG-1	Proposals in areas where a licence for oil and gas has been granted or formally applied for should not be authorised unless it is demonstrated that the other development or activity is compatible with the oil and gas activity.
South East	SE-OG-2	Proposals within areas of geological oil and gas extraction potential demonstrating compatibility with future extraction activity will be supported.
South East	SE-PS-1	Only proposals demonstrating compatibility with current activity and future opportunity for sustainable expansion of port and harbour activities will be supported.

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		Proposals that may have a significant adverse impact upon current activity and future opportunity for expansion of port and harbour activities must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate significant adverse impacts d) if it is not possible to mitigate significant adverse impacts, proposals should state the case for proceeding.
South East	SE-PS-2	Proposals that require static sea surface infrastructure or that significantly reduce under-keel clearance must not be authorised within or encroaching upon International Maritime Organization routeing systems unless there are exceptional circumstances.
South East	SE-PS-3	Proposals that require static sea surface infrastructure or that significantly reduce under-keel clearance which encroaches upon high density navigation routes, strategically important navigation routes, or that pose a risk to the viability of passenger services, must not be authorised unless there are exceptional circumstances.
South East	SE-PS-4	Proposals promoting or facilitating sustainable coastal and/or short sea shipping as an alternative to road, rail or air transport will be supported where appropriate.
South East	SE-REN-1	Proposals that enable the provision of renewable energy technologies and associated supply chains, will be supported.
South East	SE-REN-2	Proposals in areas held under a lease or an agreement for lease for renewable energy generation should not be supported, unless it is demonstrated that the proposed development or activity will not reduce the ability to construct, operate or decommission the existing or planned energy generation project.
South East	SE-SCP-1	Proposals that may have a significant adverse impact upon the seascape and landscape of an area should only be supported if they demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate d) if it is not possible to mitigate, the public benefits for proceeding with the proposal must

Plan Area	Full Policy Code	Final Wording
		outweigh significant adverse impacts to the seascape and landscape of an area and its significance. Where possible, proposals should demonstrate that they have considered how highly the seascape and landscapes of an area is valued, its quality, and the areas potential for change. In addition, the scale and design of the proposal should be compatible with its surroundings, and not have a significant adverse impact on the seascape and landscapes of an area
South East	SE-SOC-3	Those bringing forward proposals are encouraged to consider and enhance public knowledge, understanding, appreciation and enjoyment of the marine environment as part of (the design of) the proposal.
South East	SE-TR-1	Proposals that promote or facilitate sustainable tourism and recreation activities, or that create appropriate opportunities to expand or diversify the current use of facilities, should be supported. Where proposals may have a significant adverse impact on tourism and recreation activities they must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate that impact.
South East	SE-UWN-1	Proposals that result in the generation of impulsive sound must contribute data to the UK Marine Noise Registry as per any currently agreed requirements. Public authorities must take account of any currently agreed targets under the UK Marine Strategy part one descriptor 11.
South East	SE-UWN-2	Proposals that result in the generation of impulsive or non-impulsive noise must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate significant adverse impacts on highly mobile species d) if it is not possible to mitigate significant adverse impacts, proposals must state the case for proceeding.
South East	SE-WIND-2	Proposals for offshore wind inside areas of identified potential will be supported

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South East	SE-WQ-1	Proposals that enhance and restore water quality will be supported. Proposals that cause deterioration of water quality must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate deterioration of water quality in the marine environment.
South West	SW-ACC-1	Proposals demonstrating appropriate enhanced and inclusive public access to and within the marine area, and also demonstrate the future provision of services for tourism and recreation activities, will be supported. Where enhanced public access cannot be provided, proposals should demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate significant adverse impacts on public access.
South West	SW-AGG-1	Proposals in areas where a licence for extraction of aggregates has been granted or formally applied for should not be authorised, unless it is demonstrated that the other development or activity is compatible with aggregatr extraction.
South West	SW-AGG-2	Proposals within an area subject to an Exploration and Option Agreement with The Crown Estate should not be supported unless it is demonstrated that the other development or activity is compatible with aggregate extraction.
South West	SW-AGG-3	Proposals in areas where high potential aggregate resource occurs should demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate significant adverse impacts on aggregate extraction d) if it is not possible to mitigate significant adverse impacts, proposals should state the case for proceeding.

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South West	SW-AIR-1	Proposals must assess their direct and indirect impacts upon air quality and greenhouse gas emissions. Where proposals are likely to result in air pollution or increased greenhouse gas emissions, they must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate air pollution and or greenhouse gas emissions in line with current national or local air quality objectives.
South West	SW-AQ-1	Proposals within existing or potential strategic areas of sustainable aquaculture production must demonstrate consideration of and compatibility with sustainable aquaculture production. Where compatibility is not possible, proposals must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate significant adverse impacts on sustainable aquaculture production, d) if it is not possible to mitigate significant adverse impacts, proposals should state the case for proceeding.
South West	SW-AQ-2	Proposals enabling the provision of infrastructure for sustainable aquaculture and related industries will be supported.
South West	SW-BIO-1	Proposals that enhance or facilitate native species or habitat adaptation or connectivity or native species migration will be supported. Proposals that may cause significant adverse impacts on native species or habitat adaptation or connectivity or native species migration must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate d) compensate for significant adverse impacts.

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South West	SW-BIO-3	Proposals that deliver environmental net gain for coastal habitats where important in their own right and/or for ecosystem functioning and provision of ecosystem services will be supported. Proposals must take account of the space required for coastal habitats where important in their own right and/or for ecosystem functioning and provision of ecosystem services, and demonstrate that they will in order of preference: a) avoid b) minimise c) mitigate d) compensate for net habitat loss and deliver environmental net gain.
South West	SW-BIO-4	Proposals that enhance the distribution of priority habitats of priority species will be supported. Proposals that may have significant adverse impacts on the distribution of priority habitats and priority species must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate d) compensate for significant adverse impacts.
South West	SW-BIO-5	Proposals should deliver environmental net gain for components of marine or coastal natural capital. Proposals that may have significant adverse impacts on components of marine and coastal natural capital must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate d) compensate for significant adverse impacts and deliver environmental net gain.
South West	SW-CAB-1	Preference should be given to proposals for cable installation where the method of installation is burial. Where burial is not achievable, decisions should take account of protection measures for

Plan Area	Full Policy Code	Final Wording
		the cable that may be proposed by the applicant. Where burial or protection measures are not appropriate, proposals should state the case for proceeding without those measures.
South West	SW-CAB-2	Proposals demonstrating compatibility with existing landfall sites and incorporating measures to enable development of future landfall opportunities should be supported. Where this is not possible proposals will, in order of preference: a) avoid b) minimise c) mitigate significant adverse impacts on new and existing landfall sites d) if it is not possible to mitigate significant adverse impacts, proposals should state the case for proceeding.
South West	SW-CAB-3	Where seeking to locate close to existing sub-sea cables, proposals should demonstrate compatibility with ongoing function, maintenance and decommissioning activities of the cable.
South West	SW-CC-2	Proposals in the south west marine plan areas should demonstrate for the lifetime of the project that they are resilient to the impacts of climate change and coastal change.
South West	SW-CC-3	Proposals in the south west marine plan areas and adjacent marine plan areas that are likely to have significant adverse impacts on coastal change should not be supported. Proposals that may have significant adverse impacts on climate change adaptation measures outside of the proposed project area must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate the significant adverse impacts upon these climate change adaptation measures.
South West	SW-CC-4	Proposals which enhance habitats that provide a flood defence or carbon sequestration will be supported. Proposals that may have significant adverse impacts on habitats that provide a flood defence or carbon sequestration ecosystem service must demonstrate that they will, in order of preference: a) avoid

Plan Area	Full Policy Code	Final Wording
		b) minimise c) mitigate significant adverse impacts, or, as a last resort d) compensate and deliver net gains in line with and where required in current legislation and policy.
South West	SW-CE-1	Proposals which may have adverse cumulative effects with other existing, authorised or reasonably foreseeable proposals must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate significant adverse cumulative and/or in-combination effects.
South West	SW-CO-1	Proposals that optimise the use of space and incorporate opportunities for co-existence and co-operation with existing activities will be supported. Where potential conflicts with existing activities are likely (including displacement) proposals must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate significant adverse impacts on existing activities (including displacement) d) if it is not possible to mitigate significant adverse impacts on existing activities (including displacement), proposals should state the case for proceeding.
South West	SW-DD-1	In areas of authorised dredging activity, including those subject to navigational dredging, proposals for other activities will not be supported unless they are compatible with the dredging activity.
South West	SW-DD-2	Proposals that cause significant adverse impacts on licensed disposal areas should not be supported. Proposals that cannot avoid such impacts must, in order of preference a) minimise b) mitigate c) if it is not possible to mitigate the significant adverse impacts, proposals must state the case for proceeding.

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South West	SW-DD-3	Proposals for the disposal of dredged material must demonstrate that they have been assessed against the waste hierarchy. Where there is the need to identify new dredge disposal sites, proposals should be supported which are subject to best practice and guidance.
South West	SW-DEF-1	Proposals in or affecting Ministry of Defence areas should only be authorised with agreement from the Ministry
South West	SW-DIST-1	Proposals that may have significant adverse impacts on highly mobile species through disturbance or displacement must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate significant adverse impacts
South West	SW-EMP-2	Proposals that result in a net increase to marine related employment will be supported, particularly where they meet one of more of the following: i) are created in areas identified as the most deprived or; ii) are in line with local skills strategies and the skills available in and adjacent to the south west marine plan area or; iii) create a diversity of opportunities or; iv) implement new technologies.
South West	SW-FISH-1	Proposals supporting a sustainable fishing industry, including the industry's diversification, should be supported.
South West	SW-FISH-2	Proposals that enhance access for fishing activities should be supported. Proposals that may have significant adverse impacts on access for fishing activities, must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate significant adverse impacts d) if it is not possible to mitigate the significant adverse impacts, proposals should state the case for proceeding.
South West	SW-FISH-4	Proposals enhancing essential fish habitat, including spawning, nursery and feeding grounds, and migratory routes should be supported.

Plan Area	Full Policy Code	Final Wording
		If proposals cannot enhance essential fish habitat, they must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate significant adverse impact on essential fish habitat, including spawning, nursery and feeding grounds, and migration routes.
South West	SW-GOV-1	Proposals must consider transboundary impacts throughout the lifetime of the proposed activity (including decommissioning). Proposals that impact upon one or more marine plan areas or impact upon terrestrial environments must show evidence of the relevant public authorities (including other countries) being consulted and responses considered.
South West	SW-HAB-1	Proposals which incorporate measures to conserve deep sea habitats will be supported. Proposals which may have direct adverse impacts on deep sea habitats must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate direct adverse impacts on deep sea habitats.
South West	SW-HER-1	Proposals that demonstrate they will enhance elements contributing to the significance of heritage assets will be supported. Proposals unable to enhance elements contributing to the significance of heritage assets will only be supported if they demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate harm to those elements contributing to the significance of heritage assets d) if it is not possible to mitigate, then the public benefits for proceeding with the proposal must outweigh the harm to the significance of heritage assets.
South West	SW-INF-1	Appropriate land-based infrastructure which facilitates marine activity (and vice versa), including the diversification or regeneration of marine industries, should be supported.

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South West	SW-ML-1	Public authorities must make adequate provision for the prevention, re-use, recycling and disposal of waste to reduce and prevent marine litter. Public authorities should aspire to undertake measures to remove marine litter within their jurisdiction.
South West	SW-ML-3	Proposals that facilitate waste re-use or recycling to reduce or remove marine litter will be supported. Proposals that could potentially increase the amount of marine litter in the marine plan area, must include measures to: a) avoid b) minimise c) mitigate waste entering the marine environment.
South West	SW-MPA-1	Proposals that support the objectives of marine protected areas and the ecological coherence of the marine protected area network will be supported. Proposals that may have adverse impacts on the objectives of marine protected areas must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate adverse impacts, with due regard given to statutory advice on an ecologically coherent network.
South West	SW-MPA-2	Proposals that enhance a marine protected area's ability to adapt to climate change, enhancing the resilience of the marine protected area network will be supported. Proposals that may have adverse impacts on an individual marine protected area's ability to adapt to the effects of climate change and so reduce the resilience of the marine protected area network, must demonstrate that they will, in order of preference: a) avoid b) minimise

Plan Area	Full Policy Code	Final Wording
		c) mitigate adverse impacts.
South West	SW-MPA-3	Where statutory advice states that a marine protected area site condition is deteriorating or that features are moving or changing due to climate change, a suitable boundary change to ensure continued protection of the site and coherence of the overall network should be considered.
South West	SW-MPA-6	Proposals must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate significant adverse impacts on designated geodiversity.
South West	SW-NIS-1	Proposals that reduce the risk of spread and/or introduction of non-native invasive species should be supported. Proposals must put in place appropriate measures to avoid or minimise significant adverse impacts that would arise through the introduction and transport of non-native invasive species, particularly when: 1) moving equipment, boats or livestock (for example fish or shellfish) from one water body to another 2) introducing structures suitable for settlement of non-native invasive species, or the spread of non-native invasive species known to exist in the area.
South West	SW-NIS-2	Public authorities with functions to manage activities that could potentially introduce, transport or spread non-native invasive species should implement adequate biosecurity measures to avoid or minimise the risk of introducing, transporting or spreading non-native invasive species.
South West	SW-OG-1	Proposals in areas where a licence for oil and gas has been granted or formally applied for should not be authorised unless it is demonstrated that the other development or activity is compatible with the oil and gas activity.
South West	SW-OG-2	Proposals within areas of geological oil and gas extraction potential demonstrating compatibility with future extraction activity will be supported.
South West	SW-PS-1	Only proposals demonstrating compatibility with current activity and future opportunity for sustainable expansion of port and harbour activities will be supported. Proposals that may have a significant adverse impact upon current activity and future opportunity for expansion of port and harbour activities must demonstrate that they will, in order of preference:

Plan Area	Full Policy Code	Final Wording
		a) avoid b) minimise c) mitigate significant adverse impacts d) if it is not possible to mitigate significant adverse impacts, proposals should state the case for proceeding.
South West	SW-PS-2	Proposals that require static sea surface infrastructure or that significantly reduce under-keel clearance must not be authorised within or encroaching upon International Maritime Organization routeing systems unless there are exceptional circumstances.
South West	SW-PS-3	Proposals that require static sea surface infrastructure or that significantly reduce under-keel clearance which encroaches upon high density navigation routes, strategically important navigation routes, or that pose a risk to the viability of passenger services, must not be authorised unless there are exceptional circumstances.
South West	SW-PS-4	Proposals promoting or facilitating sustainable coastal and/or short sea shipping as an alternative to road, rail or air transport will be supported where appropriate.
South West	SW-REN-1	Proposals that enable the provision of renewable energy technologies and associated supply chains, will be supported.
South West	SW-REN-2	Proposals in areas held under a lease or an agreement for lease for renewable energy generation should not be supported, unless it is demonstrated that the proposed development or activity will not reduce the ability to construct, operate or decommission the existing or planned energy generation project.
South West	SW-SCP-1	Proposals that may have a significant adverse impact upon the seascape and landscape of an area should only be supported if they demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate d) if it is not possible to mitigate, the public benefits for proceeding with the proposal must outweigh significant adverse impacts to the seascape and landscape of an area and its significance. Where possible, proposals should demonstrate that they have considered how highly the

Plan Area	Full Policy Code	Final Wording
		seascape and landscapes of an area is valued, its quality, and the areas potential for change. In addition, the scale and design of the proposal should be compatible with its surroundings, and not have a significant adverse impact on the seascape and landscapes of an area
South West	SW-SOC-3	Those bringing forward proposals are encouraged to consider and enhance public knowledge, understanding, appreciation and enjoyment of the marine environment as part of (the design of) the proposal.
South West	SW-TR-1	Proposals that promote or facilitate sustainable tourism and recreation activities, or that create appropriate opportunities to expand or diversify the current use of facilities, should be supported. Where proposals may have a significant adverse impact on tourism and recreation activities they must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate that impact.
South West	SW-UWN-1	Proposals that result in the generation of impulsive sound must contribute data to the UK Marine Noise Registry as per any currently agreed requirements. Public authorities must take account of any currently agreed targets under the UK Marine Strategy part one descriptor 11.
South West	SW-UWN-2	Proposals that result in the generation of impulsive or non-impulsive noise must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate significant adverse impacts on highly mobile species d) if it is not possible to mitigate significant adverse impacts, proposals must state the case for proceeding.
South West	SW-WIND-2	Proposals for offshore wind inside areas of identified potential will be supported.
South West	SW-WQ-1	Proposals that enhance and restore water quality will be supported. Proposals that cause deterioration of water quality must demonstrate that they will, in order of preference: a) avoid

Plan Area	Full Policy Code	Final Wording
		b) minimise c) mitigate deterioration of water quality in the marine environment.

There are a number of policies that will form part of a policy framework to protect European sites from various impacts discussed in this AAIR in each of the seven marine plan areas. Those policies relevant to specific impact pathways (such as water quality) are discussed throughout the AAIR. However, it should also be noted that policies BIO-1, BIO-3 and BIO-4 and policy MPA-1 present in all seven marine plans provide some general overall protection as follows:

- Policy BIO-1 states that proposals that may cause significant adverse impacts on native species or habitat adaptation or connectivity or native species migration must demonstrate that they will, in order of preference: a) avoid, b) minimise, c) mitigate significant adverse impacts or, as a last resort, d) compensate for significant adverse impacts.
- Policy BIO-3 states that proposals must take account of the space required for coastal habitats where important in their own right and/or for ecosystem functioning and provision of ecosystem services, and demonstrate that they will in order of preference a) avoid, b) minimise, c) mitigate net habitat loss or, as a last resort, d) compensate for net habitat loss and deliver environmental net gain.
- Policy BIO-4 states that proposals that may have significant adverse impacts on the distribution of priority habitats distribution of priority species must demonstrate that they will, in order of preference a) avoid, b) minimise, c) mitigate d) compensate for significant adverse impacts.
- Policy MPA-1 states that proposals that may have adverse impacts on the objectives of marine protected areas must demonstrate that they will, in order of preference: a) avoid, b) minimise, or c) mitigate adverse impacts, with due regard given to statutory advice on an ecologically coherent network.

None of these policies are specific to European sites but European sites and their interest features will be encompassed by the requirements in these policies to a) investigate potential adverse effects, b) take account of the space required for habitats associated with European sites that may be mobile in response to sea level rise and c) follow the mitigation hierarchy of seeking to avoid adverse effects before exploring mitigation. Policies BIO-1, BIO-3 and BIO-4 all refer to compensation as a last resort. Although not specifically mentioned in policy, where interest features of European sites are involved the case for proceeding if adverse effects on integrity will arise must by law be based on a) imperative reasons of overriding public interest (IROPI) and b) no alternatives to delivering the objectives of the project. All proposals must also comply with MPA-1 which stipulates that proposals which cannot avoid, minimise and mitigate adverse impacts will not be supported. MPA-1 does not remove the derogation provision detailed above.

In reading the receptor group by receptor group assessments below, it is essential to bear in mind that a) all assessments are in the absence of mitigation (or with regard to a plan, in the absence of consideration of policy measures to ensure harmful activities are not permitted without adequate mitigation) and b) the level of site specific assessment is severely limited by the very limited amount of information regarding activities that may result from each policy and where those activities may be located (except somewhere within the relevant marine plan area). The assessment is therefore intentionally highly precautionary. At the end of each section the role of mitigating policy in the marine plans is then discussed, with recommendations for further mitigating wording covered at the end of this AAIR.

Note that this AAIR must cover impacts on over 350 European sites. Some types of European site (those designated for fish or marine mammals) are designated for a small number of interest features and involve a small number of European sites. Impacts can therefore be discussed in this report tailored to each European site and their interest features. However, for other types of site (those designated for birds or habitats) a very large number of sites and interest features is involved. Moreover, there is extensive replication of policies across the seven marine plan areas and impacts arising within a given marine plan area can potentially affect European sites located hundreds of kilometres from that marine plan area's boundary (particularly for long-distance foraging seabirds, migratory fish and, potentially, marine mammals). For example, proposals in the south west and north west marine plan areas could affect SACs designated for migratory fish throughout the west coast of the UK. This means that it is not possible or appropriate to discuss each marine plan in isolation or to discuss every SPA, or every SAC designated for habitat features, individually in this document. Therefore, for a conclusion regarding adverse effects on integrity (or otherwise) for each European site, refer to the accompanying Excel database that can be filtered by marine plan area thus enabling one to focus only on the assessments for those European sites relevant to a particular area. The database lists every European site considered in the assessment, whether it was screened in or out of assessment and why, what marine plan areas are affected and documents the ultimate conclusion (adverse effects on integrity, or no adverse effects on integrity) for each European site that was screened into assessment.

5.1. European sites designated for avian interest features (Special Protection Areas)

Seabirds, waders and waterfowl are heavily dependent on marine and costal habitats for foraging, growth and migration (Ricklefs ,1990). They are a fundamental component of the marine ecosystem; for example 15 species of seabirds (including the procellariiformes[7], auks and terns) have more than 10 million individuals(Soanes, 2000). Such large population sizes result in the removal of huge amounts of biomass in prey annually. Brooke (2004) has compared the food consumption of the world's seabirds to the equivalent of global fishery extraction by humans. Despite their strong relationship with the marine environment they must unavoidably breed on land. This has resulted in the evolution of several traits, such as a longer life expectancy, delayed sexual maturity and a lower reproductive rate that tends to favour parental investment in fewer chicks(Ballance , 2007). Because of human pressures and life histories seabirds are declining unsustainably by 30% over the last three decades (Croxall *et al,* 2012); becoming threatened at a faster rate than any other group of birds. Alternatively, other groups of birds such as *Accipitridae* (kites, hawks and eagles) and *Ciconiiformes* (herons and storks) may not rely on the sea for foraging; rather cross UK waters to reach overwintering or summer breeding grounds. These birds too have similar life history traits to that of seabirds including low reproductive outputs and longer life expectancies.

Considering waders, waterfowl and seabirds dependence on the marine environment at all stages of their life cycle and/or the fact that many species travel long distances and cover vast areas of sea when foraging (up to 100-400km), and even greater distances on migration, there is a strong probability that policies which will lead to an

[7] Albatrosses, petrels & shearwaters and storm petrels.

increase in anthropogenic marine activity or the construction of anthropogenic structures within the seven marine plan areas could have likely significant effects on various populations and species associated with the 'screened in' Special Protection Areas in the screening matrix.

In addition, there is the potential for impacts on otherwise terrestrial birds that migrate through the marine environment, particularly from displacement or bird-strike due to wind farms. Of relevance to this discussion the following species of migratory bird have English SPA/Ramsar sites designated for them (and are thus likely to pass through the marine plan areas) but are not aquatic: nightjar, merlin, hobby, quail, stone curlew and woodlark. In addition to this, hen harrier, marsh harrier and bittern also make up the suite of English SPA/Ramsar sites, although most of the UK population of these species is resident. Some SPA/Ramsar sites on the eastern English coast are designated for marsh harrier and bittern so there is also a habitat loss impact potentially involved.

This risk of significant effects arises from the following policies:

- Enhanced public access (ACC-1, SOC-3, FISH-2, TR-1 and TR-4);
- Provision of infrastructure, including for employment, sustainable fisheries, aquaculture and related industries (AQ-2, EMP-2, INF-1 and INF-3);
- Cable burial and future cable landfall (CAB-1, CAB-2 and CAB-3);
- Environmentally positive policies that may have negative effects (CCS-1, CCS-2 and HAB-1);
- New dredge disposal sites (DD-3);
- Renewable energy, including wind turbines (REN-1 and WIND-2); and,
- Promotion of short sea shipping (PS-4)

The purpose of this section is to explore the potential impacts and effects further in the form of an 'appropriate assessment' to determine whether a conclusion of no adverse effects on integrity can be drawn for any of the 'screened in' European sites designated for these receptors, based on the limited information available at the plan level regarding the potential outcomes of these policies.

During the screening exercise a series of impact pathways were identified associated with these policies. The assessment therefore expands further on those pathways. Since most of the 'screened in' policies have very limited spatial information the appropriate assessment is based on the *sensitivity* of the interest features of relevant European sites, rather than on the level of *risk*, since the latter requires knowledge not only of the vulnerability of the species but also of the likelihood of specific activities and impacts occurring within sensitive areas; a level of detail that does not exist at the plan level. Taking a precautionary approach, it is therefore assumed that exposure of sensitive interest features to these impact pathways would occur in the absence of mitigation.

For a minority of policies a level of spatial information does exist:

- Policy ACC-1 refers to *'enhanced and inclusive public access to and within the marine area'* with regard to services including tourism and recreation. While that could theoretically occur throughout all seven marine plan areas, such activities and proposals are more likely to occur in the inshore coastal environment in locations where existing populations and/or levels of recreational activity are high.

- Policy WIND-2 refers to '*areas of identified potential for offshore wind resource'.* The licencing of such areas is the responsibility of the Crown Estate rather than the Marine Management Organisation but since the locations of these areas are known they can be considered in the appropriate assessment information report. However, they cover a large proportion of each marine plan area so only provide a limited amount of spatial resolution for the purposes of impact assessment. Note that these only denote areas of potential and do not indicate where in those areas of potential Crown Estate may ultimately choose to licence wind farms.
- The marine plans refer to '*potential sustainable aquaculture production areas'*. New aquaculture infrastructure as per policy AQ-2 could theoretically be throughout all seven marine plan areas. However, there are no specific proposals available to assess. To aid in the spatial specificity of the assessment we have, however, noted that aquaculture in the relevant marine plan areas is currently focussed(Defra, 2015) on the west Cumbria coast between Morecambe Bay and the Solway Firth, the Devon and Cornwall coastline between Falmouth and Exeter and the Thames Estuary (particularly the coastline of Essex as well as Whitstable and Herne Bay in north Kent). There are also a small number of aquaculture sites along the north Cornwall and Devon coastline and the Northumberland coast. The majority of these sites are shellfish production sites in shallow coastal waters, although these are not evenly distributed since the Northumberland coast only has one shellfish site; England has no marine finfish farms(Black and Hughes, 2017). Offshore Shellfish Limitedhas been pioneering offshore rope-based mussel production on three sites between 3 and 6 miles offshore in Lyme Bay, Devon but this is in the south marine plan area and thus outside the scope of this HRA.
- Policy PS-4 supports promotion of short-sea shipping and coastal shipping as an alternative to other transport methods. While this has no explicit spatial component, some of the most likely areas for impacts associated with the expansion of short-sea shipping and coastal shipping are at existing ports that coincide with the locations of Special Protection Areas and Ramsar sites designated for seabirds, waders and waterfowl. The key areas (the major ports rather than a comprehensive list) within the relevant marine plan areas are therefore:
    - north east inshore marine plan area: the Port of Tyne, Port of Blyth and the Ports of Teesport & Hartlepool.
    - north west inshore marine plan area: the Port of Heysham and the Ports of Liverpool & Garston.
    - south west inshore marine plan area: The Port of Bristol and the Port of Plymouth.
    - south east inshore marine plan area: the Port of Dover and the major ports of the greater Thames Estuary: Medway, London and Harwich.

Although existing concentrations of activities have been used to add spatial specificity to the analysis and as examples of the known potential for conflict between certain types of development and European sites, it is recognised that the intent of the marine plan policies is to promote these activities wherever they are suitable, not just in existing locations. Therefore the Excel Database of European sites that accompanies this report takes account of the fact that these activities could

occur throughout the seven marine plan areas in reaching a judgment regarding potential for adverse effects on integrity.

The potential impact pathways to seabirds generated by the plan are extremely complex; however, these impacts have been grouped into 9 different categories of impact pathway:

- Physical Damage to Habitat (change to habitat; impact pathways 1 - 4)
- Physical Damage to Species (direct damage to species from collision risk; impact pathway 6)
- Physical Damage to Species (direct damage to species from marine litter; impact pathway 7)
- Non-Physical Disturbance (barrier to species movement; impact pathway 8)
- Non-Physical Disturbance to Species (visual/noise disturbance; impact pathways 9 and 10)
- Toxic Contamination (spillage and contamination causing a reduction in water quality; impact pathways 11 to 13)
- Non-Toxic Contamination (elevated turbidity; impact pathway 14)

Physical damage to habitat (impact pathways 1-4)

There are several pathways by which seabirds may be impacted due to physical damage to supporting habitats. For clarity, this section also includes situations where habitat is effectively lost to the seabirds, waterfowl or waders such as through the displacement effect of wind arrays. These pathways may include:

- Coastal habitat damage could be generated directly from cable burial activities (CAB-1, CAB-2 and CAB-3) or indirectly from enhanced public access (ACC-1, FISH-2, TR-1 and TR-4). This latter could arise from trampling or exposure of nests, disorientation of nestlings, enhanced predation thereby reducing the availability of suitable nesting sites for birds.
- Foraging habitat loss could be generated by the provision of infrastructure and employment (AQ-2, EMP-2, EMP-4, FISH -1 and INF-1); dredging (DD-3); renewable energy, including wind turbines (REN-1 and WIND-2) and promotion of short sea shipping (PS-4). In the latter case this could arise through avoidance of vessels and marine infrastructure making an area of foraging habitat unavailable to birds.
- Displacement of birds without actual habitat loss could occur due to the provision of infrastructure and employment (AQ-2, EMP-2, EMP-4, FISH -1 and INF-1) dredging (DD-3); and renewable energy, including wind turbines (REN-1 and WIND-2): presence of anthropogenic structures, lighting and disorientation may reduce the ability of an area to support forging and/or migrating birds.

These pathways of impact are discussed in more detail below.

The creation of new infrastructure for employment, renewable energy, enhanced public access, cable burial/landfall, short-sea shipping and coastal shipping, fisheries or aquaculture on the seabed, foreshore, or coastal area has the potential to result in the replacement of a habitat that is suitable for foraging, nesting or roosting birds with one that is unsuitable in either the short term (during exploratory surveys, or construction and decommissioning) and long-term (during operation). Habitat loss

might, for example, occur if areas of saltmarsh, lagoons, intertidal mudflat or grazing marsh for waterfowl, waders and birds such as marsh harrier are directly removed, or their structure, and thus function to the bird population, is changed through alterations in hydrology, water level, salinity or smothering, which might in turn affect prey availability.

The effect could be direct but also indirect, through erosion from changes to the hydrodynamic and/or sediment transport regime. Such habitat loss could potentially also arise as an unintended result of projects under policies HAB-1 (proposals to improve the resilience of deep sea habitats), or those policies which promote the positive reuse of existing infrastructure for carbon capture and storage (CCS-1 and CCS-2).

There is a link between losses of habitat resulting in loss of prey resulting in impacts on birds. For example, reef habitat is typically associated with high fish populations and is therefore excellent foraging grounds for seabird species such as, terns, shearwaters and kittiwakes. For birds, this habitat may reduce in quality due to the physical loss of habitat (i.e. smothering) due to dredging (DD-3) or due to foraging displacement, this pathway is expected to be generated from multiple routes including the provision of infrastructure and employment (AQ-2, EMP-2, EMP-4, FISH -1 and INF-1), renewable energy (REN-1 and WIND-2) and the promotion of short sea shipping (PS-4). Also of high relevance to birds are estuarine habitats since these support mudflats that provide important foraging habitat to waders such as avocet, black-tailed godwit, oystercatcher and ringed plover. Development of these areas for increased shipping (PS-4) may also result in displacement issues for birds.

The delivery of infrastructure for sustainable aquaculture production (AQ-2) could potentially occur throughout all seven marine plan areas. The locations of new aquaculture activities are not known at this stage and therefore cannot be specifically assessed with regard to individual European sites. However, it is reasonable to assume that at least some will be linked with existing core areas of aquaculture and thus pose the greatest risk of affecting the following Special Protection Areas within the seven marine plan areas:

- West Cumbria coast between Morecambe Bay and the Solway Firth: Morecambe Bay and Duddon Estuary Ramsar site and Solway Firth pSPA/Ramsar site;
- Devon and Cornwall coastline between Falmouth and Exeter: Falmouth Bay to St Austell Bay pSPA, Tamar Estuaries Complex SPA/Ramsar site, Exe Estuary SPA/Ramsar site;
- Thames Estuary (particularly the coastline of Essex as well as Whitstable and Herne Bay in north Kent): The Swale SPA/Ramsar site, Outer Thames Estuary SPA and the network of Essex estuarine SPA/Ramsar sites: Benfleet & Southend Marshes SPA/Ramsar site, Crouch & Roach Estuaries SPA/Ramsar site, Foulness SPA/Ramsar site, Dengie SPA/Ramsar site, Blackwater Estuary SPA/Ramsar site and Colne Estuary SPA/Ramsar site.

Short-sea and coastal shipping expansion could result in direct and indirect habitat loss for SPA/Ramsar site birds. The level of spatial detail in the marine plans is insufficient to enable a detailed assessment of effects on each European site due to

expansion of short-sea and coastal shipping (PS-4) because the nature, quantum or location of such new infrastructure is not specified (as it will not be known until proposals come forward). Therefore it is not possible to undertake a specific assessment. That said, at least some of the delivery of infrastructure associated with the expansion of short-sea shipping and coastal shipping may affect those SPA/Ramsar sites that lie close to the existing centres of short-sea shipping and coastal shipping activity, although other SPA/Ramsar sites could be affected depending on the nature and location of proposals:

- north east inshore marine plan area: the Ports of Teesport & Hartlepool lie adjacent to the Teesmouth & Cleveland Coast SPA/Ramsar site, while the Port of Blyth lies close to the Northumbria Coast SPA/Ramsar site.
- north west inshore marine plan area: the Port of Heysham lies adjacent to Morecambe Bay & Duddon Estuary SPA/Ramsar site, while the Ports of Liverpool & Garston lie adjacent to Liverpool Bay SPA and Mersey Narrows & North Wirral Foreshore SPA/Ramsar site and close to Ribble & Alt Estuaries SPA/Ramsar site.
- south west inshore marine plan area: The Port of Bristol lies adjacent to the Severn Estuary SPA/Ramsar site.
- south east inshore marine plan area: the major ports of the greater Thames Estuary (Medway, London and Harwich) lie close to The Swale SPA/Ramsar site, The Medway Estuary & Marshes SPA/Ramsar site, the Outer Thames Estuary SPA and (in the case of Harwich) the Stour & Orwell Estuaries SPA/Ramsar site.

As a more detailed example potentially associated with expansion of short-sea shipping and coastal shipping, the full expansion of the Port of Liverpool as envisaged by Peel Ports (Peel Ports, 2011) would require the development of Seaforth Nature Reserve (RSPB, 2019a), part of the Mersey Narrows & North Wirral Foreshore SPA and Ramsar site, with the potential for adverse habitat loss effects on the common tern colony that nest at the site and on the passage and wintering waterfowl that use the area. Similarly, the delivery of coastal erosion protection associated with such infrastructure could result in changes to long-shore sediment transport or to hydrodynamics through (for example) wave reflection erosion from sheet piling or concrete walls.

The potential impact pathways linking new dredge disposal sites (Policy DD-3) to habitat loss for seabirds, waterfowl and waders are complex. Impacts may be a result of direct dredging activity or the movement of dredging machinery and vessels (Kube, 1996). Dredging activities could have the opposite impact to birds via displacement (Kaiser, 2002). For example, a review by the MMO 1139 (2018) categorised seabirds by displacement susceptibility; results showed that ducks, divers, cormorants and terns either have high or very high displacement index due to aggregate extraction. Effectively, this form of displacement results in the loss of foraging and/or breeding habitat as seabirds are unable to utilise the area. In addition, habitat loss for seabirds, waders and waterfowl can result from the smothering of habitats of relevance to the prey species for which the birds forage in areas where high sediment loading is not a natural phenomenon, or if the dredged arisings are dispersed to intertidal areas, smothering intertidal vegetation.

The ecological effects of direct habitat loss on SPA/Ramsar site birds are obvious. The effects of effective habitat loss that could arise as a result of schemes permitted in accordance with screened in marine plan policies are less immediately obvious

but essentially constitute displacement. Not all bird species for which SPA/Ramsar sites are designated are at equal risk of displacement. Based upon the literature available, there are several seabird species for which European sites within the marine plan areas are designated and which have high displacement risk (indices). The list of species includes:

- Arctic tern *Sterna paradisaea*;
- Common scoter *Melanitta nigra*;
- Common tern *Sterna hirundo;*
- Cormorant *Phalacrocorax carbo;*
- Red-throated diver *Gavia stellata;*
- Roseate tern *Sterna dougallii;*
- Sandwich tern *Sterna sandvicensis*; and
- Shag *Phalacrocorax aristotelis.*

In contrast, several seabird species that exhibit low displacement indices to marine aggregate extraction:

- Black-headed gull *Chroicocephalus ridibundus;*
- Fulmar *Fulmarus glacialis;*
- Gannet *Morus bassanus;*
- Herring gull *Larus argentatus;*
- Kittiwake *Rissa tridactyla;*
- Lesser black-backed gull *Larus fuscus;*
- Manx shearwater *Puffinus puffinus;* and
- Storm petrel *Hydrobates pelagicus.*

These indices have been developed for aggregate extraction and increases in aggregate extraction will not result from particular marine plan policies as this activity is licenced by the Crown Estate and there are no marine plan policies in any of the seven marine plans under consideration that promote this activity. However, the degree of relative susceptibility to displacement effects is transferable to other sources of displacement such as dredge disposal activities.

Joint Natural England and JNCC guidance (JNCC and Natural England, 2012) has applied sensitivity scores to an assessment of displacement buffers for seabirds. They recommend a 2km displacement buffer for most seabirds and 4km for divers and seaducks. Wind farm projects such as East Anglia Three have used a 2km buffer for construction activities across the wind farm and the export cable corridor.

Those sites that are considered to be fully terrestrial (e.g. the New Forest SPA/Ramsar site) will not be impacted by the physical loss of habitat due to projects that may come forward under any of the seven marine plans. However, it is not possible at this stage to conclude no adverse effects on site integrity for nearly all other screened in Special Protection Areas since these are designated due to the presence of multiple Annex II bird species which interact with habitats in the marine or coastal environment and could therefore be affected by proposals brought forward under the screened in policies of the seven marine plans without mitigation or further examination on a project by project basis.

Physical Damage to Species (direct damage to species from collision risk; impact pathway 6)

Seabirds, waterfowl and waders spend much of their life foraging or migrating at sea and are therefore susceptible to above ground and (in the case of divers for example) below water surface collisions. The degree of collision risk for birds is heavily dependent on species, abundance, foraging behaviour, weather conditions and foraging area dynamics (Department of Energy and Climate Change, 2009).

The key pathways for bird collisions linked to the 'screened in' marine plan policies are:

- Vessels travelling to and from site (potentially associated with all screened in marine plan policies at some point in the project lifecycle, from exploratory survey through construction to operation, maintenance and decommissioning); and
- Wind turbines (Policy WIND-2) or other renewable energy solutions, such as tidal stream turbines and wave energy devices (Policy REN-1).

Vessel-related mortality

Industrial activities such as dredging can attract seabirds, particularly gulls (Garthe and Hüppop, 1999), due to increased shipping activity and construction works. This could increase the collision risk of these birds leading to mortality. The collision risk is not just associated with birds on the surface but also with those below the surface in the case of plunge-diving seabirds. Research has indicated that an increase in vessels at night, particularly in poor visibility, can correlate with an increase in seabird collisions particularly when the birds are attracted to, or disoriented by, artificial lighting on the vessels (Merkel, 2010). Given this could apply to any project that came forward under any of the screened in marine plan policies at some point in their history, and cannot be assessed in further detail at this level, an adverse effect on integrity could arise for any 'screened in' European site designated for any bird species that dives or which rests on the surface of the sea.

Fishing activities and collision risk

Bird bycatch as a direct result of industrial fishing activities are a global threat to seabird survivorship (Žydelis *et al,* 2009). Those bird species that are of greatest threat from longline and trawl fisheries includes divers, grebes, sea ducks, diving ducks, auks and cormorants. Since these birds tend to dive under the surface of the water in search for food there is therefore an increased chance of colliding with fishing lines either accidently or via activity seeking prey items that are hooked to fishing lines. In the Baltic gillnet fishery bird mortality because of bycatch is a serious threat to seabird species with a minimum estimate of 17,551 seabirds killed annually due to bycatch between November to May (Bellebaum *et al,* 2013).

Wind turbines and collision risk

The UK Government has set a target to deliver 30% of the UK's energy from offshore wind sources by 2030 (Department for Business, Energy and Industrial Strategy, 2019). To meet this target offshore wind farms will be necessary. It is valuable at this point to express the RSPB's opinion regarding wind turbines. They explain that they favour '*energy efficiency together with a broad mix of renewables, including solar, wind, biomass (for heat and power) and marine power; located and used in ways which minimise damage to the natural environment' (*RSPB, 2019c*)*.

Although Policy WIND-2 refers to '*areas of identified potential'* for offshore wind resource, the licencing of such areas is the responsibility of the Crown Estate rather than the Marine Management Organisation. The Crown Estate carries out its own plan-level HRA for each licencing round. Although the broad locations of these areas are known, they are numerous and complex and cover a large proportion of each marine plan area. As such they actually provide little basis for a detailed impact assessment. This analysis therefore assumes that any bird species associated with one of the 'screened in' SPA/Ramsar sites could be affected by bird-strike from the delivery of wind arrays in the relevant marine plan area, thus leading to an adverse effect on the integrity of the associated SPA/Ramsar site. Determining whether an adverse effect on integrity would actually arise from a specific wind array proposal will depend upon survey data and on the specific details of the array and must be undertaken for individual applications. Moreover, most SPA/Ramsar sites are designated for a suite of species which vary in their risk of bird-strike from wind arrays; if even one species for which a given SPA/Ramsar site was designated would have its ability to achieve its conservation objectives compromised then an adverse effect on the integrity of the relevant SPA/Ramsar site must be concluded. However, some bird species are at lower risk than others and this section discusses that variation in risk.

There are a handful of studies that are frequently cited within literature that suggest high mortality rates due to turbine collisions. These studies were located at Altamont Pass in California, USA, Tarifa and Navarra, Spain; deaths resulting from turbine collisions are high, notably of golden eagle *Aquila chrysaetos* and griffon vulture *Gyps fulvus*, respectively (BirdLife International, 2003). However, it was later considered that these windfarms was poorly positioned and without the appropriate ecological impact assessments untaken. Due to seabird life histories, high mortality rates can have significant impacts to the heath of a population causing declines and removing breeding individuals from the population (Sæther and Bakke, 2000).

Understanding the true extent of wind turbine impacts to birds is a difficult task due to the number of variables involved. These include: wind speed, wind direction, air temperature, humidity, flight types, distance of flight, height of flight, time of day, topography and weather conditions (Furness *et al*, 2013). All of these can impact the risk of collision and therefore the overall impacts turbines have to individuals, populations and species. Table 5 reviews literature investigating mortality impacts arising from wind farms.

Table 5 Literature investigating mortality impacts arising from wind farms.

Study	Species	Results and impacts
Smart Wind (2013)	Gannet; black-headed gull; herring gull; Great black-backed gull; Kittiwake; and Sandwich tern.	The percentage of seabird ability to avoid wind turbines was concluded at 99.5% based upon carcass evidence.
Desholm and Kahlert (2005)	Long-lived geese and ducks	The percentage of flocks entering wind farm areas decreased from pre-construction of operation. At night, birds were more prone to passing through the wind turbines, however, demonstrated capabilities to pass between individual turbines. In summary, less than 1% of duck and geese migrated close enough to turbines to be at collision risk.
Garthe and Hüppop (2004)	Variety of birds	Authors developed a wind farm sensitivity index (WSI) for seabirds that was based upon species' attributes (e.g. flight manoeuvrability; flight altitude; percentage of time flying and nocturnal flight activity). Trends displayed great differences between species with black-throated diver *Gavia arctica* and red-throated diver *Gavia stellata* were most sensitive to the impacts of wind turbines whereas the lowest WSI scores were for kittiwake *Rissa tridactyla*, black-headed gull *Larus ridibundus* and northern fulmar *Fulmarus glacialis*. In comments on the Screening Report for this HRA JNCC clarified that red-throated diver are at low collision risk but the risk of displacement from visual disturbance is a significant issue.
Bradbury,Trinder *et al* (2014)	European Protected Seabirds	Out of 54 seabirds assessed only 9 species scored either a high or very high risk of population vulnerability to collision risk. These results suggest that gull and kittiwake species are more likely to be impacted by the development of wind turbines. The SeaMaST tool was generated from this study to highlight areas of highest sensitivity to windfarm impacts.
Rothery *et al* (2009)	European Protected Seabirds	While observing bird fight behaviour around wind turbines for a total of 352 hours post-construction observations suggests seabirds demonstrated capabilities to manoeuvre out of turbine blades while for other species their

		normal low flight heights while foraging low enough to prevent collisions occurring.
Cleasby *et al* (2015)	Gannet	Authors used the latest GPS tracking devises to produce tracking information with regards to the norther gannet and their vulnerability to turbine collisions. Overall, gannets were not considered vulnerable to bird strike when commuting (i.e. between colonies and foraging areas) at flight heights of 12m. However, gannets were vulnerable to bird strike when actively foraging within wind farms at heights of 27m. Due to the emergence of modern GPS tracking data this study suggests that conventional modelling systemics are underrepresenting mortality of seabirds from wind farms.
Conway *et al*, 2007	Nightjar	Nightjars are more likely to be impacted by onshore wind turbines as opposed to offshore turbines. In addition, extensive migratory research for nightjar was undertaken between 1993 and 2004 to investigate population declines. GPS tracking displayed that nightjar migrated through the western half of north Africa, eastern Spain and cross from northern France to the south east of England. Tracking suggests that few birds cross into the south west of England.

As a general rule smaller, more highly manoeuvrable, bird species or those that habitually fly at low altitude are likely to be at lower risk of collision with wind arrays than larger less manoeuvrable species, particularly when the latter species occur in large flocks or soar on thermals. Many species of seabird adopt soaring behaviour (including gulls, petrels, shearwaters and terns) and this can pose a specific risk from wind turbines if wind arrays are situated where thermals are located.

Table 6 identifies wind turbine collision risk for bird species located within each of the seven marine plan areas. Since there are no specific proposals to assess at the plan level the purpose of this table is to highlight species for which European sites are designated and for which collision risk data are available. These data can be used to inform project level assessments. Note that only bird species with sufficient peer-reviewed data were included from the following sources: Cook *et al* (2014), Garthe and Hüppop (2004), IMARES (2011, 2016), Johnston and Cook (2016), Kruger and Garthe (2001), Marine Scotland (2012), Newton (2007), Scottish Natural Heritage (2017), Smart Wind (2013), Snow and Perrins (1998) and Zhalakevicius, M. (1977).

For many waders, waterfowl and other migratory bird species data were too limited to be included.

Table 6 Wind turbine collision risk for relevant bird species for which European sites within the seven marine plan areas are designated

Bird species	Foraging mode	Foraging height	Nocturnal activity	Collision risk (% of birds at blade height)	Manoeuvrability (1= Very High, 5= Very low)
Great Black-Backed Gull	Surface feeder	Average of 15m	Yes	35%	2
Herring Gull	Surface feeder	Average of 15m	Yes	33%	2
Lesser Black-Backed Gull	Surface feeder	Average of 15m	Yes	27%	1
Common Gull	Surface feeder	Average of 10m	Yes	21%	1
Black-headed Gull	Surface feeder	Average of 15m	Yes	20%	1
Gannet	Plunge/Pursuit-diver	Up to 30m	No	16%	3
Kittiwake	Surface feeder	Average of 15m	Yes	11%	1
Arctic Skua	Surface feeder	Up to 10m	No	10%	1
Great Skua	Surface feeder	Up to 10m	No	10%	1
Sandwich Tern	Surface feeder	1-2m	No	7%	1
Common Tern	Surface feeder	1-2m	No	7%	1
Little Tern	Surface Feeder		No	7%	1
Shag	Pursuit-diver	Below 20m	No	5%	3
Arctic tern	Surface feeder	1-2m	No	5%	1
Roseate Tern	Surface feeder	1-2m	No	5%	1
Red-Throated Diver	Pursuit-diver	1.5m	No	5%	5
Black-Throated Diver	Pursuit-diver	1.5m	No	5%	5
Horned Grebe	Pursuit-diver	1.5m	No	5%	DU
Little Grebe	Pursuit-diver	1.5m	No	5%	DU

Razorbill	Pursuit Diver	0-5m	No	5%	4
Northern Fulmar	Surface feeder	0-5m	Yes	5%	3
Great northern diver	Pursuit Diver	DU	No	5%	5
Great Crested Grebe	Pursuit-diver	1.5m	No	4%	4
Common Guillemot	Pursuit Diver	0-5m, Max. 20m	No	4%	4
Great Cormorant	Surface/Pursuit Diver	0-5m	No	4%	4
Slavonian Grebe	Pursuit Diver		No	4%	4
Common Scoter	Diver/Pursuit-diver	1 – 2m (1,000 – 4,500m during migration)	No	3%	3
Common eider		0-5m	Yes	3%	4
Velvet Scoter	Pursuit Diver	0-5m	Yes	3%	3
Manx Shearwater	Surface/Pursuit diver	10m or less	Yes	1%	3
Atlantic Puffin	Pursuit Diver	0-5m, Max. 20m	No	1%	3
Whooping Swan		Average of 228m for migration		DU	DU
Storm Petrel	Surface feeder	10m	Yes	DU	DU
Black Tern	Surface Feeder	0-5m	No	DU	DU
Pomarine Skua		DU	DU	DU	1
Mediterranean Gull	Surface feeder	DU	DU	DU	DU
Red necked Grebe	Pursuit Diver	DU	DU	DU	DU
Shelduck	DU	DU	DU	DU	DU

Other forms of renewable energy

In addition to wind turbines, research indicates collision risk can be associated with other forms of renewable energy, such as tidal stream turbines and wave energy devices. For example, birds may collide with wave turbines due to swimming or diving activities. Furness et al (2012) described that Black guillemot, Razorbill, Shag, Common guillemot and Great cormorant were species considered to have the highest vulnerability index to tidal turbine impacts. Since these bird species are divers it is reasonable to assume that this group would be more susceptible to the collision risk of underwater structures such as wave energy devises (generated from policy REN-1).

With increasing infrastructure in the marine environment there is the significant risk of increased birdstrike. Of highest concern are the impacts of renewable energy sources (REN-1 and WIND-2), such as wind turbines, since these are typically mobile structures that can increase birdstrike during foraging activities both above water and below water. A conclusion of no adverse effects on integrity cannot be reached for the screened in European sites designated for avian species since these sites support many different protected species that cannot be dismissed in isolation without mitigation or further examination on a project by project basis.

Physical Damage (direct damage to species from marine litter impact pathway 7)

Marine litter could be generated by schemes that come forward under many of the screened in policies within each of the seven marine plans. These include enhanced public access (ACC-1, FISH-2 and TR-1) through the discarding of litter from increased human activity, or from development supported or promoted by the other policies (AQ-2, EMP-2, EMP-4, INF-1, CAB-1, CAB-2, CAB-3, REN-1, WIND-2 and PS-4) through the accidental and/or incorrect disposal of construction materials, or operational materials. Fisheries can also be a source of litter, although it is noted that the main fisheries policy in the seven marine plans (FISH-1) specifically promotes sustainable fisheries; fishing activities that have an adverse effect on European sites would therefore not be complaint with this policy due to their unsustainable nature. Marine litter is a general issue rather than just something associated with the marine plans, but where policies support industries and applications that can be associated with an increase in such litter the issue requires consideration in the AAIR of those policies.

Marine litter may entangle seabirds and chicks and/or be ingested when mistaken for food. Entanglement may arise from discarded or lost fishing gear, equipment related to aquaculture, or plastic bags relating to the policies that generally promote increased access to and use of the marine environment (AQ-2, ACC-1, FISH-2, TR-1) (Derraik, 2002). These forms of litter may also be collected by seabirds mistaken for suitable nesting material and inevitably causing the entanglement of chicks and adults resulting in injury or death(Votier *et al*, 2011).

The ingestion of marine litter is also of concern; birds frequently mistake litter for food that leads to lethal and sub-lethal impacts. The ingestion of materials such as netting, fishing hooks and plastics will lead to blockage of the oesophagus and/ or the digestive systems leading to a net reduction in the update of food. These materials are also likely to cause internal punctures to the digestive system that may

lead in infections or death. The impacts of ingested marine litter are far reaching ranging from the individual bird and chicks to global populations and other marine organisms where material is passed through tropical levels (Rochman *et al,* 2016). Wilcox et al (2015) modelled that up to 90% of all global seabirds currently have marine litter in their digestive system with predicted forecasts to reach 99% by 2050.

Studies have suggested that some bird species may be more susceptible to the impacts of marine litter. For example, Species within the *Procellariiformes* order that are designated within (or overlap with the long-distance foraging seabird impact zones of) all seven marine plan areas includes:

- Manx shearwater *Puffinis puffinis*;
- Fulmar *Fulmarus glacialis*; and
- Storm-petrel *Hydrobates pelagicus*.

These species have been recorded to accumulate more plastics within their gut as there is a constriction between the gizzard and the proventriculus that makes it harder for the birds to expel gizzard content. It is therefore reasonable to assume that European Sites supporting these species for nesting such as Skomer, Skokholm & the Seas off Pembrokeshire SPA located within the influence zone of the inshore and offshore south west marine plan area. Since this site supports in excess of 150,000 breeding pairs of Manx Shearwater and a population of Storm-petrel there is a significant threat to European Site integrity from marine litter which could be exacerbated by proposals that fall within the support and consenting regime in the screened in marine plan policies. In contrast, those sites that are fully terrestrial will not be impacted by marine litter generated by schemes that come forward in response to supportive policies in each of the seven marine plans.

Research has shown that aquaculture (promoted under policy AQ-2) in particular can be a significant source of marine litter (Clean Water Action, 2011). For example, aquaculture within Chile is a major economic activity and provides a suitable case study of environmental impacts when minimal environmental mitigation is enforced. Hinojosa and Thiel (2009) suggest that within an area of high aquaculture activity; this industry was responsible for most marine litter within their study area: 80% of marine litter consisted of Styrofoam (expanded polystyrene), plastic bags and other plastic fragments. Styrofoam is frequently used throughout the world as floatation devises (IEEP, 2017) for mussel farms. Styrofoam is particularly polluting as it is easily fragmented into microplastics that entre the food chain of marine animals.

The Canadian Aquaculture Styrofoam®-Encasement project demonstrated that the encasement of Styrofoam floats in plastic designed to withstand the harsh marine environment, significantly reduced the breakdown of floats into microplastic to less than 0.0005 mg/L thereby protecting the marine environment and a reduction of 40-60% in output costs(Fisheries and Oceans Canada, 2013) for mussel farmers. Azzarello and Vleet (1987) suggest that certain groups of seabirds may be more susceptible to the impacts of ingested marine litter. *Procellariiformes* tend to accumulate more plastic than other species within different orders. This is relevant

because this group of birds contains a series of species for which European sites are designated in UK waters, as already discussed.

Due to the significant threat to seabird life, and indeed other marine organisms, it is imperative that proposals that come forward in response to supportive policies in the seven marine plans do not contribute to the problem to such an extent that an adverse effect on European site integrity results. The seven marine plans all include three policies specifically to deal with the issue of marine litter. These are policies ML-1 to ML-3. Policy ML-1 requires public authorities with functions capable of releasing marine litter to make adequate provision for waste management to prevent the generation of such litter or to ensure it is appropriately recycled or disposed and requires such authorities to also make provision for the removal of marine litter. In particular, policy ML-3 states that proposals that could potentially increase the amount of litter discharged into the marine area either intentionally or accidentally must include measures to (in order) avoid, minimise or mitigate such discharges.

There is therefore a strong policy framework in place for addressing the potential for generation of marine litter from proposals that come forward under screened in marine plan policies and for ensuring that mitigation mechanisms are delivered to tackle it. However, due to the high level nature of the plan it is not possible to determine specifically what schemes would be involved or what specific mitigation proposals would be required, or whether they would be effective in a given situation. Therefore down-the-line assessment at the scheme/application level is required, as it will be for the other impact pathways discussed in this AAIR due to the high level nature of the marine plans. Text for inclusion in the marine plans to address this issue is discussed in the mitigation section. Prior to inclusion of that text, for most of the European Sites brought forward from the screening stage (i.e. those within the coastal or marine environment) the conclusion of adverse effect on integrity remains since no details of marine development are documented within any of the marine plans.

Non-Physical Disturbance (barrier to species movement; impact pathway 8)

In addition to birdstrike (covered under discussion of impact pathway 6) and their role in making areas of ocean potentially unavailable for foraging (covered under discussion of impact pathways 1-4), wind arrays in particular may impact migratory bird species (including some of those that are otherwise primarily inland) by acting as barriers to movement. Birds may be displaced by the presence of wind turbines and change their migratory route. While this does inevitably avoid direct mortality from wind turbines (as discussed under pathway 6); changes in migratory routes could lead to a less direct migratory route thereby increasing energy output.

The impact report produced by Hötker *et al* (2006)analyses the varying impacts of wind turbines as barriers to movement for a variety of migratory bird species. In total, 104 out of 168 daytime observations were determined to be impacted by the barrier effect. However, only 81 of these species were concluded to be ‘significant’. Birds that were particularly sensitive included geese, kites, cranes and passerines with these groups tending to change their migratory routes depending on wind farm placement. Larger-sized birds such as cormorants, ducks, some birds of prey, terns and crows where unfazed by the presence of turbines and did not tend to change their migratory route. Alternatively, the allocation of wind farms between resting,

roosting and/ or breeding areas could have far greater consequences across a higher number of species. For those birds that displayed sensitivity to the presence of turbines there is the risk that due to increased energy expenditure of migratory routes there could be a reduction in body condition.

A reduction in parental body condition could reduce the reproductive success of breeding birds with the reduced ability to provide provisions to chicks (Wendeln and Becker, 1999). Modelling of these energetic costs was undertaken by Masden et al (2010); research suggested a positive correlation between increased distance travelled whilst foraging and energetic output. These results were expected, however, the different magnitudes of increased energetic output at a given distance displayed considerable variation. For example, shag and cormorant showed up to 35% more energy use when travelling an additional distance of 10km. Other species that indicated a large increase in energy output are guillemot and puffin (an up to 20% energetic increase). Welcker and Nehls (2016) found that divers, gannets, little gull, terns and alcids (auks, guillemots and puffins) were significantly displaced by wind farms with 75-92% lower abundances inside the wind farm compared to outside. For little gulls, alcids and terns the avoidance distance to the outermost turbines was identified to be greater than 1km.

Barriers to species movement for birds could be generated from several screened in policies of each marine plan. Those of greatest concern are promotion of renewable energy (REN-1 and WIND-2). Seabird groups with high energy expenditure due to the avoidance of wind farms include divers, terns and alcids. More specifically, studies have suggested that the following species for which European sites in the seven marine plan areas are designated have high expenditure rates to avoid wind farms:

- Shag *Phalacrocorax aristotelis;*
- Little gull *Hydrocoloeus minutus;*
- Gannet *Morus bassanus;*
- Cormorant *Phalacrocorax carbo;*
- Guillemot *Uria aalge*; and
- Puffin *Fratercula arctica.*

All of these will potentially forage up to 100km from their nest sites and several (gannet, guillemot and puffin) are on the list of long-distance foraging seabirds that will routinely forage over 100km, and in some cases up to 400km, from their nest sites. These species are supported by a variety of SPA/Ramsar site sites throughout the UK and therefore all seven of the marine plans could impact European Sites that support these species. Refer to the European site database to filter by marine plan area and identify which SPAs are relevant to each marine plan.

Furthermore, due to the limited data available for other species of migratory birds it is not possible at this stage to conclude no adverse impacts to site integrity. For example, Natural England have flagged in consultation over this AAIR that the southern North Sea is particularly constrained regarding the potential for delivering new wind farms without a conflict with European sites. They have also flagged that the kittiwake population of Flamborough Head and Bempton Cliffs SPA will be adversely affected by any new wind farm development within their identified core foraging area (hotspot), which extends up to 160km from the SPA boundary at its greatest extent, as has been noted earlier in this AAIR. This is because the primary

conservation objective for this SPA is not simply to maintain the existing kittiwake population but to restore it.

Therefore, the majority of European Sites brought forward from the screening exercises are likely to be impacted from the barrier effects and therefore threatening site integrity. As such, for most sites a conclusion of no adverse effects on integrity cannot be reached without mitigation or further examination on a project by project basis.

Non-Physical Disturbance to Species (visual/noise disturbance; impact pathways 9 and 10)

The impacts of visual, noise and light pollution can have a range of consequences ranging from impacts to the individual to the population. By definition, measuring and understanding the impacts of non-physical disturbance is extremely complex with issues not always pronounced. Impacts from non-physical disturbance include:

- The changes in the local distribution of the population (displacement); and
- The indirect impact these may have to food supply, foraging efficiency and compensation for increased energy expenditure due to flight (Riddington *et al,* 1996).

Disturbance issues differ in magnitude, frequency, predictability, spatial distribution and duration. Examples of anthropogenic activities generated from marine plans include:

- Human activity;
- Construction works;
- Vessel and vehicle movements;
- Infrastructure in operation (i.e. wind turbines and aquaculture); and
- Light generation.

Examples of disturbance generated from marine plans include:

- Visual;
- Light;
- Noise; and
- Vibration.

In addition, species may react to disturbance in different ways this may be due to age, season, weather and previous exposure. Disturbance to bird species may result in:

- Reduced foraging;
- Increased energy expenditure;
- Reducing breeding success;
- Effects to population density;
- Effects to community structure; and
- Effects to distribution and habitat use.

The impacts of disturbance generated from anthropogenic activities within and around estuaries have been identified as a potential issue for waterfowl for several years. The impacts listed above tend to operate within a zone of influence in addition to wider implications through in-direct effects. The extent of the zone of influence will depend largely on the type of activity, existing bird habituation levels, scale of stimuli and abiotic factors. Goss-Custard (2002) suggests that the supporting ability of a designated site for migrating bird species could reduce due as bird species may be

unable to utilise the sites resources thereby resulting in local decreases in abundances.

In comments on the Screening Report for this HRA JNCC commented that red-throated divers (associated with the Outer Thames Estuary SPA and Liverpool Bay SPA among other sites) are at low collision risk but the risk of displacement from visual disturbance is a significant issue.

Table 7. Based upon Marine Management Organisation (2018) displacement and habituation of seabirds in response to marine activities are assessed in relation of renewable energy and shipping.

Species group	Species	Renewable energy	Traffic and transport
Seaduck	Scaup	Moderate	
	Eider		
	Long-tailed duck		
	Common scoter		
	Velvet scoter		
	Red-breasted merganser		
Diver	Red-throated		
	Black-throated diver;		
	Great northern diver;		
Tubenose	Fulmar	High	Low
	Manx shearwater		
	Balearic shearwater		
	Storm petrel		
	Gannet		
Cormorant	Cormorant	Low	
	Shag		
Grebe	Great crested grebe;	High	High
	Great crested grebe;		
	Great crested grebe		
	Slavonian grebe		
	Great crested grebe		
	Black-necked grebe		
Auk	Puffin	High	Moderate
	Black guillemot		
	Razorbill		
	Guillemot (murre)		

Based upon Table 7, the bird species group that is of greatest concern regarding displacement are divers. It was identified in Marine Management Organisation (2018) that each diver species is easily displaced by industrial activities that could form part of schemes supported by development policies of each marine plan, notably policies AQ-2, EMP-2, INF-1, INF-3.

Table 8 reviews literature investigating disturbance impacts on waterfowl and seabirds.

Table 8 Literature investigating disturbance impacts on waterfowl and seabirds

Study	Species	Result and impacts
Sandvik and Barrett, 2001	Black-legged Kittiwake	Investigator disturbance decreased adult nest attendance and increased daily chick loss rates. Chick survival rate was also reduced.
Beale, 2004	Kittiwake and European shag	Observed that heart rates of birds that responded to threatening stimulus increased by 50%.
Harwood et al, 2017	Sandwich tern	Visual tracking illustrated avoidance of areas of construction activity. During the assembly of turbines avoidance was measured at around 30% fewer birds entering the study area. Although, the flight lines of birds that entered the site tended to use corridor between turbines thereby avoid collision. The overall abundance of birds within the study site was not significant reduced. However, it was observed that there were several responses not foreseen by the Environmental Impact Assessment.
Linley et al, 2007	Review of UK seabirds	Indirect effects in the long term could outweigh the short-term effects such as displacement issues. For example, artificial reefs produced from anthropogenic structures may provide increased foraging opportunities
Vanermen et al, 2015	Northern gannet; common guillemot; razorbill; lesser black-back gull and herring gull.	Northern gannet; common guillemot; and razorbill avoided the wind farm study area with a decrease in abundances from 64-85%. Whereas, lesser black-back gull and herring gull were attracted the to study area.
Topping and Petersen, 2011	Red-throated Diver	Displaced by approaching ships at a flush distance of 1km.

Joint Natural England and JNCC guidance, (JNCC and Natural England, 2012)has applied sensitivity scores to an assessment of displacement buffers for seabirds. They recommend a 2km displacement buffer for most seabirds and 4km for divers and seaducks. Wind farm projects such as East Anglia Three have used a 2km buffer for construction activities across the wind farm and the export cable corridor.

Recreational disturbance

Recreational disturbance of waterfowl and waders associated with coastal European sites is a particular concern for terrestrial planning in the inshore coastal environment.

Habitat Regulation Assessments of local plans tend to focus on recreational sources of disturbance as a result of new residents, a large number of student residents (who are, for example, much less likely to be dog owners) or an aging population with more leisure time available. Human activity can affect birds either directly (e.g. through causing them to flee) or indirectly (e.g. through damaging their habitat). The most obvious direct effect is that of immediate mortality such as death by shooting, but human activity can also lead to behavioural changes (e.g. alterations in feeding behaviour, avoidance of certain areas *etc.*) and physiological changes (e.g. an increase in heart rate) that, although less noticeable, may ultimately result in major population-level effects by altering the balance between immigration/birth and emigration/death (Riley, 2003).

Concern regarding the effects of disturbance on birds stems from the fact that they are expending energy unnecessarily and the time they spend responding to disturbance is time that is not spent feeding (Riddington *et al,* 1996). Disturbance therefore risks increasing energetic output while reducing energetic input, which can adversely affect the 'condition' and ultimately survival of the birds. In addition, displacement of birds from one feeding site to others can increase the pressure on the resources available within the remaining sites, as they have to sustain a greater number of birds (Gill *et al*, 1998). Moreover, the more time a breeding bird spends disturbed from its nest, the more its eggs are likely to cool and the more vulnerable they, or any nestlings, are to predators.

For the European sites discussed in this HRA promotion of improved recreational access (Policy ACC-1) is a particular risk during the breeding season for those which are located within the four inshore marine plan areas and designated for disturbance-sensitive ground nesting birds in easily accessed locations, particularly breeding arctic, roseate, common, sandwich or little tern: Morecambe Bay & Duddon Estuary SPA/Ramsar site, Ribble & Alt Estuaries SPA/Ramsar site, Mersey Narrows & North Wirral Foreshore SPA/Ramsar site, Dee Estuary SPA/Ramsar site (north west inshore marine plan area), Farne Islands SPA, Lindisfarne SPA, Northumbria Coast SPA/Ramsar site, Teesmouth & Cleveland Coast SPA/Ramsar site (north east inshore marine plan area), Dungeness, Romney Marsh & Rye Bay SPA/Ramsar site, Foulness SPA/Ramsar site, Blackwater Estuary SPA/Ramsar site, Colne Estuary SPA/Ramsar site (south east marine plan area) and Chesil Beach & The Fleet SPA/Ramsar site (south west inshore marine plan area)[8]. It is also relevant for sites that are designated for other ground-nesting birds in the marine plan areas, such as the Farne Islands SPA in the north east inshore marine plan area, which is also designated for breeding guillemot and puffin.

The potential for disturbance may be less in winter than in summer, in that there are often a smaller number of recreational users. In addition, the consequences of disturbance at a population level may be reduced because birds are not breeding. However, winter activity can still cause important disturbance, especially as birds are particularly vulnerable at this time of year due to food shortages, such that disturbance which results in abandonment of suitable feeding areas through

[8] Coquet Island SPA is not included in this list despite being located in the North East Marine Plan area because it is not publically accessible.

disturbance can have severe consequences. Several empirical studies have, through correlative analysis, demonstrated that out-of-season (October-March) recreational activity can result in quantifiable disturbance.

Recent research has established that human activity including recreational activity can be linked to disturbance of wintering waterfowl populations in the coastal environment (Cruickshanks *et al*, 2010, Footprint Ecology *et al*, 2010 and Liley *et al,* 2017). Those Special Protection Areas most at risk of increased disturbance from promotion of improved recreational access (Policy ACC-1) are the estuarine European sites within each of the inshore marine plan areas that are coincident with areas of high tourism, a large resident population, or both.

Disturbing activities are on a continuum. The most disturbing activities are likely to be those that involve irregular, infrequent, unpredictable loud noise events, movement or vibration of long duration. Birds are least likely to be disturbed by activities that involve regular, frequent, predictable, quiet patterns of sound or movement or minimal vibration. The further any activity is from the birds, the less likely it is to result in disturbance.

The factors that influence a species response to a disturbance are numerous, but the three key factors are species sensitivity, proximity of disturbance sources and timing/duration of the potentially disturbing activity.

The distance at which a species takes flight when approached by a disturbing stimulus is known as the 'tolerance distance' (also called the 'escape flight distance') and differs between species to the same stimulus and within a species to different stimuli. These are given in Table 9, which compiles 'tolerance distances' from across the literature. It is reasonable to assume from this that disturbance is unlikely to be experienced more than a few hundred metres from the birds in question. Tolerance distances are unknown for many birds and simple extrapolation to other species is not advised.

Table 9 Tolerance distances of 21 water bird species to various forms of recreational disturbance, as described in the literature. All distances are in metres. Single figures are mean distances; when means are not published, ranges are given. [1] Tydeman (1978), [2] Keller (1989), [3] Van der Meer (1985), [4] Wolff et al (1982), [5] Blankestijn et al (1986).

Species	Type of disturbance		
	Rowing boats/kayak	Sailing boats	Walking
Little grebe		60 – 100 [1]	
Great crested grebe	50 – 100 [2]	20 – 400 [1]	
Mute swan		3 – 30 [1]	
Teal		0 – 400 [1]	
Mallard		10 – 100 [1]	
Shoveler		200 – 400 [1]	
Pochard		60 – 400 [1]	
Tufted duck		60 – 400 [1]	
Goldeneye		100 – 400 [1]	

Smew		0 – 400 [1]	
Moorhen		100 – 400 [1]	
Coot		5 – 50 [1]	
Curlew			211 [3]; 339 [4]; 213 [5]
Shelduck			148 [3]; 250 [4]
Grey plover			124 [3]
Ringed plover			121 [3]
Bar-tailed godwit			107 [3]; 219 [4]
Brent goose			105 [3]
Oystercatcher			85 [3]; 136 [4]; 82 [5]
Dunlin			71 [3]; 163 [2]

Birds can also be disturbed by the movement of ships. For instance, a DTI study of birds of the north west coast noted that: "*Divers and scoters were absent from the mouths of some busier estuaries, notably the Mersey... Both species are known to be susceptible to disturbance from boats, and their relative scarcity in these areas... may in part reflect the volume of boat traffic in these areas*"(Department for Trade and Industry, 2006).

Light pollution

Another aspect of disturbance is light pollution; many seabirds forage at night allowing them to avoid predators. To forage at night seabirds, use prey bioluminescence, diel vertical migration prey and the night sky for navigation (Reed *et al,* 1985) all of which can be disrupted by artificial light. Research has indicated that seabirds can be attracted to artificial lighting on vessels (Merkel, 2010). Light pollution has the ability to disorientate birds during flight and disrupt circadian rhythms influences a range of biological and ecological aspects of birds. The attraction of birds to man-made light has existed throughout history including fire (Murphy , 1936), the first lighthouses (Clarke, 1912), ceilometer lights at airports (Howell *et al,* 1954), lights of fishing vessels (Dick and Donaldson, 1978) and gas flares on oil platforms (Sage , 1979). These all have their own hazards for nocturnal birds ranging from direct injury or death to disorientation. Most collisions with synthetic structures caused by light pollution usually occur during poor weather conditions.

Light pollution, depending on detail of design, could be associated with the construction and/or operation of most types of development supported or promoted by screened in marine plan policies (AQ-2, EMP-2, EMP-4, INF-1, CAB-1, CAB-2, CAB-3, REN-1, WIND-2 and PS-4) as well as by the increase in short-sea and coastal shipping associated policy PS-4, refer to Table 9.

Light pollution generated both from land and from structures inshore can impact breeding seabirds. Those that are particularly vulnerable include burrow-nesting petrels and shearwaters.

Table 10 Literature investigating light pollution impacts arising from wind farms.

Reference	Source of light pollution	Findings

Dick and Donaldson (1978)	86-foot long crab-fishing vessel	An estimated 6,000 crested Auklet *Aethia cristatella* were attracted to the vessel of the coast of Alaska. It was believed by ornithologists that due to vessel lights the birds sought refuge at the ship rather than searching for land during bad weather. Many birds were killed upon striking the vessel when attempting to land.
Black (2005)	*MV Dorada* (a 75m trawler)	A total of 900 birds collided with the ship at the South Georgia Maritime Zone during a single night. The vessel and crew were conducting Fisheries Biomass Surveys. Out of the 900 collisions 250 birds died. Causes of death were due to direct collision with the ship, hypothermia and/or drowning where the deck of the ship was flooded.
Cabrera-Cruz et al, 2018	Light pollution generated from human habitation (i.e. houses and street lights)	It was discovered that a total of 298 nocturnally-migrating birds tended to be more susceptible to light pollution during the migratory season. It was considered that this was the most critical stage of bird's annual cycle. In addition, migratory birds with a shorter migration distance were considered to have a greater level of impact as these species tend to travel through the temperate region where urbanisation is higher.

All bird species reviewed are in some way disturbed or displaced by human activities. This may be a very minute disturbance such as the increase in heart-rate due to stress (i.e. through enhanced public access (ACC-1, FISH-2, TR-1 and TR-4)) or the displacement of species from an area of foraging ground or the attraction of a species to human activity (i.e. through dredging activities (DD-3)). Alternatively, it can equally be viewed positively that the displacement of birds away from anthropogenic structures, such as turbines, thereby reducing the risk of bird-strike and mortality. Indeed, many of the studies mentioned within the assessment of this impact pathway can also be used as evidence to suggest the learnt behaviour of birds to avoid turbines. Much of each marine plan's coastline consists of opportunity areas for off-shore wind farms. As such, there is the risk that construction works of turbines and other artificial structures within and around these sites could cause disturbance stimuli thereby reducing carrying capacity (i.e. their ability to support designated features).

For example, Carmarthen Bay SPA located within the south west marine plan area supports 16,946 individuals of common scoter (*Melanitta nirgra*). Populations of this species in the UK are declining and the species is now Red Listed. Increased disturbance to this population could result in further declines and therefore reduce the ability of the site to support common scoter thus impacting site integrity.

Examples of nocturnal seabirds occupying European sites within the seven marine plan areas (or whose impact zones overlap with the marine plans areas), include:

- Northern Fulmar;
- Manx Shearwater;

- Storm Petrel;
- Herring Gull; and
- Lesser Black-Backed Gull.

Aside from the herring gull, all of these species have a mean maximum foraging distance of 100km or more and therefore the impacts of light pollution generated by projects within the seven marine plan areas are expected to be far reaching. It was considered that due to the extreme complexity of human disturbance none of the European Sites supporting seabirds as features can be dismissed. Therefore, all European Sites brought forward from the screening exercise are likely to be impacted by non-physical disturbance thereby threatening site integrity and conclusion of adverse effects on integrity in the absence of further detail or mitigation is reached.

Table 10 reviews literature investigating light pollution impacts arising fomr windfarms.

Toxic Contamination (spillage and contamination causing a reduction in water quality; impact pathways 11 to 13)

Spillages from oils and toxic fluids can impact all aspects of the marine environment. Causes of spills may arise from vessel collisions, improper construction and/or maintenance. As with a number of the other impact pathways discussed in this document, these issues may arise from any of the 'screened in' marine plan policies.

Aquaculture, dredging and beach nourishment
A reoccurring theme listed within the impact pathways described in this appropriate assessment is the direct contact aquaculture has to the marine environment and by default all marine organisms. For example, the treatment of cages with pesticides may result in the bioaccumulation of toxins within seabirds. Dichlorodiphenyltrichloroethane (DDT) and its derivatives are well studied for their extensive impacts to most living organisms (Dabi and Dzorvakpor , 2015). For birds, the use of DDT has been linked to egg-thinning and the reduction in breeding success (Fry and Toone , 1981). Further evidence suggests that xenobiotic organic compounds (polychlorinated biphenyl (PCBs), DDT, tributyltin chloride (TBT)) can disrupt sex hormones in birds and may lead to a reduction in fertility, alternations of generations, offspring variation and ultimately disrupting the successful evolution of a species thereby resulting in an increased probability of extinction (Price and Morris, 2013).

Oil spills
There have been several oil spills throughout the world with serious environmental consequences. These are summarised in Table 11.

Table 11 Oil spills of significance to the UK

Event	Environmental implications
In January 1993 the MV Braer oil tanker released 85,000t of	Based upon WWF Scotland figures, a minimum of 1,500 birds were killed and up to 25% of the local grey seal population declined.

crude oil off the Shetland Isles, UK (Hall *et al*, 1996).	
In February 1996 the MV Sea Empress oil tanker spilled an estimated 73,000t of crude oil off the Pembrokeshire Coast National Park (Johnson, 2006).	Over 7,000 birds were died or brought into care for oil contamination. The large percentage of these birds was the common scoter where it was estimated that 20% of the local population was killed.
In 1967 the Supertanker SS Torrey Canyon spilled 119,000t of crude oil of the Cornish Coast (The Guardian, 2010).	In total 150 miles of Cornish coastline and 50 miles of the French coastline were impacted by the spill. It is estimated that around 15,000 seabirds were killed as a direct result of oil contamination.
In November 2002 the *Prestige* oil tanker released 60,000t of oil off the coast of Galicia, Spain (Vince, 2003).	The *Prestige* oil spill is considered Spain's biggest ecological disaster to date. The worst affected area was the coast of Galicia; an ecological rich area supporting reefs, sharks, seabirds and a well-established fishing industry. Over 22,000 seabirds were found dead with predictions far exceeding this figure, polyaromatic hydrocarbons poisoned plankton, fish eggs and crustaceans and carcinogenic effects in fish and humans were expected. These impacts would also impact those species at higher trophic levels. Other coastlines and wildlife affected include Portugal, France and the UK.
In October 2018 Ro-Ro Ulysse and CSL Virginia oil vessels collided releasing a total of 600t of oil in the Mediterranean Sea.	Italian and French authorities coordinated an oil spill response containing much of the spill. However, a portion of hydrocarbons did reach the beach of Var, southeast France.

Evidence of the impacts of oil spills within the marine environment to seabirds can have a variety of direct and indirect impacts. Impacts discussed here are based upon the well-studied Exxon Valdez oil spill into the Prince William Sound, Alaska. This data set was used as a case study due to the clarity of data and the extensive, long-term research undertaken post-oil spill Short-term and long-term impacts of oil pollution resulting from spills include:

- **Injury and mortality**- seabird feathers may absorb oil causing loss of flight and insulation. This may lead to death from predation, hypothermia, drowning or ingestion of toxic hydrocarbons.
- **Persistence of oil within marine and costal environments** – toxic hydrocarbons and/or degraded forms persist within the marine environment for many years after an oil spill. Reservoirs of these toxins can be found within gravel beaches, under mussel beds and within subsurface cobbles of stream banks. These sources are either food, exposed to costal weathering, or represent a significant stage of an organism's life cycle. Thereby acting as a reservoir of toxic hydrocarbons.

- **Population impacts of species associated with shallow sediment** – there is a positive correlation between seabirds that prey upon benthic invertebrates (previously exposed to oil) and mortality rates. Evidence suggests that a variety of species can be significantly impacted due to the accumulation of toxins within body tissues.
- **Cascading indirect effects** – modelling techniques have predicted that the removal of lower trophic levels due to deposition of oil can lead to significant losses in predator abundances and implications to indirect interactions. This in turn reduces the biodiversity and function of the local marine ecosystem.

The impacts of toxic contamination are a significant threat to birds as they have higher positioning within tropic levels. There are certain bird groups that are expected to be more vulnerable to the impacts of toxic contamination, these include:

- Waders (Scolopacidae),
- Wildfowl (Anatidae),
- Gulls (Laridae),
- Terns (Sterninae), and
- Other aquatic birds that regularly use coastal habitats.

These birds obtain a considerable proportion of their food from intertidal areas (i.e. estuaries and mudflats). These areas have high levels of toxic contamination due to the location of harbours that are industrial outlets for the shipping industry. Increased shipping within and around these areas due to the promotion of short sea shipping (PS-4) and due to the provision of infrastructure and employment (AQ-2, EMP-2, EMP-4, FISH -1 and INF-1), if the latter is shipping related, could increase toxic contaminate release into the marine environment, thereby impacts European Site integrity. For example, the Exe Estuary SPA/Ramsar site, located within the south west inshore marine plan area, Morecambe Bay & Duddon Estuary SPA/Ramsar site and the suite of SPA/Ramsar sites around the Merseyside coast, within the north west marine plan areas, and Northumbria Coast SPA/Ramsar site located within the north east inshore marine plan area are example of estuaries that could see increased toxic contamination due to marine plan activities. These European Sites support mudflat habitats that provide excellent foraging resources to the following Annex II bird species:

- Bar-tailed godwit *Limosa lapponica*,
- Common scoter *Melanitta nigra*,
- Oystercatcher *Haematopus ostralegus*,
- Turnstone *Arenaria interpres*.

These species feed either partly or wholly upon benthic invertebrates and are therefore at risk of toxic contamination from oil spills. The Common scoter for example, has very similar life history traits and behaviours to the Harlequin duck *Histrionicus histrionicus* case studied in the Peterson et al (2003). It is therefore reasonable that the higher mortality rates due to oil contamination compared to Harlequin duck populations are transferable to the overwintering populations of Common scoter.

Policy WQ-1 in all seven marine plans states that proposals that cause deterioration of water quality must demonstrate that they will, in order of preference a) avoid, b) minimise or c) mitigate deterioration of water quality in the marine environment. There is therefore a policy in place for addressing the potential for deterioration in

water quality and pollution from proposals that come forward under screened in marine plan policies and for ensuring that mitigation mechanisms are delivered to tackle it. However, due to the high level nature of the plan it is not possible to determine specifically what schemes would be involved or what specific mitigation proposals would be required, or whether they would be effective in a given situation. Therefore down-the-line assessment at the scheme/application level is required, as it will be for the other impact pathways discussed in this AAIR due to the high level nature of the marine plans.

Text for inclusion in the marine plans to address this issue is discussed in the mitigation section. Prior to inclusion of that text, all European Sites brought forward from the screening exercises are at risk of being impacted from toxic contamination in the absence of project level assessments and mitigation, thereby threatening site integrity and a conclusion of adverse effects on integrity in the absence of mitigation or further examination on a project by project basis must be reached. This particularly relates to policies promoting short sea shipping (PS-4) or the provision of infrastructure and employment (WIND-2, AQ-2, EMP-2, EMP-4, FISH -1 and INF-1) in all seven marine plan areas.

Non-toxic Contamination (increased turbidity; impact pathways 11 to 13)

As well as its role in habitat loss due to smothering (discussed above with regard to impact pathways 1-4) increased turbidity arising from suspended sediment can occur as a result of construction and operation activities generated by activities permitted under policies in any of the seven marine plans (or as the result of new dredge disposal sites associated with policy DD-3) and could negatively impact the foraging efficiency of seabirds. Species that are most at risk includes visual hunters such as divers that capture their prey under the water for example cormorants, terns and gannets that are generally considered to reply heavily upon visual cue for hunting fish (Garthe *et al,* 2000). There are multiple impacts that may arise due to an increase in turbid waters these include:

- Suspended material could be transported by water currents during construction and any contaminants within the sediment;
- Reduced foraging efficiency;
- Changes to predator-prey interactions;
- Indirect effects to species and populations within lower and higher trophic levels; and
- Risk of injury and mortality.

For example, Vanhellemont and Ruddick (2014)observed that suspended particulate matter concentration were considerably higher around wind turbines situated within shallow sand banks and small-scale eddies when compared to deeper water just south of the studied wind farm. Suspended material generated from the changes in habitat use of construction sites could transport sediment and smother other habitats supporting protected species (Gill, 2005). Alternatively, Haney and Stone, 1988 (Marine, 1988) revealed that 5 out of 12 species of diving seabirds tended to use turbid waters and only 1 species (white-tailed tropicbird *Phaethon lepturus*) was significantly recorded to use clear waters for foraging. Diving species such as Auks, Shags and Cormorants could be at risk of collision with sub-surface structures such as wind turbine platforms and cable burials due to increased turbidity.

It is appropriate to conclude that those European Sites that are fully terrestrial are not expected to be impacted by locally elevated turbidity due to development activities such as dredging (DD-3) and cable burial (CAB-1, CAB-2 and CAB-3). On the other hand, surface feeding waterfowl and waders are likely to be at a lower risk as they do not tend to drop below the water surface and are less likely to have their visual food location abilities hampered by increased turbidity. It is considered that diving bird species are expected to be more vulnerable to reduced feeding success and possibly collision from sub-surface structures where locally increased turbidity occurs.

It is considered that, due to the lack of data, sites that do support seabirds foraging at sea and below the surface are vulnerable to local deteriorations in water turbidity. Therefore, all remaining SPAs for seabirds that were brought forward from the screening exercises are likely to be impacted by increased water turbidity levels which could arise during construction of projects delivered under a range of marine plan policies (AQ-2, EMP-2, EMP-4, INF-1, CAB-1, CAB-2, CAB-3, REN-1, WIND-2 and PS-4) as well as operationally at new dredge disposal sites (DD-3). This relates not only to those SPAs which are located within the seven marine plan areas but also to those which support species likely to forage within the marine plan areas. Given the foraging distances used in this HRA process that therefore includes all SPAs designated for seabirds located within 100km of the marine plan areas and those designated for long-distance foraging seabirds located within 400km. The list of SPAs is therefore lengthy and readers should refer to the accompanying European site database for a full list. As such, for these sites conclusion of adverse effects on integrity is reached in the absence of mitigation or further examination on a project by project basis.

5.2. European sites designated for habitats

There is a strong probability that marine plan policies which will lead to an increase in anthropogenic marine activity or the construction of anthropogenic structures within the seven marine plan areas could have adverse effects on habitats associated with the ‘screened in’ Special Areas of Conservation in the European sites database, prior to consideration of mitigation. This applies particularly to those within each marine plan area but may also apply to those outside the marine plan areas with regard to certain impact pathways, notably impact pathways 11 to 14 associated with changes in sediment regime/coastal processes or contamination.

This risk of significant effects prior to mitigation arises from the following policies:

- Enhanced public access (ACC-1, SOC-3, FISH-2, TR-1 and TR-4);
- Provision of infrastructure, including for employment, sustainable fisheries, aquaculture and related industries (AQ-2, EMP-2, INF-1 and INF-3);
- Cable burial and future cable landfall (CAB-1, CAB-2 and CAB-3);
- Environmentally positive policies that may have negative effects (CCS-1, CCS-2 and HAB-1);
- New dredge disposal sites (DD-3);
- Renewable energy, including wind turbines (REN-1 and WIND-2); and,
- Promotion of short sea shipping (PS-4)

The potential impact pathways to habitats generated by marine plans are extremely complex, however, these impacts have been grouped into 6 different categories of impact pathway. These are:

- Physical Loss of Habitat (loss of habitat in development footprint; impact pathway 1) and direct, indirect and temporary damage to habitat (impact pathways 2, 3 and 4);
- Toxic Contamination (reduction in water quality and atmospheric pollution (nutrient enrichment); impact pathways 11 to 13);
- Non-Toxic Contamination (elevated turbidity; impact pathway 14); and
- Biological Disturbance (direct and indirect introduction of non-native species, translocation of native species, and introduction/transfer of parasites/pathogens; impact pathways 15 to 19).

As discussed for birds, some spatial information does exist for a minority of policies:

- Policy ACC-1 refers to *'enhanced and inclusive public access to and within the marine area'* with regard to services including tourism and recreation. While that could theoretically occur throughout all seven marine plan areas, such activities and proposals are more likely to occur in the inshore coastal environment in locations where existing populations and/or levels of recreational activity are high.
- Policy WIND-2 refers to '*areas of identified potential for offshore wind resource'.* The licencing of such areas is the responsibility of the Crown Estate rather than the Marine Management Organisation but since the locations of these areas are known they can be considered in the appropriate assessment information report. However, they cover a large proportion of each marine plan area so only provide a limited amount of spatial resolution for the purposes of impact assessment. Note that these only denote areas of potential and do not indicate where in those areas of potential Crown Estate may ultimately choose to licence wind farms.
- The marine plans refer to '*potential sustainable aquaculture production areas'*. New aquaculture infrastructure as per policy AQ-2 could theoretically be throughout all seven marine plan areas. However, there are no specific proposals available to assess. To aid in the spatial specificity of the assessment we have however noted that aquaculture in the relevant marine plan areas is currently focussed (Defra, 2015) on the west Cumbria coast between Morecambe Bay and the Solway Firth, the Devon and Cornwall coastline between Falmouth and Exeter and the Thames Estuary (particularly the coastline of Essex as well as Whitstable and Herne Bay in north Kent). There are also a small number of aquaculture sites along the north Cornwall and Devon coastline and the Northumberland coast. The majority of these sites are shellfish production sites in shallow coastal waters; England has no marine finfish farms(Black and Hughes, 2017). Offshore Shellfish Limited has been pioneering offshore rope-based mussel production on three sites between 3 and 6 miles offshore in Lyme Bay, Devon, but this is in the south marine plan area and thus outside the scope of this HRA.
- Policy PS-4 supports promotion of short-sea shipping and coastal shipping as an alternative to other transport methods. While this has no explicit spatial component, some of the most likely areas for impacts associated with the expansion of short-sea shipping and coastal shipping are at existing ports that coincide with the locations of Special Areas of Conservation and Ramsar sites designated for seabirds, waders and waterfowl. The key areas (the major

ports rather than a comprehensive list) within the relevant marine plan areas are therefore:

- north east inshore marine plan area: the Port of Tyne, Port of Blyth and the Ports of Teesport & Hartlepool.
- north west inshore marine plan area: the Port of Heysham and the Ports of Liverpool & Garston.
- south west inshore marine plan area: The Port of Bristol and the Port of Plymouth.
- south east inshore marine plan area: the Port of Dover and the major ports of the greater Thames Estuary: Medway, London and Harwich.

Although existing concentrations of activities have been used to add spatial specificity to the analysis and as examples of the known potential for conflict between certain types of development and European sites, it is recognised that the intent of the marine plan policies is to promote these activities wherever they are suitable, not just in existing locations. Therefore the Excel Database of European sites that accompanies this report takes account of the fact that these activities could occur throughout the seven marine plan areas in reaching a judgment regarding potential for adverse effects on integrity on each European site.

For the purpose of this review, the range of habitats designated within European Sites has been grouped into five broad categories as follows:

1. **Morphological features encompassing a range of habitat:**
    - Estuaries that encompass sub-feature habitats such as saltmarsh, eelgrass, reefs and as any other Annex 1 habitats referenced below.

2. **Subtidal habitats with typically soft-sediment habitat:**
    - Subtidal sandbanks (‘Sandbanks which are slightly covered by seawater at all time’)
3. **Subtidal habitat with typically hard-substratum habitat:**
    - Reefs.
    - Submerged or partially submerged sea caves.

4. **Intertidal habitats (including saltmarshes):**
    - Intertidal mudflats and sandflats (i.e. ‘Mudflats and sandflats not covered by seawater at low tide’)
    - Annual vegetation of drift lines.
    - *Salicornia* and other annuals colonising mud and sand.
    - *Spartina* sawards.
    - Atlantic salt meadows.
    - Mediterranean and thermo-Atlantic halophilous scrubs (*Sarcocornetea fruticosi*)

5. **Supralittoral habitats:**
    - Coastal lagoons.
    - Supralittoral dune habitats, encompassing the following:
        i. Fixed dune with herbaceous vegetation (‘grey dunes’).
        ii. Atlantic decalcified fixed dunes (*Calluno-Ulicetea*).

iii. Shifting dunes along the shoreline with *Ammophila arenaria* ('white dunes').

- Perennial vegetation of stony banks.
- Vegetated sea cliffs.
- Petalwort (*Petalophyllum ralfsii).*

In addition to these habitats, there will also be individual habitats that are identified within Ramsar citations (e.g. "sand and shingle spit"), although these individual features are not listed in this report. There will also be sub-features of SACs which will include a range of habitats such as rocky shore or mussel bed communities. The impact pathways for these supporting features are considered to be the same as for the qualifying habitat interest features, with particular distinctions being possible between soft sediment, hard substratum, intertidal and supralittoral categories as identified above. Therefore, the impacts to these specific habitats have not been considered separately as part of this assessment.

To assess whether there is any adverse effects on the integrity of the European/Ramsar sites that were identified, a review of the sensitivities of these habitat features follows, organised by the identified impact pathways (physical damage to habitat, toxic contamination, non-toxic contamination and biological disturbance).

Physical Damage to Habitat (impact pathways 1-4 and direct, indirect and temporary damage to habitat; impact pathways 2, 3 and 4)

The creation of new infrastructure for employment, renewable energy, enhanced public access, cable burial/landfall, short-sea shipping and coastal shipping, fisheries or aquaculture on the seabed, foreshore, or coastal area has the potential to result in the temporary (during exploratory surveys, or construction and decommissioning) or permanent (during operation) loss of habitats for which European sites has been designated. This could potentially also arise as an unintended result of projects under policies HAB-1 (proposals to improve the resilience of deep sea habitats) depending on how that resilience is to be delivered on a project level, or those policies which promote the positive reuse of existing infrastructure for carbon capture and storage (CCS-1 and CCS-2). Some losses would be potentially reversible but others, such as loss of reef habitat for example, would be irreversible.

The effect could be direct but also indirect[9], through erosion from changes to the hydrodynamic and/or sediment transport regime. Such habitat loss might, for example, occur if infrastructure projects resulted in changes in the underlying functional processes (such as hydrology, water level or salinity) that enabled those habitats to persist, or interfered with habitat management. Similarly, if infrastructure projects resulted in changes to coastal processes such as long-shore sediment transport or coastal erosion, habitats could be indirectly lost or damaged.

[9] Indirect interactions: when the effects of one organism to another is mediated through a third party. These interactions tend to be the underlying relations within an ecological community shaping population dynamics and habitats. *Note: indirect effects may be harder to predict and of greater consequence over larger spatial scales.*

Proposals to increase access to the areas covered by the marine plans could also result in indirect mechanical damage to sensitive coastal habitats through excessive footfall, resulting in erosion. For example, Penhale Dunes SAC in Cornwall abuts the south west inshore marine plan area. It is designated for its sand dune succession. Such habitats require a certain amount of disturbance to ensure that various successional stages are maintained, but excessive disturbance can retard succession completely and adversely affect the value of the site. The site is also designated for its colonies of petalwort, shore dock and early gentian. The resident population density in the surrounding area is quite low but there is an extremely high concentration of campsites and tourists probably contribute considerably to recreational activity. Dune trampling has long been recognised as an issue by Cornwall Council. People visiting the sand dunes for recreation can have a severe impact on their environment if they do not act responsibly and the Cornwall Council website identifies that there is still some ongoing evidence of excessive recreational activity in the form of a large 'blow out' (literally an area in which the sand is denuded of vegetation and thus blows away) at Penhale.

The level of spatial detail in the marine plans is insufficient to enable a detailed assessment of effects of infrastructure delivery on each European site because the nature, quantum or location of such new infrastructure is not specified (as it will not be known until proposals come forward). Therefore it is not possible to undertake a specific assessment. That said, at least some of the delivery of infrastructure associated with the expansion of short-sea shipping and coastal shipping may affect those SACs that lie close to the existing centres of short-sea shipping and coastal shipping activity, although other SACs could be affected depending on the nature and location of proposals:

- north west inshoremarine plan area: the Port of Heysham lies adjacent to Morecambe Bay SAC, while a potential expansion area for the Port of Liverpool (Seaforth) lies adjacent to Sefton Coast SAC.
- south west inshore marine plan area: The Port of Bristol lies adjacent to the Severn Estuary SAC and the Port of Portsmouth lies adjacent to Plymouth Sound & Estuaries SAC.
- south east inshore marine plan area: the Port of Dover lies adjacent to Dover to Kingsdown Cliffs SAC.

The delivery of infrastructure for sustainable aquaculture production could potentially occur throughout all seven marine plan areas. The locations of new aquaculture activities are not known at this stage and therefore cannot be specifically assessed with regard to individual European sites. However, it is reasonable to assume that at least some will be linked with existing core areas of aquaculture and thus pose the greatest risk of affecting the following Special Areas of Conservation within the seven marine plan areas:

- West Cumbria coast between Morecambe Bay and the Solway Firth: Morecambe Bay SAC, Drigg Coast SAC and Solway Firth SAC;
- Devon and Cornwall coastline between Falmouth and Exeter: Fal & Helford SAC, Plymouth Sound & Estuaries SAC, Blackstone Point SAC, South Devon Shore Dock SAC[10];

[10] Polruan to Polperro SAC, South Hams SAC and Dawlish Warren SAC are not included in this list because they are not sites likely to be affected by aquaculture activities.

- Thames Estuary (particularly the coastline of Essex as well as Whitstable and Herne Bay in north Kent): Thanet Coast SAC, Essex Estuaries SAC.

Subtidal, intertidal and supralittoral interest feature habitats are sensitive to the physical loss of, or damage to, habitat (i.e. removal of habitat within the development footprint and construction works). Examples include the following activities:

- Fisheries, aquaculture and related industries (Policies FISH-2 and AQ-2);
    - **Trawling**– fishing gear is pulled across the sea bed resulting in the unselective removal and destruction of benthic habitats and topographic features (Turner *et al,* 1999). This can range from 0.2-2m wide and up to 30cm deep in the seabed (i.e. direct habitat implications).
    - **Dredging** – includes the use of scallop dredges on benthic communities reduces species richness and biodiversity (Beukers-Stewart and Beukers-Stewart, 2009) . Habitat and species recovery post scallop dredging can take up to 20 years (Kaiser *et al,* 2018).
    - **Aquaculture** – the assembly of aquaculture cages to hold stock could result in the loss of subtidal habitats (i.e. direct habitat implications). Whereas the waste products of aquaculture (i.e. pesticides, sewage, fertilizer, feed) may smoother other habitat types (i.e. indirect habitat implications).
- Cable burial and future cable landfall (Policies CAB-1, CAB-2 and CAB-3);
    - **Seabed disturbance** – the burial of cables would result in the temporary or permanent alteration of habitat and supported species. Direct impacts generated from a potential scheme are expected to reach 2-3m both sides of the cable route.
    - **Increase in suspended sediment concentrations and subsequent settlement** – burial will release sediment into water suspension this may result in the direct smothering of habitats and therefore the loss of species within the primary trophic level.
- Re-use of existing oil and gas infrastructure for carbon capture (Policies CCS-1 and CCS-2);
    - **New installation of specifically designed storage service** – potential loss of subtidal habitats both during the conversion of infrastructure to carbon capture storage (CCS).
    - **Air pollution impacts** – particulate matter and nitrogen oxide emissions are expected to increase. This is discussed further in the toxic contamination section.
- New dredge disposal sites (Policy DD-3);
    - **Direct loss of habitat** – includes the removal of sediment from the seabed and depositing this in a new location. Uses of this dredged material in the marine environment include construction of ports, flood and storm protection, and mineral extraction (Todd *et al,* 2014). Unselective removal can result in destruction of benthic habitats and topographic features (Thrush and Drayton 2002).
- Renewable energy (Policies REN-1 and WIND-2)
    - **Permanent habitat loss** – as a result of wind turbine bases and supporting structures.
    - **Temporary habitat loss** – generated post construction and during construction (i.e. the movement of vessels, the removal of habitat for sampling during surveying).

Table 12 displays direct and indirect physical change/damage impacts potentially resulting from Marine Plan policies.

Table 12 Direct and indirect physical change/damage impacts potentially resulting from Marine Plan policies

Impact pathway	Source	Discussion
Changes in coastal processes	Dredging activities and construction works to modify habitat for aquaculture (Policies AQ-2, EMP-2, INF-1, INF-3 and DD-3)	**Aquaculture** Aquaculture can compartmentalise the water body and result in significant changes to the vegetation structure of coastal habitats (i.e. increases in suspended sediment results in the reduction of light penetration). In addition, hydrological processes may also be impacted such as water supply and water levels. **Dredging** (Price *et al,* 1978) Offshore dredging sites can interfere with coastal process, these include: • *Beach drawdown* – this is when naturally beach material is eroded from the foreshore and deposited to the intertidal areas. If a dredging site is located too close the foreshore it can change this coastal dynamic (i.e. transported material may be deposited to the dredging site rather than the foreshore). • *Interception of sediment* – a dredging site may trap sediment that is carried by current and wave action thereby preventing this sediment reaching the shore. • *Coastline protection from sandy beaches* – sandy beaches protect the coastline from wave abrasion. A reduction in sand banks due to the presence of dredging sites (as described above) may increase coastal erosion rates. • *Changes to wave action* – wave velocity is dependent upon distance travelled and the depth of water. The presence of a dredging hole and/or site changes the depth of water and therefore the wave action (i.e. the angle of wave approach) this can lead to erosion or accretion.
Disturbance	Construction and operation (Policies ACC-1, SOC-3, CAB-1 and CAB-2, REN-1 and WIND-2)	**Aquaculture** Human activity around aquaculture sites is high. For example, daily tasks will include feeding, maintenance activities, predatory deterrents, vehicle movements, harvesting and construction works of the facility itself. In turn,

		these activities contributed to light and noise pollution, the production of dust, increased water turbidity and changes in water chemistry. **Cable burial** Construction works for cable burial will disturb the local marine environment with the potential to damage the local and wider environment, generate issues with regards to displacement of species and the direct removal of species. With regards to the benthic environment key sessile species that make up a particular community may be removed. These species do not have the ability to move away from disturbance and are therefore selected against during the construction of cables. As a result, the fundamentals of this community may be disrupted and unable to rehabilitate post construction.
Heat dissipation	Operations (Policies CAB-1, CAB-2 and CAB-3 REN-1 and WIND-2)	**Cable burial** Studies have suggested that cables within the marine environment can have physio-chemical implications for the surrounding marine environment due to heat generated from cable operation. Impacts include changes in the chemical profile of the environment (i.e. O_2 and nutrient concentrations), increased bacterial activity and changes in species composition (Meißner *et al,* 2002).

The delivery of infrastructure, particularly for future cable landfall (Policy CAB-2) could result in habitat loss adjacent in European sites that abut the seven marine plan areas even when no designated habitat is present below the line of Mean High Water Spring (and thus within the marine plan area itself). At the same time, this risk is considered very low where the topography or ground stability is inimical to cable landfall, such as at cliff sites or sites where habitats have a high water table. This would apply for example to Dover to Kingsdown Cliffs SAC, Durham Coast SAC, Hastings Cliffs SAC, Polruan to Polperro SAC, South Hams SAC, Exmoor Heaths SAC, St Abbs Head to Fast Castle SAC, Tankerton Slopes & Swalecliffe SAC, The Lizard SAC, Tintagel-Marsland-Clovelly Coast SAC and Beast Cliff-Whitby (Robin Hoods Bay) SAC.

Habitats that are considered more vulnerable to habitat loss include reefs (i.e. bedrock reef; stony reef; biogenic reef). There are European Sites located between all seven marine plan areas that support reef habitat. For example, in the south west inshore marine plan area, Lyme Bay & Torbay SAC and Studland to Portland SAC are considered to be two of the best examples of reefs in the whole of the UK. Morecambe Bay SAC in the north west marine plan area, Flamborough Head SAC in the north east marine plan area and Margate & Long Sands SAC and Thanet Coast SAC in the south east marine plan area also support reef habitats of significant importance. Those sites that that are located within 1 tidal ellipse of each marine plan area are expected to be impacted by the proposals that could come forward in line with the screened in supporting policies of each Marine Plan. In addition, indirect impacts generated by these proposals, such as toxic contamination, could affect sites at significantly greater distances than 1 tidal ellipse.

Those sites that are fully inland and terrestrial are not expected to be impacted by the physical loss of habitat due to the marine plan; for example, the New Forest SAC is within 100km of the south west marine plan area but sufficiently remote that marine plan policies will not affect it. However, given the high level nature of the marine plan policies it is not possible to conclude no adverse effects on site integrity for the majority of European Sites that are connected to marine/sea processes/impacts, without mitigation or further examination on a project by project basis.

Toxic Contamination (reduction in water quality and air quality; impact pathways 11 to 13)

Sources and risks of toxic contamination and atmospheric nutrient enrichment that have the potential to be generated by proposals that could come forward in line with the screened in supporting policies of the Marine Plans include:

- Aquaculture and fishing (AQ-2, EMP-2, INF-1 and INF-3) – already discussed with regard to birds and discussed later regarding other receptor groups in previous sections
- Cable burial and future cable landfall (CAB-1, CAB-2 and CAB-3) – spillages from construction works (i.e. oil, hazardous chemicals and heavy metals) and the exposure of lead and/ or copper wiring during operation.
- Environmental positive activities that may have negative impacts (CCS-1, CCS-2 and HAB-1) – spillages, leakages and CO_2 release from vessel uses during environmental surveys.

- Dredging (DD-3) – spillages from construction works and the release of chemicals from contaminated seabed.
- Wind farms (REN-1 and WIND-2) – spillages from construction works and the release of hazardous chemicals and heavy metals from operation and maintenance activities.
- Promotion of short sea shipping (PS-4) – spillages/leakages and the release of emissions (sulphur dioxide and nitrogen oxides) from vessels and the risk of cargo spillage (i.e. oil, coal or fertilizer cargo) into the sea from collisions and/or vessel failure.
- Infrastructure for employment, sustainable fisheries, aquaculture and related industries (AQ-2, EMP-2, INF-1 and INF-3) – if road infrastructure is included and the roads in question lie within 200m of a sensitive European site then atmospheric nitrgen oxides, nitrogen and (potentially) ammonia emissions may be relevant for terrestrial coastal and (to a lesser extent) intertidal habitats.

Examples of key impact pathways are discussed further in Table 13 below.

Table 13 Toxic contamination impacts potentially resulting from marine plan policies

Impact pathway	Source	Discussion
Chemical use/ contamination	Treatment of aquaculture cages and stock; and construction; and operation (Policies ACC-1, CAB-1 and CAB-2)	**Aquaculture** Discussed in more detail in the section of the AAIR concerning fish. **Cable burial and dredging** During cable burial and dredging activities, the seabed will be unavoidably disturbed. This will result in the release of sediment into the water column in addition to any chemicals that may be presence at the time of disturbance. When seeking permission for burial/ dredging; sediment quality assessments are required to ensure that areas of 'toxic hot spots' are screened and assessed to avoid the release of harmful contaminants (URS, 2006). For example, areas that are of high risk includes those within proximity to major ports and oil rigs; areas that were previously used for industrial or sewage disposal and/or areas that are a natural sink for contaminates. When assessing the long-term impacts of cable presence there is evidence to suggest that cables can deteriorate and release heavy metals into the marine environment. The marine environment is harsh and the constant weathering of cables due to temperature and wave action may reveal the

		lead and/ or copper wiring that is a source of chemical pollution.
Release of nutrients directly into the water environment	Caged fish and shellfish farms in the sea/ lochs (Policy ACC-1)	**Aquaculture** The deposition of waste organic and inorganic material from faecal material and waste feed. These materials are easily leached into the benthic environment through sediment enrichment or directly smothering habitats. Organic matter is a source of food for benthic fauna, although changes to this supply may result in O_2 increases or decreases and ultimately changes in species assemblages (Fernandes *et al,* 2002). Without the presence of benthic species removing waste material toxic chemicals may build up impacting marine life. In addition, changes in abiotic conditions may favour threatening bacteria and algae that could give rise to harmful algal blooms. These blooms do not solely occur at the site of organic enrichment but frequently occur several kilometres away from the source (Shumway, 1990) thereby having the ability to impact a range of marine and coastal habitats.
Release of atmospheric emissions	Anthropogenic operations and construction work (policy AQ-2, EMP-2, INF-1, INF-3 and PS-4)	**Infrastructure and promotion of short sea shipping** Terrestrial coastal sites can be vulnerable to increased emissions of nitrogen oxides (NOx) and ammonia (NH_3). NOx in particular is associated with increased combustion from vehicle exhausts including shipping. NOx can potentially be toxic in very high concentrations but its main ecological importance is as a source of nitrogen, which can change the competitive balance between less competitive plant species that are generally more desirable in ecologically diverse sites, and more competitive species that are generally less desirable in such sites. This can therefore affect the botanical quality of such sites. Although nitrogen deposition attributable to combustion is reducing individual projects can still play a significant role in retarding that improvement. If an infrastructure proposal relates to increased traffic flows within 200m of a sensitive site then adverse effects may arise, as the 200m zone adjacent to the road is the area within which the local effect of car and heavy duty vehicle exhaust emissions is greatest. European sites of greatest risk within the context of these Marine Plans are sites that support habitats of particular air quality sensitivity, as defined by

		having low nitrogen critical loads. This particularly relates to the various forms of sand dune (some of which have critical loads as low as 8 kgN/ha/yr) and coastal heathlands and grasslands. In contrast, intertidal habitats such as saltmarsh are generally much more nitrogen tolerant which is reflected in their much higher critical loads (typically 20-30 kgN/ha/yr). In addition, shipping is not only a source of NOx and nitrogen but also of sulphur dioxide (SO_2). Both sulphur dioxide and nitrogen can lead to acidification of habitats. Those habitats which are generally slightly acidic are particularly vulnerable to increased acid deposition because they lack the acid buffering capacity of more neutral and calcareous habitats. **Radioactivity** The use of radioisotopes within industrial activities may leak into the marine environment. Technetium-99m and iodine-131 are examples of radioisotopes that are readily available within the marine environment (IAEA, 2005).

Pollution arising from aquaculture has been previously described in the section on birds relating to suspended material. Other forms of direct and indirect pollutants resulting from aquaculture include:

- **Fish feed** – as cages are directly connected to the marine environment uneaten food is realised into the sea; wasting around 20% of feed (Enell, 1995).
- **Fertilizers** – are used to increase productivity and farming yields; organic and inorganic fertilizers are used and are released directly into the marine environment (Tacon *et al,* 1995).
- **Pesticides** –fish and cages are treated with pesticides that are released to the sea causing direct chemical pollution.
- **Antibiotics/ probiotics** – to prevent the spread of disease antibiotics having significant implications to bacterial resistance.
- **Sewage** – due to the direct connection fish cages have to the marine environment untreated, raw sewage generated from farmed fish is deposited to the sea.
- **Resource use** – intense uses of resources for vessel movements between fish farms.

Biocides are the pesticides used for the treatment of aquaculture cages too kill and prevent the growth of biofouling organisms (Löschau and Krätke,2005) . The use of these chemicals has demonstrated to be threatening to habitats and species. Historically, Tributyltin (TBT) was the primary biocide used as an antifoulant. It was later discovered that this chemical caused a significant reduction in species richness and diversity and causes habitat degradation indirectly impacting supported species. In addition, TBT was also the causal link of deformities arising in farmed fish and the

chemical was also found in humans. However, since 1987 the UK government banned the use of TBT as an aquaculture biocide. Since this time alternative biocides consisting of copper metal oxides and organic based pesticides have been taken up (Yebra *et al,* 2004) but these also have the potential to leach into designated site and degrade site integrity. The use of such chemicals to kill biofouling organisms are not species specific and there is the considerable risk that these chemicals will impact other, non-target marine organisms if these organisms are ecosystem engineers (Jones *et al,* 1994).As a result there is a considerable risk to ecosystem function and the potential risk of habitat loss (Katagi, 2010). Ecosystem engineers tend to be highly vulnerable to the impacts of toxic contamination. In addition, these substances can easily diffuse into the marine environment as such there is the considerable risk of bioaccumulation of chemical within other organisms at higher trophic levels (Scarlett *et al,* 1999).

Case study: short sea shipping as a source of toxic contamination (Policy PS-4)

The global shipping industry consumed 2-4% of global fuel reserves and is responsible for 15-30% of NOx emissions, 5-8% of SO_2 emissions and 3% of CO_2 emissions; 70% of these maritime emissions are released within 400km from land. Global international shipping emissions have grown by 3.7% on average per annum since the 1990. Based upon these annual increases it is predicted that CO_2 emissions could account up to 25% of CO_2 emissions by 2050. It was believed that transportation of cargo via the sea was a *better environmental option* in relation to emissions and air quality issues. However, in the last decade there has been a huge drive to reduce vehicle air pollution in Europe through the implementation of legislation thereby significantly reducing vehicle emissions. This has brought to light the lack of modern legislation aimed at preventing the forecast 25% increase in CO_2 emission of ships by 2050.

In addition to the litigation challenges of shipping emission caps the lifetime of shipping vessels (averaging at 15yrs) are considerably longer than those of vehicles (averaging at 5yrs), as such, the presence of out-of-date technology with within the shipping industry is more prevalent, further increasing emission rates. As such, the level of emissions typically released by vessels is higher when compared to train and vehicle emissions. Emission types that tend to be higher for shipping includes sulphur dioxide and nitrogen oxides. Emission rates and the environmental impacts generated from shipping tend to be modelled from a long-distance shipping vessel. However, for short sea shipping modelled and current data is limited. Short sea shipping has higher levels of emission rates than long distance shipping vessels and other forms of transport. For example, a study by Hjelle and Fridell (2012) observed that SO_2, NOx and PM emissions were higher for short sea shipping when compared to truck transportation. There is a risk that the promotion of short sea shipping (Policy PS-4) within all seven of the marine plan areas could increase SO_2 and NOx emissions and degrade European Sites due to ocean acidification and nitrogen enrichment.

Coastal terrestrial habitats particularly vulnerable to atmospheric nutrient inputs include sand dunes, coastal heathland and coastal grassland. Those marine and intertidal habitats that are particularly vulnerable to the impacts of toxic contamination include reefs and sandy, gravel or cobbled beaches and/ or saltmarsh. For example, Braunton Burrows SAC and Pembrokeshire Marine / Sir

Benfro Forol SAC located within the south west inshore marine plan area, and Minsmere to Walberswick Heaths and Marshes SAC located within the south east inshore marine plan area. There is also a risk to European Sites that are terrestrial but are linked/ connected to the sea in some way. For example, South Devon Shore Dock SAC and SCI supports maritime grassland communities including thrift *Armeria maritima* and sea plantain *Plantago maritima*; species that are adapted to living within dry, mineral-rich, saline conditions. Since these species are habitat specialist their ranges are restricted and therefore toxic contamination of these habitats that may cause a reduction or removal of the species would have a national impact to species populations and future resilience to extinction.

Policy WQ-1 in all seven marine plans states that proposals that cause deterioration of water quality must demonstrate that they will, in order of preference a) avoid, b) minimise or c) mitigate deterioration of water quality in the marine environment. Policy AIR-1 is contained within all seven marine plans and states that "proposals must assess their direct and indirect impacts upon air quality and greenhouse gas emissions and that where proposals are likely to result in air pollution or increased greenhouse gas emissions, they must demonstrate that they will, in order of preference, avoid, minimise of mitigate significant effects". There is therefore a policy framework in place for addressing the potential for water quality and air quality effects on European sites from proposals that come forward under screened in marine plan policies and for ensuring that mitigation mechanisms are delivered to tackle it. However, due to the high level nature of the plan it is not possible to determine specifically what schemes would be involved or what specific mitigation proposals would be required, or whether they would be effective in a given situation. Therefore down-the-line assessment at the scheme/application level is required, as it will be for the other impact pathways discussed in this AAIR due to the high level nature of the marine plans. Text for inclusion in the marine plans to address this issue is discussed in the mitigation section. Prior to inclusion of that text, a conclusion of no adverse effects on integrity cannot be reached for the screened in European sites designated for habitat interest features connected to the marine environment and located within 100km of the seven marine plan areas.

Non-Toxic Contamination (elevated turbidity; impact pathway 14)

Turbidity is '*a reduction in water clarity because of the presence of suspended matter absorbing or scattering downwelling light, and water is considered turbid when the presence of suspended particles becomes conspicuous*' (Grobbelaar, 2009). An increase in suspended matter within the water column may reduce light availability and therefore result in the congregation of bacteria, algae and zooplankton. Increases in turbidity may result in the reduction of vegetation cover; this in turn has a negative effect on turbidity thereby resulting in a positive feedback loop. In addition, increased turbidity levels result in reduced dissolved oxygen therefore a reduction in oxygen levels may negatively impact marine populations (Argenal and Gomez, 2006). Increases in suspended matter may arise from:

- Aquaculture and fishing activities (FISH-2 and ACC-1) – both organic and inorganic material;
- Cable burial (CAB-1, CAB-2 and CAB-3) – seabed disturbance;

- Environmental positive policies (CCS-1, CCS-2 and HAB-1) – habitat creation, surveys and sampling (as these can all involve sediment disturbance which may be significant in scale depending on the extent of the proposals);
- Dredging disposal sites (DD-3) – extraction and deposition of substances; and
- Renewable energy (REN-1 and WIND-2) – construction works and operational impacts.

These impacts would have a potential effect on the surrounding marine environment not only within the footprint of the activity but potentially within 1 tidal ellipse of the source where changes to sediment transport and associated smothering (for example) might occur. Habitats and the communities they support that are particularly sensitive to the habitat changes describe above are:

- **Phytoplankton-zooplankton communities** - primary productivity and population dynamics within the marine environment consists of interactions between nutrients, phytoplankton and zooplankton communities (Fasham *et al,* 1990). The nutrient-phytoplankton-zooplankton model describes this relationship (Franks*,* 2002). Within the model there are several variables that are taken into consideration. These include phytoplankton's response to light and nutrient uptake, zooplankton grazing rate upon phytoplankton, phytoplankton and zooplankton excretion, predation, competition and mortality rate (Fasham *et al,* 1990)Impacts generated by proposals that come forward under screened in policies in the marine plans may interact with this process having consequences to the local environment and to organisms in higher trophic levels.
- **Benthic communities** - the benthic environment refers to sea bottom communities that constitute primary and secondary communities of marine (and aquatic) habitats. These include sediment; seagrass communities; and rock outcrops (Mote, 2019). These environments support bivalve shellfish that are ecosystem engineers as they fill important roles such as filter feeding, which maintains water cleanliness, also different species of shellfish can be used as indicators to reflect current environmental conditions and health of a local marine environment (Barnes and Hughes, 2006). For example, some species may only exist in clean waters while others are more tolerant of toxic contamination and/ or higher nutrient levels thereby indicating environmental degradation. Impacts generated by proposals that come forward under screened in policies in the marine plans could result in habitat degradation and therefore benthic communities that are essential to the healthy function of marine ecosystem. *Note: when reference is made to the benthic environment or community during this section of Habitat Sensitivities the basic elements explained above are included by this umbrella term.*

As a general rule, impacts from hydrodynamic changes (i.e. erosion), sediment disturbance and sediment transport at any designated site that lies more than the distance of one tidal ellipse[11] away from the marine plan area boundary are unlikely to arise in practice (Thompson, 2005). This is based on evidence from plume studies that even fine particles mobilised from the sea bed settle out again to a large extent within the distance of one tidal excursion. The average distance over which there could be potential direct and indirect effects, as defined by an average tidal ellipse, is

[11] Elliptical packages of water will move to and fro over one tidal cycle, typically along a dominant axis, returning to almost the same position. These are 'tidal ellipses'.

around 10-15km. The potential direct and indirect impacts generated from the marine plans are explored further in Table 14.

Table 14 Sediment dispersal impacts potentially resulting from marine plan policies

Impact pathway	Source	Discussion
Sedimentation and changes in bio-chemistry	Caged fish and shellfish farms in the sea/ lochs; and dredging machinery and construction works	**Dredging** Due to the intrusive nature of dredging activities they are likely to result in the release of seabed sediment into the water column. In addition, toxic contaminants such as organic material and heavy metals may also be released. The result of this is an increase in suspended sediment composition and the deposition of sediment many kilometres away from the source. For example, Grimwood and McGhee (1979) suggests that finer sediments persist within the water column for longer thereby having a higher level of environmental impact at greater distances. Increases in suspended sediment within the water column has the potential to: • endanger benthic communities as increased sediment can smother or block their feeding organs; • reduce light penetration to aquatic vegetation and other photosynthetic organisms as these are primary organisms there are significant effects for those at higher trophic levels; and • increased nutrient concentrations may give rise to harmful algal blooms, create a selective pressure and/ or increase primary productivity. **Aquaculture** Turbidity levels from aquaculture (finfish, caged fish and shellfish) can dramatically increase due to suspended particles (i.e. uneaten feed and waste) and dissolved substances (i.e. fertilizer and pesticides). In addition, certain types of species disturb the sediment at a greater level (i.e. common carp *Cyprinus carpio*). The presence of aquaculture cages within and around sensitive habitats may result in nutrient enrichment and

		habitat smothering. Sensitive habitats include reefs, seagrass beds, sand and mudflats, maerl beds and seaweed beds. These habitats support a range of marine organisms therefore the smothering of these may result in significant reduction in biodiversity (European Commission, 2012).

The impacts of increased turbidity can have implications on a range of habitat types and therefore marine communities. However, it is reasonable to assume that impacts with regards to sediment release and dispersal would only impact those habitats and European Sites that are located within one tidal ellipse (i.e. 15 km) of the release source. However, since there is little spatial detail within each of the seven marine plan areas the 15km buffer is applied to each marine plan area boundary.

As a result, for those European Sites that are located more than 15km from a marine plan area boundary, a conclusion of no adverse effect on integrity can be reached even if they are within the 100km buffer. For example, Dogger Bank SAC and Durham Coast SAC are located within the North East offshore marine plan area and are therefore expected to be impacted by elevated turbidity levels. In contrast, Firth of Tay and Eden Estuary SAC is located within the 100km buffer of the same marine plan area but 86km north of the area boundary and thus well outside of the 15km turbidity impact zone. Therefore, development policies within the marine plan areas that are expected to elevated turbidity levels would not adversely affect the integrity of this site or similar sites. In addition, those sites that are fully terrestrial are not expected to be impacted by elevated turbidity levels within each marine plan area. For all other European sites (i.e. those SACs that lie within 15km or 1 tidal ellipse of any of the seven marine plan areas, a conclusion of potential adverse effects on integrity must be reached without mitigation or further examination on a project by project basis.

Biological Disturbance (direct and indirect introduction of non-native species, translocation of native species, and introduction/transfer of parasites/pathogens; impact pathways 15 to 19)

Anthropogenic activities within the marine environment result in ample opportunities for introductions of non-native species. These introductions may in turn result in an invasive species that can have significant impacts to the marine environment and ecosystem function. Activities within the marine plans that could lead to biological introductions include:

- **Aquaculture and Dredging (ACC-1 and DD-3)** – non-native fish and shellfish species have been stocked within the UK throughout history for a variety of reasons, although, aquaculture makes up the largest proportion of this. For example, fish may escape from damaged cages directly into the sea and/or those stocked fish may introduce parasites.
- **Shipping (Policies FISH-2 and PS-4)** – the movement of ships, including long and short distance barges, allows a significant opportunity for the movement of organisms into a new habitat range. Example routes if introduction includes, vessel fouling, accidental imports (i.e. through ballast

water and ballast tanks), biofouling and drifting and/or rafting (i.e. attachment of species to a raft that is transported to a non-indigenous area).

- **Recreational activities (Policies TR-1, TR-4)** – recreational vessels are considered high risk for the introduction of non-native species due to typical travel patterns, frequency and spatial distribution. In addition, due to the variation in vessel types there is a significant number of these possessing what is known as a '*high risk hub*' (Pranovi *et al,* 2006).
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Examples of marine invasives

There are many invasive marine species that have colonised UK waters and are a serious threat to biological diversity. For example, the Slipper limpet *Crepidula fornicate* was introduced from North America, in 1872 and is now common throughout the south of England and Wales. This species typically aggregates in large numbers resulting competition for food with native species and the deposition of waste material leading to smothering of habitats. The Carpet sea squirt *Didemnum vexillum was* introduced in 2008 in Holyhead, Wales and is now found throughout the coast of Wales and south England. The species has been recorded to have adverse ecological impacts to a variety of hard substrata in the subtidal zone including reefs and rockpools. The presence of the Carpet sea squirt can result in the smothering of habitats and the competition of resources to native species. The Zebra mussel *Dreissena polymorpha* was introduced to the UK in 1825 is now found throughout England. The mussel invades fresh water habitats; however, it is believed to have travelled to the UK attached to ship hulls. Ecologically, it improves water quality although due to the mussel's capability to proliferate their water cleaning ability can result in increased sun exposure to invasive weeds.

Historically the view was taken that 10% of non-native species would ultimately become invasive (i.e. a pest). This is known as The Tens Rule (Williamson and Fitte, 1996). However, since this rule was devised Jarić and Cvijanović (2012)have observed that the Tens Rule massively underestimated invasives due to the wider lack of understanding invasive ecology and Natural England have endorsed this view in reports horizon-scanning for invasive non-native plants in Great Britain. Based upon this, there is a considerable risk that impacts generated by proposals that come forward under screened in policies in all seven marine plans could increase the spread of current invasives and/ or introduced new invasive species to the English coast and European Sites, without mitigation.

The transfer, introduction and spread of invasive species is often on a considerable scale. Those European Sites that are of highest risk are connected to areas of high human activity. In addition, the transfer of invasives from the marine environment can be pushed further inland by human movement. It is therefore not possible at this stage to conclude no adverse effects on site integrity for the majority of European Sites (see the accompanying database of European sites for a comprehensive list as the list is extensive). European Sites that are expected to be most vulnerable to the impacts of invasives are those that are frequently disturbed by humans including Humber Estuary SAC and Tweed Estuary SAC located within the north east inshore marine plan area and Alde, Ore and Butley Estuaries SAC and Essex Estuaries SAC located within the south east marine plan area.

The seven marine plans all include two policies specifically to deal with the issue of invasive non-native species. These are policies NIS-1 and NIS-2. Policy NIS-1 states that proposals that could potentially introduce invasive species into the marine area must include measures to (in order) avoid or minimise the risk, particularly when: 1) moving equipment, boats or livestock (for example fish or shellfish) from one water body to another and 2) introducing structures suitable for settlement of non-native invasive species, or for the spread of non-native invasive species known to exist in the area. Policy NIS-2 requires public authorities with functions capable of releasing invasive species into the marine environment to implement adequate biosecurity measures.

There is therefore a strong policy framework in place for addressing the potential for the spread of invasive non-native species from proposals that come forward under screened in marine plan policies and for ensuring that mitigation mechanisms are delivered to tackle it. However, due to the high level nature of the plan it is not possible to determine specifically what schemes would be involved or what specific mitigation proposals would be required, or whether they would be effective in a given situation. Therefore down-the-line assessment at the scheme/application level is required, as it will be for the other impact pathways discussed in this AAIR due to the high level nature of the marine plans. Text for inclusion in the marine plans to address this issue is discussed in the mitigation section. Prior to inclusion of that text, a conclusion of adverse effects on integrity must therefore be drawn for all European sites located within (or within 100km) of the marine plan areas and which are connected to the marine environment.

5.3. European sites designated for fish and invertebrates

Fish and the fish industry within UK waters are of major economic importance both to the UK and to Europe. For example, UK vessels land around 400,000 tonnes of fish each year in the UK (valuing in £936 million in 2016), and between 200,000 and 300,000 tonnes abroad. IUCN has classified freshwater fish as one of the most threatened group of vertebrates (Reid *et al*, 2013) with habitat modification, fragmentation, and destruction; invasive species; overfishing; environmental pollution; and climate change as key causes of declines.

Designated sites with fish and aquatic invertebrate interest features

During the screening stage it was concluded that there is a possibility of likely significant effects on the following species for which European sites linked to the marine plan areas (though in some cases considerably distant) are designated:

- Atlantic salmon *Salmo salar;*
- Sea lamprey *Petromyzon marinus;*
- River lamprey *Lampetra fluviatilis;*
- Allis shad *Alosa alosa;*
- Twaite shad *Alosa fallax;* and
- Freshwater pearl mussel *Margaritifera margaritifera.*

The following sections focus on the fish species mentioned above because any effect on freshwater pearl mussel will only arise as an indirect consequence of effects on Atlantic salmon.

Sensitivities to plan activities

- Physical Damage to Habitat (change to habitat; impact pathways 1 - 4)
- Physical Damage to Species (direct damage to species from collision risk; impact pathway 6)
- Physical Damage to Species (direct damage to species from marine litter; impact pathway 7)
- Non-Physical Disturbance to Species ((barrier to species movement; impact pathway 8 and visual/noise disturbance; impact pathways 9 and 10)
- Toxic Contamination (spillage and contamination causing a reduction in water quality; impact pathways 11 to 13)
- Non-Toxic Contamination (elevated turbidity; impact pathway 14)
- Biological Disturbance (direct and indirect introduction of non-native species, translocation of native species, and introduction/transfer of parasites/pathogens; impact pathways 15 to 19).

The marine plans refer to '*potential sustainable aquaculture production areas'*. New aquaculture infrastructure as per policy AQ-2 could theoretically be throughout all seven marine plan areas, It is therefore not possible to relate these proposals (which do not yet exist) with individual European sites. However, aquaculture in the relevant marine plan areas is currently focussed[12] on the west Cumbria coast between Morecambe Bay and the Solway Firth (the north west inshore marine plan area), the Devon and Cornwall coastline between Falmouth and Exeter (the south west marine plan area) and the Thames Estuary (particularly the coastline of Essex as well as Whitstable and Herne Bay in north Kent) in the south east marine plan area. There are also a small number of aquaculture sites along the north Cornwall and Devon coastline and the Northumberland coast (the latter in the north east marine plan area). The majority of these sites are shellfish production sites in shallow coastal waters; England currently has no marine finfish farms.[13] Offshore Shellfish Limited has been pioneering offshore rope-based mussel production on three sites between 3 and 6 miles offshore in Lyme Bay, Devon.

Physical Damage to Habitat (change to habitat; impact pathways 1 - 4)

As described in section 5.2, the presence of anthropogenic structures results in the direct loss of marine habitat. The loss of such habitat may impact migratory fish species. For example, structures placed within sites designated for migratory fish or along migratory routes may displace fish from these areas. All seven marine plans contain screened in policies that present a risk to fish migration due to development of anthropogenic structures:

- Provision of infrastructure, including for employment, sustainable fisheries, aquaculture and related industries (AQ-2, EMP-2, EMP-4, INF-1 to INF-4);
- Cable burial and future cable landfall (CAB-1, CAB-2 and CAB-3);

[12] Derived from Figure 1 in the following: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/480928/sustainable-aquaculture-manp-uk-2015.pdf

[13] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/635209/Future_of_the_sea_-_trends_in_aquaculture_FINAL_NEW.pdf

- Environmentally positive policies that may have negative effects (CCS-1, CCS-2 and HAB-1);
- New dredge disposal sites (DD-3);
- Renewable energy, including wind turbines (REN-1 and WIND-2); and,
- Promotion of short sea shipping (PS-4).

As has been previously investigated, structures may change the hydrodynamic and/or sediment transport regime, quality of foraging habitat, or be a significant barrier to movement. Migrating fish may be displaced by the presence of structures along their migratory routes or at the mouth of their spawning river. Fish use several cues at the river mouth to identify the correct spawning river. For example, Atlantic salmon can detect spawning rivers, by (Perrier *et al, 2007)*:

- Specific chemical identity of the river (i.e pH of the river);
- Geological substrate (i.e. sand or gravel);
- Geographical differences (i.e. and gravel size);
- Temperature differences; and
- Upstream difficultly (i.e. the physical difficulty migrating upstream).

If a population of migrating fish are not able to detect these cues, reproductive success of that population could be jeopardised, and this may impact the wider species population as a whole. Again, the level of spatial detail in the marine plans is insufficient to enable a detailed assessment of effects on each European site integrity and designated fish populations. However, the delivery of infrastructure at fish spawning grounds, river mouths and established migratory routes would mostly likely have the greatest level of impact to migrating fish and associated European Sites. Table 15 The relevant European Sites for migratory fish that are vulnerable to the activities of the marine plans. Note no sites apply to the south east inshore marine plan area.lists the relevant European Sites that are vulnerable to Impacts generated by proposals that come forward under screened in policies in the marine plans.

Table 15 The relevant European Sites for migratory fish that are vulnerable to the activities of the marine plans. Note no sites apply to the south east inshore marine plan area.

Marine Plan	Designated migratory fish	European Site
North West Marine Plan	Atlantic salmon; Sea lamprey;	• Afon Gwyrfai a Llyn Cwellyn SAC; • River Dee and Bala Lake/ Afon Dyfrdwy a Llyn Tegid SAC; • River Derwent and Bassenthwaite Lake SAC; • River Eden SAC
	River lamprey	• Solway Firth SAC
South West Marine Plan	Atlantic salmon; Sea lamprey; River lamprey	• Afon Teifi/ River Teifi SAC; • River Usk/ Afon Wysg SAC; and • River Wye/ Afon Gwy SAC;
	Atlantic salmon; Sea lamprey; Twaite shad	• River Wye/ Afon Gwy SAC;

	Sea lamprey; River lamprey; and Twaite shad	• Severn Estuary/ Môr Hafren SAC
	River lamprey	• Afonydd Cleddau/ Cleddau Rivers SAC
	Twaite shad	• Afon Tywi/ River Tywi SAC; and • Carmarthen Bay and Estuaries/ Bae Caerfyrddin ac Aberoedd SAC
North East Marine Plan	River lamprey	• River Derwent SAC
	River lamprey, sea lamprey, brook lamprey and salmon	• River Tweed SAC

This issue is particularly relevant to the north west and south west marine plan areas due to the large number of European sites designated for migratory fish that lie on the west coast of Great Britain and the fact that migratory fish travelling to and from those sites must traverse the south west and north west marine plan areas. While there are no relevant European sites in the south east marine plan area, lamprey travelling to the River Derwent SAC in the north east marine plan area may traverse the south east marine plan area on migration.

Fish Aggregating Devices (FADs)

An FAD '*is a permanent, semi-permanent or temporary structure or device made from any material and used to lure fish'*. The presence of anthropogenic structures may act as a FAD thereby attracting a variety of priority fish species. Artificial reefs may result in the change of prey and/or species behaviour and/or distributions. Fish occupy many trophic levels of the estuarine food chain, feeding on phytoplankton, zooplankton, algae, invertebrates and other fish. To forage for these food items, their feeding habits comprise grazers, plankton filter feeders (e.g. shad, smelt), suckers and parasites (e.g. sea lamprey) and predators (e.g. gobies). For example, fish may be attracted to FADs for several reasons (Freon and Dagorn, 2000) these include:

- Shelter from predators;
- Concentration of food supply;
- Spatial reference in otherwise featureless environments;
- Resting;
- Indicators of other characteristics, such as productive areas; and meeting points.

Many demersal fish are opportunistic predators and their prey choice reflects the species that are available in the area (Elliott *et al,* 1998). Table 16 provides examples of the variety of persistent structures that could be associated with development under the marine plan policies and which may result in the presence of FADs disrupting feeding regimes of fish (Jaquemet *et al* 2011).

Table 16 Examples of the variety of persistent structures that could be associated with development under the Marine Plan policies

Activity generated by the Marine Plans	Example structures
Fisheries (Policy FISH-1)	Suspension lines, cages, log piles, rafts
Aquaculture (Policy AQ-2)	Cages

Cable burial/ wind farm infrastructure (Policies CAB-1, CAB-2 CAB-3 REN-1 and WIND-2)	Artificial reeds, suspension lines
Dredging (Policy DD-3)	Stationary structures
Shipping (Policy PS-4)	Moorings, vessels, sunken vessels
Other (Policies CCS-1 and CCS-2)	Oil platforms, marinas, pontoons

The presence of FADs could potentially affect fish populations of a European Site as fish are attracted elsewhere to forage. This has additional consequences such as collision risk, which are discussed under a separate heading below. That said, sensitivity to the temporary change in a food resource is considered a low to moderate impact for most fish species.

In addition to the potential population dynamic changes caused by the FADs; the structure itself may cause physical harm to fish. For example, when water flows past a structure, velocity gradients are created otherwise known as vortices. Depending on hydrodynamic conditions, fish can be attracted to or repelled by the turbulence (Liao, 2007). Extremely high levels of shear stress can harm fish (Odeh *et al,* 2002) and turbulence could increase energetic costs of swimming (Enders *et al,* 2003). On the other hand, altered flows that remain steady, or maintain an aspect of predictability, can be exploited by swimming fish to reduce locomotion cost. Fish may seek refuge from currents by 'flow refuging' behind structures. In tidally swept locations bentho-pelagic fish such as cod, have been found to use sand ripples as flow refuges to hold station, reducing energetic costs (Gerstner, 1998).

Development within each of the marine plan areas could affect the integrity of each of the thirteen European Sites designated for migratory fish in Table 15 through effects on habitats, particularly where those sites lie within the seven marine plan areas. Even European sites located outside the marine plan areas could be affected since the species for which these sites are designated forage or migrate through the marine plan areas. For example, the development of wind farms generated by policies REN-1 and WIND-2 within the north west marine plan areas could result in the direct loss of habitat within the migratory route of Atlantic salmon and sea lamprey travelling to the River Dee and Bala Lake/ Afon Dyfrdwy a Llyn Tegid SAC. Due to the migratory pathways of the Atlantic salmon, placement of wind farms within the north west may not impact those salmon travelling to those sites identified within the south west marine plan area. This is because migratory fish generally travelling from the north (i.e. from Iceland and the Greenland Sea) are expected to use European Sites within the north of England and vice-versa.

Since each marine plan has limited information on the spatial location or type of development that may be delivered, an assessment of potential adverse effects on integrity, in combination, is made for all European Sites that support migratory fish without mitigation or further examination on a project by project basis.

Physical Damage to Species (direct damage to species from collision risk; impact pathway 6)

The main collision risk to fish is posed by increased vessel activity and construction works and associated equipment. The ability of fish to avoid a potential collision with

an object is dependent on sensory capabilities (i.e. vision and hearing), perception levels and swimming speeds of the species. In addition, for those species located within high latitude coastal areas (i.e. the north west and north east inshore and offshore marine plan areas) resident and/or migrating fish must contend with variable and often poor visual conditions. Table 17 describes the various activities that may increase collision risk to fish.

Table 17 Activities that could occur within the seven marine plan areas and with which fish may collide or become entrapped during conditions of poor visibility and/or the presence of human disturbance scares fish into these structures.

Activity generated by the marine plans	Possible collision risks and impacts to fish
Fisheries (EMP-2, EMP-4, FISH -1 and INF-1)	Suspension lines, nets, cages, log piles, rafts, vessels and other forms of infrastructure all has the potential to collide with fish and cause harm.
Aquaculture (AQ-2)	Cages, vessels and other equipment frequently uses for aquaculture has the potential to collide with fish and cause harm.
Cable burial/ wind farm infrastructure (CAB-1, CAB-2 and CAB-3)	Suspension lines, blade movement, construction and maintenance equipment have the potential to collide with fish and cause harm.

Salmonids have well developed eyes that allow them to see a variety of colour, pattern and behavioural displays indicating that they are a visually orientated group (Cheng and Flamarique, 2004). They can therefore detect and avoid structures within the marine environment. Fish vision is heavily dependent of light availability. For example, a study by Cui et al (1991) quantified the light level thresholds for the visual reactions of mackerel to monofilament netting, were -1 log lux and - 4 log lux (1-0.001 lux) for multifilament. At light levels below these thresholds, fish were unaware of the netting barriers and were observed swimming through them. Alternatively, lamprey morphology is not believed to have evolved significantly in 340 million years and are a species with one of the earliest examples of the vertebrate eye structures (Binder and McDonald, 2007) and consequently have more limited visionary capability when compared to salmonids. In addition, lampreys are parasitic fish that attach to the flesh of their hosts during adulthood. As a result, they are heavily dependent upon their host for movement therefore lamprey hosts have an indirect impact to the populations of lamprey (Igoe *et al,* 2004).

Fish may avoid collisions with an object through "startle" (or "C-start") responses. The C-start response can be initiated by transient sound, visual or touch stimuli. For example, herring escape behaviour is a reflex response stimulated by transient sound stimuli, detected in the labyrinth (inner ear) (Blaxter *et al,* 1981). 'Visually looming' objects will also trigger evasion behaviour in most if not all species, with a greater response rate to edges moving horizontally rather than vertically (Wilson *et al,* 2006). The behavioural response to an approaching net is to turn and swim in the direction of the moving net, using the minimum swimming speed to avoid the object (resulting in them 'holding position' at the mouth of the net) whilst reserving energy

for an escape response. However, on exhaustion, the fish turn and allow the net mouth to overtake them.

Based upon the described evidence, there is a risk that the activities of the seven marine plans could increase the collision risk of designated fish species. Polices that are of highest risk include enhanced public access (ACC-1, SOC-3, FISH-2, TR-1 and TR-4); provision of infrastructure (AQ-2, EMP-2, EMP-4, FISH -1, INF-1) and promotion of short sea shipping (PS-4). These policies would involve the increased use of vessels and stationary infrastructure, which if present along migratory routes, could cause harm to fish. Also these polices are likely to have a greater effect within marine plans located in the north of England due to poor weather conditions that decrease water clarity. Moreover, policies such as cable burial and future cable landfall (CAB-1, CAB-2 and CAB-3) and new dredge disposal sites (DD-3) may increase turbidity levels further increasing collision risk.

Effects of sedimentation and coastal processes are discussed separately in a later section. However, collision risk resulting from suspension lines, nets and cages due to amplified fishing activity within each marine plan area may result in the entanglement of Atlantic salmon and/ or Twaite shad during migration to spawning grounds. Increased fish deaths due to collisions may result in a population declines and therefore a reduction in supported protected species within a European Site. Example sites that could be directly impacted include the River Wye/ Afon Gwy SAC located inland of the south west marine plan areas, as this site supports both species and is therefore highly vulnerable to population changes. Inland of the north west marine plan areas, the River Derwent and Bassenthwaite Lake SAC and River Eden SAC support Atlantic salmon that may become more vulnerable to the impacts listed above. The seven marine plans contain little detail regarding the proposals that may come forward. As such, an assessment of adverse effects on integrity, in combination, is made for all European Sites that support migratory fish without mitigation or further examination on a project by project basis.

Physical Damage to Species (direct damage to species from marine litter; impact pathway 7)

As discussed for birds in section 5.1, marine litter could be generated by schemes that come forward under many of the screened in policies within each of the seven marine plans. These include enhanced public access (ACC-1, SOC-3, FISH-2 and TR-1) through the discarding of litter from increased human activity. There are risks of people discarding litter inappropriately either directly into the sea or leaving rubbish on beaches (and European Sites) that are connected to the sea. The Great British Beach Clean report (2017) recorded 717 items found per 100 metres of coast (Marine Conservation Society, 2018) . Litter items observed included plastic bottles, discarded fish equipment and fragmented infrastructure equipment. However, 20% (Smithers, 2018)of all litter found was classed as ‘on the go’ items these included drinks cups, plastic cutlery, foil wrappers, straws, sandwich packets, lolly sticks, plastic bottles, drinks cans, glass bottles, plastic cups, lids and stirrers. There is a risk that these items may become fragmented and enter the gut content of protected species such as salmon, shad and lamprey.

Marine litter can also stem from development supported or promoted by the other policies (AQ-2, EMP-2, EMP-4, INF-1, CAB-1, CAB-2, CAB-3, REN-1, WIND-2 and PS-4) through the accidental and/or incorrect disposal of construction materials, or operational materials. Fisheries can clearly also be a source of litter, although it is noted that the main fisheries policy in the seven marine plans (FISH-1) specifically promotes sustainable fisheries; fishing activities that have an adverse effect on European sites would therefore not be complaint with this policy due to their unsustainable nature. Marine litter is a general issue rather than just something associated with the marine plans, but where policies support industries and applications that can be associated with an increase in such litter the issue requires consideration in the AAIR of those policies.

Marine litter is a significant threat to fish survival, health and welfare. Litter is easily moved within the marine environment and can therefore impact a significant proportion of marine life and therefore impact European site integrity. Fish may be impacted by marine litter in the following ways:

- **Entanglement** – for example, abandoned or broken nets or plastic bags could trap fish reducing movement or increase movement whereby the litter wraps around the fish causing serious injury or death by starvation.
- **Ingestion** - for example, fragmented litter could be mistaken for food by fish this can cause physical harm and potential mechanical blockage of the oesophagus and digestive system that in turn could lead to internal infections or death.
- **Transfer through trophic levels** – fish are a food source for a range of other marine life, including marine mammals. There is the risk of microplastics being transferred to these organisms and impacting health. This is discussed further in the sections on birds and marine mammals.
- **Pollution and toxic chemicals** – this is discussed as a separate impact pathway later.

The first records of plastic ingested by fish are from the 1970s when Opaque polystyrene plastic was in ingested by fish in the coastal waters of southern New England. Subsequently 92 species of fish have been observed ingesting plastic. The English Channel is currently ranked as one of the highest areas for fish ingested plastic particles when compared globally (Boerger *et al,* 2010). In total, 36.5% of all fish within the English Channel have ingested plastics, followed by 11% for the North Atlantic and 2.6-6.1% for the North Sea (Davison and Ash, 2011). Further research has suggested that fish species within the North Sea contain microplastic particles. For example, Foekema et al (2013) observed that the highest plastic contamination of cod within the English Channel was over 33%, although, on average one plastic particle per fish was found with higher levels of plastic contamination at southern latitudes. Microplastics have also been observed in juvenile Chinook salmon (Collicutt *et al,* 2019) and King mackerel (Miranda and de Carvalho-Souza, 2016).

Microplastics are of significant relevance to fish since litter can enter fish tissues either through ingestion or through gill systems. The accumulation of plastics inside a fish may hamper buoyancy control, cause internal ulcerations, blockages of the digestive tract and impair the satiation signal resulting in starvation.

In addition to issues that ingestion of marine litter poses, there is also the risk of harmful chemicals that are associated with marine litter. For example, impacts of

PVC particles to European Sea bass *Dicentrarchus labrax*. The fish were fed a 90-day diet of microplastics that consisted of 0.1 % (w/w) of microplastics less than 0.3 mm in size and some of the PVC particles were treated to obtain a contamination level similar to the microplastics in the environment. It was discovered after 60 days that the PVC particles caused severe alterations the epithelium structure of the intestine with the severity increasing over time.

Even though of the incorporation of microplastics and associated chemicals into fish tissues is demonstrated; there is limited knowledge regarding microplastic transfer through food webs.

Due to the significant threat to migratory fish, and indeed other marine organisms, it is imperative that proposals that come forward in response to supportive policies in the seven marine plans do not contribute to the problem to such an extent that an adverse effect on European site integrity results. The seven marine plans all include three policies specifically to deal with the issue of marine litter. These are policies ML-1 to ML-3. Policy ML-1 requires public authorities with functions capable of releasing marine litter to make adequate provision for waste management to prevent the generation of such litter or to ensure it is appropriately recycled or disposed. ML-1 then requires such authorities to also make provision for the removal of marine litter. In particular, policy ML-3 states that proposals that could potentially increase the amount of litter discharged into the marine area either intentionally or accidentally must include measures to (in order of preference) avoid, minimise or mitigate such discharges.

There is therefore a strong policy framework in place for addressing the potential for generation of marine litter from proposals that come forward under screened in marine plan policies and for ensuring that mitigation mechanisms are delivered to tackle it. However, due to the high level nature of the plan it is not possible to determine specifically what schemes would be involved or what specific mitigation proposals would be required, or whether they would be effective in a given situation. Therefore down-the-line assessment at the scheme/application level is required, as it will be for the other impact pathways discussed in this AAIR due to the high level nature of the marine plans. Text for inclusion in the marine plans to address this issue is discussed in the mitigation section. Prior to inclusion of that text, the conclusion of adverse effect on integrity remains for all thirteen European sites in Table 15, since no details of marine development are documented within any of the marine plans.

Non-Physical Disturbance to Species (barrier to species movement; impact pathway and visual/noise disturbance; impact pathways 9 and 10)

Salmon (Hendry and Cragg-Hine, 2003), lamprey (Maitland , 2003) and shad are highly mobile species that undergo large seasonal movements and migrations to forage and breed. Therefore, there is the considerable risk that the addition of new anthropogenic structures associated with implementation of Marine Plan policies could result in fish displacement and barriers to fish migration. There are several impacts that may act as a barrier to movement for migrating fish and these are described separately, beginning with anthropogenic (human caused) noise.

Human-caused noise is recognised as a form of environmental pollution. Fish hear sound and use this information to perceive their environment. For example, sound may be used for mating, communication, and predator avoidance (Gill and Bartlett, 2011). Change in noise levels is likely to affect a fish's behaviour, physiology, anatomy, and development. For instance, Kunc *et al* (2016) describes that noise may impact behaviour in the following ways: compromised communication, orientation, feeding, parental care, and prey detection, and increased aggression, can lead to less group cohesion, avoidance of important habitat, fewer offspring, and higher death rates. Similarly, noise impacts on physiology can cause poor growth rates, decreased immunity, and low reproductive rates. Anatomical impacts include: abnormal development or malformations, hearing loss, or injured vital organs, which can result in strandings, disorientation, and death. While some animals may recover from behavioural or physiological impacts, others, such as injury to vital organs, are irreversible. Reversible or not such impact examples that originated from the seven Marine Plans could have broad ramifications on the marine ecosystem, population health and ecology. The impacts of noise are explored further below:

- **Physical injury** - high noise levels can cause damage to fish hearing or sensory systems when exceed over a threshold. Noise has the ability depending on severity to damage either single cells or whole organs. Fish are sensitive to ear damage at noise levels ranging from 142-300 Hz pure tone at 180 dB re 1µPa (Scholik and Yan, 2001). Damage to fish hearing may result in a fish unable to detect threats and therefore more vulnerable to predation.
- **Impairment of development** Increased noise levels can delay development and reproductive success can decrease for some species. Impairment at early stages of life cycles can cause serious consequences to the population's resilience, potentially leading to overall weakened ecosystem community structure and function.
- **Physiology (stress)** – increased noise levels can induce the production of stress hormones that can have negative impacts to growth, sexual maturation, reproduction, immunity, and survival if released for long periods of time. For example, Wysocki et al. (2006) demonstrated that when fish were played underwater ship noise at 153 dB re 1 µPa for 30 min the stress hormone cortisol increases dramatically. On average, cortisol increased 99% over control values in the European perch, 81% in the common carp, and 120% in the gudgeon.
- **Masking** - is the obscuring, obliterating, or "drowning out" of sounds of interest to animals. The ability of fish to detect and recognise sound is vital to their survival. Codarin et al*.* (2009) found that such noise can reduce the detection distance of other fish sounds by 10- to more than 100-fold, depending on the species. The masking effect was most pronounced in the frequency range where fish communication takes place.
- **Disturbance** – increase noise levels can displace fish from a given area. As has been previously described, increased noise levels are linked to the inducement of stress hormones in order to avoid stress fish will avoid areas of high noise output. In addition, as previously described for birds avoidance noise may result in increased migratory distance and therefore energetic outputs that may compromise reproductive success.

Table 18 gives further examples of noise disturbance impacts that could be associated ith the implementation of marine plan policies.

Table 18 Examples of noise disturbance impacts that could be associated with implementation of marine plan policies

Source of noise pollution	Discussion
Public access (ACC-1, SOC-3, FISH-2, TR-1 and TR-4)	All seven marine plans document policies that are designed to enhance public access to the plan areas (ACC-1, SOC-3, FISH-2, TR-1 and TR-4). Increased public access to the coastal and sea areas of these plans may increase noise levels via the following pathways: Generally increasing human activity of an area. Leisure activities (i.e. dog walking, tourism, increase boat usage) Sporting activities (i.e. kite surfing, surfing, wind surfing, sailing, jet skiing) Increase noise levels within all seven Marine Plans could impact the ability of European Sites to support protect fish species for reasons described previously.
Aquaculture, fisheries and employment (AQ-2, EMP-2, FISH-1, INF-1 and INF-3)	All seven marine plans document policies that are designed to support the provision of infrastructure relating to aquaculture and fisheries (AQ-2, EMP-2, INF-1 and INF-3). When considered in operation and during construction the development of aquaculture and fisheries associated with screened in policies within all seven marine plans is likely to increase noise levels through the following pathways: Construction works (i.e. increased shipping activity, assembly, drilling, piling, increased human activity, increased vehicle activities) Operations (i.e. increased human activity, increased shipping, aerators, air and water pumps, blowers, and filtration devises, increased vehicle activities, predator deterrents) Increased fishing activities (i.e. increase vessel usage and movement, the use of fishing gear)
Cable burial and renewable energy (wind turbines) (CAB-1, CAB-2, CAB-3, REN-1 and WIND-2)	Again, all seven marine plans document policies that are designed to support the development of cable burial and renewables to support associated infrastructure (CAB-1 and CAB-2; and REN-1 and WIND-2). Increased noise levels are expected through the following pathways: Construction works (i.e. increased vessel activities, increased human activities, drilling, piling, increased vehicle activities) Operations (i.e. turbine movement, under water vibrations)
Dredging (DD-3)	New dredge disposal sites are supported by all seven marine plans (DD-3). Increase dredging when considered in operation and during construction can increase noise levels through the following pathways: Construction works (i.e. increased vessel activities, increased human activity, drilling, piling engine/generator noise, increased vehicle movement) Operations (i.e. dredging vessels)

Short sea shipping (PS-4)	All seven marine plans support the increased short sea shipping (PS-4). Increased in short sea shipping would result in elevated noise levels through the following pathways: Increased vessel movement (i.e. sound generated from thrusters, pumps, engine, mechanical, propeller)

Noise generated from dredging

Dredging can be a significant source of marine noise pollution this is largely due to the intense and invasive use of equipment to extract resources from the seabed. Noise sources from dredging vessels includes: thrusters, inboard pump, underwater pump, pipe, draghead, engine, mechanical and propeller sounds. For example, Jones and Marten (2016) reviewed the literature regarding the noise levels of dredging activities during operations, Table 19 displays these findings.

Table 19 Typical noise levels of dredging activities during operations

Activity	Received level and distance from source dB re 1µPa RMS	Estimated source level dB re 1µPa @1m	Additional information
Engine noise	-	167	Not detected more than 350m from source
Sediment extraction	-	179	Not detected more than 175m from source
Anchoring of spuds	-	172	Not detected more than 220m from source
Spud 'walking'	-	175	
Barge loading	-	166	Not detected more than 170m from source
Hydraulic ram	-	164	Not detected more than 330m from source
Ship generators and mechanism movement	140-145 @ 7m	154	-
Bucket extraction of sediment	145-162 @7m	163	-

Based upon Table 19 dredging activities do operate within noise levels that can increase stress levels and cause physical damage to fish hearing organs. For example, sediment extraction was estimated at 179 dB re 1µPa at 1m this is a significant noise level and is over the established threshold of 120 dB re 1µPa @ 1 m (Olesiuk *et al,* 2012) to induce behavioural responses such as increased stress levels and prevent effective communication. In addition, 179 dB re 1µPa @1m is also extremely close to the 180 dB re 1µPa and could therefore result in physical hearing damage to fish. In addition, Harding *et al* (2016), observed that Atlantic salmon exposed to piling recordings were displaced when compared to the control

group. There is a significant risk that dredging development within the seven marine plan areas could impact migratory fish species and their ability to use European Sites within all the seven marine plans.

There are several policies the implementation of which could impact migratory fish due to noise disturbance issues, these include enhanced public access (ACC-1, SOC-3, FISH-2, TR-1 and TR-4), revision of infrastructure and employment, (AQ-2, EMP-2, EMP-4, FISH-1, INF-1), cable burial (CAB-1, CAB-2 and CAB-3), dredging (DD-3) and short sea shipping (PS-4). As described above, noise may impact salmon and shad due to the temporary or permanent loss of hearing. This may, for example, reduce salmon perception and therefore increase predation risk. Alternatively, noise may deter fish away from the source increasing energetic outputs and/or reduce a fish's ability to find the mouth of spawning rivers (i.e. European Sites). For lamprey, activities such as increased fishing and short sea shipping are expected to be of greatest impact. This is because lamprey tend to spend much of their lives around estuaries therefore associated noisy activities to accommodate marine infrastructure growth could have a greater impact to lamprey when compared to activities that are traditionally further offshore.

Policy UWN-2 is contained within all seven marine plans and states that proposals that result in the generation of impulsive or non-impulsive noise must demonstrate that they will, in order of preference: a) avoid, b) minimise, c) mitigate significant adverse impacts on highly mobile species, and d) if it is not possible to mitigate significant adverse impacts, proposals must state the case for proceeding. Although not specifically mentioned in policy, where interest features of European sites are involved the case for proceeding even if significant noise effects will arise must by law be based on a) imperative reasons of overriding public interest (IROPI) and b) no alternatives to delivering the objectives of the project.

There is therefore a policy in place for addressing the potential for underwater noise effects on relevant European sites from proposals that come forward under screened in marine plan policies and for ensuring that mitigation mechanisms are delivered to tackle it. However, due to the high level nature of the plan it is not possible to determine specifically what schemes would be involved or what specific mitigation proposals would be required, or whether they would be effective in a given situation. Therefore down-the-line assessment at the scheme/application level is required, as it will be for the other impact pathways discussed in this AAIR due to the high level nature of the marine plans. Text for inclusion in the marine plans to address this issue is discussed in the mitigation section. Prior to inclusion of that text, a conclusion of no adverse effects on integrity cannot be reached for the thirteen screened in European sites listed in Table 15.

Toxic Contamination (spillage and contamination causing a reduction in water quality; impact pathways 11 to 13)

Based upon the research described above there are numerous development policies that could increase pollution within each of the marine plan areas, those of greatest concern include the provision of infrastructure and employment(AQ-2, EMP-2, EMP-4, FISH-1, INF-1), cable burial (CAB-1, CAB-2 and CAB-3 and REN-1 and WIND-2) and dredging (DD-3) (if in areas of previous contamination).

Toxic contamination has the potential to cause significant harm to fish species, populations and the ecosystems they occupy. Research relating to toxic contamination effects and fish heath is largely dominated by the impacts of biocide uses due to aquaculture and treatment to ship hulls.

There is a significant risk that migratory fish could pass through pollution areas of the seven marine plans. If pollution is present in high enough concentrations there is the risk of direct physical damage to fish (i.e. loss of vision, reduced nutrient uptake within the digestive track) or the impacts of pollution could be delayed to the next generation. For example, during fish development toxic chemicals can impacts fish at multiple stages of early development (i.e. during embryonic development and fry development). Toxic chemicals may lead to the death of embryos or result in body deformities. Such deformities may result in reduced fish motility making an individual more susceptible to predation, disease and risk of starvation. Pelagic fish, which includes Atlantic salmon (while at sea), would experience a lower exposure to contaminated sediments than demersal fish species that remain close to the seabed and feed mainly on benthic organisms. Lampreys attach onto a variety of pelagic and demersal fish species in the marine phase of their lifecycle and so their movements and distribution are largely dictated by their host. As is described in the section on habitats, aquaculture is a source of toxic contamination. Policy AQ-2, which provisions aquaculture infrastructure, is a substantial health risk to migrating fish species. In addition, there is also the potential for dredging (DD-3) activities and the promotion of short sea shipping (PS-4) to also increase toxic contamination due to projects that may come forward in relation to screened in policies within the seven marine plans.

In addition, shellfish and fish may bioaccumulate toxins within their body tissues and these can be passed to species within higher trophic levels. Fish also have high levels of heavy metals (Holmes and Youson, 1986), such as methylmercury, lead, cadmium and arsenic (Vračko *et al,* 2007), incorporated within their body tissues. The accumulation of moderate or high levels of contaminants in fish can cause or contribute to a range of lethal and sublethal effects, including genetic, reproductive and growth changes. On pathway heavy metals may enter the marine environment and therefore fish is via the deterioration of buried cables. There is therefore a risk of heavy metals leaching in the marine environment due to cable burial and future cable landfall policies (CAB-1, CAB-2 and CAB-3), both on their own account and associated with wind turbines (REN-1 and WIND-2).

Policy WQ-1 in all seven marine plans states that proposals that cause deterioration of water quality must demonstrate that they will, in order of preference a) avoid, b) minimise or c) mitigate deterioration of water quality in the marine environment. There is therefore a policy in place for addressing the potential for deterioration in water quality and pollution from proposals that come forward under screened in marine plan policies and for ensuring that mitigation mechanisms are delivered to tackle it. However, due to the high level nature of the plan it is not possible to determine specifically what schemes would be involved or what specific mitigation proposals would be required, or whether they would be effective in a given situation. Therefore down-the-line assessment at the scheme/application level is required, as it

will be for the other impact pathways discussed in this AAIR due to the high level nature of the marine plans.

Text for inclusion in the marine plans to address this issue is discussed in the mitigation section. Prior to inclusion of that text, an assessment of adverse effects on integrity, in combination, is made for all European Sites that support migratory fish.

Non-Toxic Contamination (elevated turbidity; impact pathway 14)

Increased turbidity may arise from all seven marine plans for reasons previously described. In relation to turbidity and fish there is the risk that elevated levels could impacts designated fish species and their migratory routes. Examples of turbidity impacts include (Bash *et al,* 2001):

- **Gill trauma** – gills can be easily damaged by abrasive sediment. Fish that are exposed to increased sediment have a positive correlation to increased deformities, lesions, tumours and 'coughing' (Schleiger, 2000).
- **Blood chemistry** – increases in plasma glucose, blood sugar levels and plasma cortisol have been seen in fish exposed to high levels of sediment. These blood compounds are indicators of stress.
- **Movement** – fish that are exposed to high levels of turbidity have demonstrated decreased swimming performance due to a reduction in aerobic conditions of the swimming area (Berli *et al,* 2014).

Wild salmonid populations are not usually exposed to high levels of turbidity; in fact salmonids are expected to avoid areas of turbidity. Estuarine fish generally show tolerance to variations in suspended sediment loadings and turbidity because of environmental adaptations to living in dynamic, variable habitats (ABPmer, 2005). Mobile species of fish such as salmon are more likely to deviate from their route to avoid elevated turbidity levels. Although the threats of turbidity are reduced, there is the risk of turbidity therefore acting as a barrier to migratory movement.

The major policies of concern with regards to turbidity is new dredge disposal sites (DD-3) and increased short-sea shipping and coastal shipping (PS-4), although all development in the marine environment could involve a dredging stage. Increased turbidity may have physical impacts to Atlantic salmon and Twaite shad and if serious physical injury was to occur to either species there is a risk of death and therefore possible population declines to European Sites. Lamprey may be expected to be more tolerant of increased turbidity and therefore not at as high risk. It should also be noted that sediment dispersal is likely to be restricted within one tidal ellipse as already discussed. It is reasonable to assume that impacts outside of this buffer are not expected, but this would not prevent migratory fish passing within one tidal ellipse of dredging being affected even if the European site for which they are designated lies more distant. Since there are no spatial details of such developments within the seven marine plans it is not possible to assess the impacts of turbidity to migratory fish and European sites further. As such, an assessment of adverse effects on integrity, in combination, is made for all European Sites that support migratory fish without mitigation or further examination on a project by project basis.

Biological Disturbance (direct and indirect introduction of non-native species, translocation of native species, and introduction/transfer of parasites/pathogens; impact pathways 15 to 19)

In relation to designated migratory fish species the impacts of biological disturbance are of significant relevance to offshore aquaculture (Policy AQ-2). This is because fish (and shellfish) escapes within aquaculture are high due to the dynamic system of the marine environment. Escapees are not only problematic in the sense that they can be introductions, but these organisms are capable of inter-breeding with their wild counterparts. For example, farmed salmon escapes in Scotland alone accounted for a total of 98,000 fish escapes during 2018 (Scotlands Aquaculture, 2019). This therefore equates to an average of 30% of all wild caught populations in UK waters. Causes of escapes include:

- Construction failure;
- Collisions;
- Storms;
- Handling; and
- Predators.

Farmed salmon are genetically different to wild Atlantic salmon as they have been selected for traits with highest yields, these include:

- **Morphology** – farmed salmon have larger bodies, are less streamlines, are faster growing and reduced fins compared to wild salmon;
- **Predator response** – farmed salmon have a reduced response to predator presence compared to wild salmon;
- **Breeding behaviour** – farmed salmon demonstrate a reduced ability to reproduce and therefore reduced reproductive success compared to wild salmon; and
- **Performance in semi-natural environment** – farmed salmon have reduced inter-population competition capabilities compared to wild salmon.

Inter-breeding between farmed and wild salmon results in the irreversible loss of gene pools that provide wild salmon with their survival and breeding capabilities (Fleming *et al,* 2000). Farmed salmon are also capable of inter-breeding with other fish species such as brown trout *Salmo trutta* having similar impacts with regards to morphology and behaviour describe above (Youngson *et al,* 1993).

Case study: Aquaculture and transfer of parasites and pathogens

Due to the high-density living conditions of many aquaculture stocks the risk of parasite and pathogen infections is significantly high. Furthermore, poor water quality and antibiotic use and resistance harbours disease outbreaks. Due to the connectivity of the species to the sea these pathogens are likely to be transferred to wild species. In addition, due to the importance of non-native species for farming there is a significant chance that the introduction of parasites and pathogens, these could impact local species and populations. For example, caged salmon farms have been confirmed to act as reservoirs to wild salmon for sea lice (exo-parasite that feed upon salmon flesh for juvenile salmon this parasite can reduce survivorship). Oysters also harbour disease such as white spot disease and yellowhead disease (both viruses) that can be transferred to native shellfish populations (i.e. freshwater pearl mussel *Margaritifera margaritifera*).

There is a significant lack of knowledge regarding the impacts of diseases within the marine environment and less still the impacts of antibiotics. The use of antibiotics to treat and prevent the spread of disease within aquaculture is of global concern both within the marine and terrestrial environment as the presence of a selective pressure arising from antibiotics promotes bacterial resistance to occur. Furthermore, animal husbandry requires human attendance thereby acting as a reservoir for the spread of bacterial resistance to land and vice-versa. Currently, the threat of global bacteria resistance is extremely high with widespread occurrence of antibiotic resistance amongst 500,000 people with suspected bacterial infections across 22 countries (World Health Organisation, 2018). The impacts of antibiotic resistance of wild fish stocks remains understudied with extremely limited research available for review.

The main concern for migratory fish disturbance is aquaculture activities (AQ-2). Atlantic salmon (and by association fresh water pearl mussel) are expected to be of greatest risk. Therefore, those European Sites that are designated from Atlantic salmon may be particularly vulnerable to aquaculture activities. Example European Sites include: Afon Gwyrfai a Llyn Cwellyn SAC and the River Dee and Bala Lake/ Afon Dyfrdwy a Llyn Tegid SAC for the North West Marine Plan and the River Usk/ Afon Wysg SAC and River Wye/ Afon Gwy SAC for the South West Marine Plan. Also, lamprey may also be particularly vulnerable to invasive species since they reside within frequently disturbed estuarine habitats that are prone to biological invasion.

The seven marine plans all include two policies specifically to deal with the issue of invasive non-native species. These are policies NIS-1 and NIS-2. Policy NIS-1 states that proposals that could potentially introduce invasive species into the marine area must include measures to (in order) avoid or minimise the risk, particularly when: 1) moving equipment, boats or livestock (for example fish or shellfish) from one water body to another and 2) introducing structures suitable for settlement of non-native invasive species, or for the spread of non-native invasive species known to exist in the area. Policy NIS-2 requires public authorities with functions capable of releasing invasive species into the marine environment to implement adequate biosecurity measures.

There is therefore a strong policy framework in place for addressing the potential for the spread of invasive non-native species from proposals that come forward under screened in marine plan policies and for ensuring that mitigation mechanisms are delivered to tackle it. However, due to the high level nature of the plan it is not possible to determine specifically what schemes would be involved or what specific mitigation proposals would be required, or whether they would be effective in a given situation. Therefore down-the-line assessment at the scheme/application level is required, as it will be for the other impact pathways discussed in this AAIR due to the high level nature of the marine plans. Text for inclusion in the marine plans to address this issue is discussed in section 5.6, mitigation. Prior to inclusion of that text, the very limited spatial information available regarding implementation of the marine plan policies means that no further assessment of biological disturbance can be undertaken and therefore an assessment of adverse effects on integrity, in combination, is made for all thirteen European Sites in Table 15 that support migratory fish.

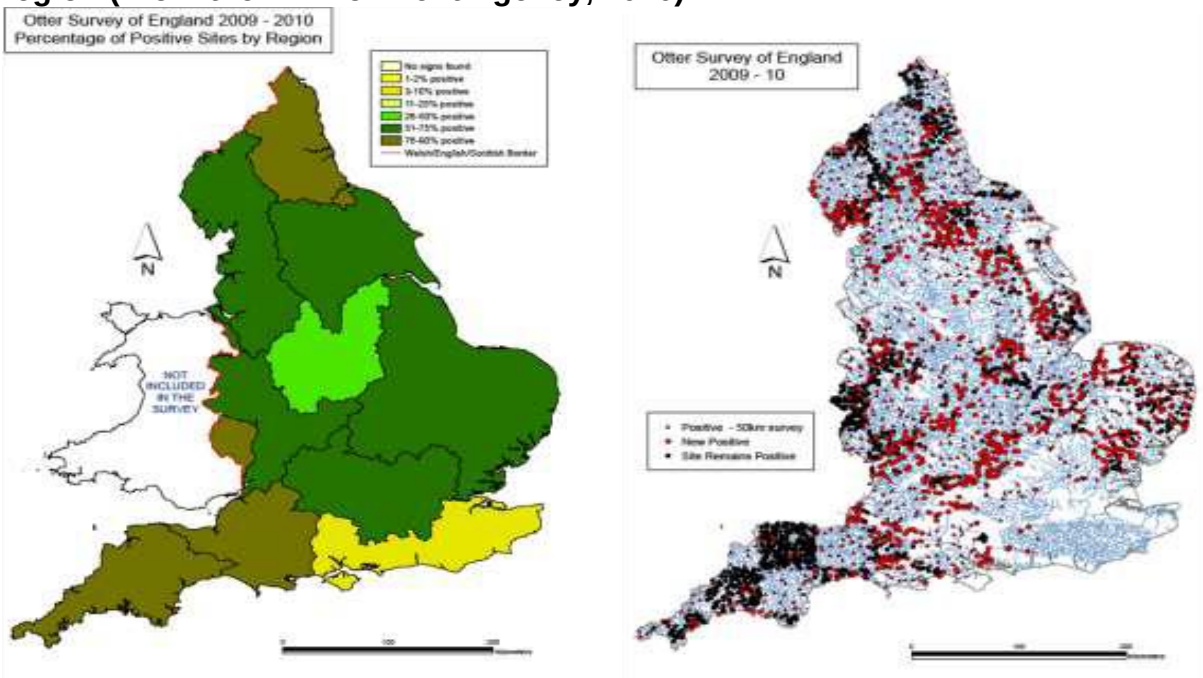
5.4. European sites designated for marine mammals and otters

Marine mammals such as dolphins and seals are important indicators of marine environmental health and so their decline and linked impact pathways are indicative of the wider marine environment. In summary, the screening phase concluded that there was a possibility of likely significant effects (or that it was not possible to conclude no likely significant effects) for the following mammal features:

- Common (Harbour) seal (*Phoca vitulina*)
- Grey seal (*Halichoerus grypus*)
- Bottlenose dolphin (*Tursiops truncates*)
- Harbour porpoise (*Phocoena phocoena*)
- European otter (*Lutra lutra)*

During the 1900s the European otter suffered serious declines throughout Europe and by the 1970s otters in the UK were largely restricted to Scotland, parts of Wales and the West Country. The cause for these declines was thought to be a result of heavy persecution (i.e. hunting) and due to deliberate and/or incidental poisoning resulting in reduced reproductive ability and death (Environment Agency, 2010). Because of these declines, otters were considered for conservation action and are now a UK Biodiversity Action Plan (UK BAP) species. Otters have been extensively surveyed with the aim of understanding population recovery and the effectiveness of UK conservation programs. The most recent national otter survey of England carried out between 2009-2010 suggests populations of otter are recovering throughout England. These data suggest otters are more heavily concentrated within the south west and north east of England, refer to Figure 2.

Figure 2. Otter Survey of England 2009-2010: Percentage of positive sites by region (From the Environment Agency, 2010).



Sensitivities to plan activities

- Physical Damage to Habitat and Species and non-Toxic Contamination (change to habitat; impact pathways 1 – 5 and elevated turbidity; impact pathway 14)

- Physical Damage to Species (direct damage to species from collision risk; impact pathway 6)
- Physical Damage to Species (direct damage to species from marine litter; impact pathway 7)
- Physical and Non-Physical Disturbance to Species (barrier to species movement; impact pathway 8 and visual/noise disturbance which can lead to mortality; impact pathways 9 and 10)
- Toxic Contamination (spillage and contamination causing a reduction in water quality; impact pathways 11 to 13)

Physical Damage to Habitat and Species and non-Toxic Contamination (change to habitat; impact pathways 1 – 5 and elevated turbidity; impact pathway 14)

The creation of new infrastructure for shipping (PS-4), renewable energy (REN-1 and WIND-2), enhanced public access (ACC-1, SOC-3, FISH-2, TR-1 and TR-4), cable burial/landfall (CAB-1, CAB-2 and CAB-3), fisheries or aquaculture (AQ-2, EMP-2, FISH -2 and INF-1) on the seabed, in the coastal or offshore marine environment has the potential to result in the temporary (during exploratory surveys, or construction and decommissioning) or permanent (during operation) loss of habitat for marine mammals and associated European sites. As described earlier, there are multiple pathways to habitat loss that are likely to be generated from each marine plan. Those impact pathways that are of most relevance to marine mammals are the loss of foraging, breeding and resting habitat. Screened in policies within the marine plans that are expected to be of greatest concern to marine mammal habitat includes:

- Provision of aquaculture infrastructure (AQ-2 and EMP-2) i.e. loss of offshore foraging habitat
- Provision of fishery infrastructure (FISH -1 and INF-1) i.e. loss of coastal habitats (seal haul outs, resting and breeding sites) for the construction of ports and harbours for fishing vessels and associated fishing infrastructure.
- Cable burial, future cable landfall (CAB-1, CAB-2 and CAB-3); i.e. temporary loss of coastal and offshore habitats for foraging, resting and breeding; and
- New dredge disposal sites (DD-3) i.e. loss of offshore foraging habitat via habitat smothering, interruption of coastal processes and displacement.

These activities are expected to affect habitats indirectly in a number of ways including increased turbidity levels from the release of sediment into the water column during dredging; the smothering of habitat from the transport and deposition of disturbed sediments and via changes in erosion and deposition processes due to impacts to natural sediment transport regimes.

Marine mammals are highly mobile organisms that may travel extensive distances in search of suitable foraging grounds or during migration in relation to breeding cycles. When species encounter suitable foraging habitat of high prey density marine mammals tend to aggregate to take advantage of ample food sources. Critical habitats for marine mammals are those that are essential for day-to-day well-being and survival, as well as for maintaining a healthy population growth rate. Areas that are regularly used for feeding, breeding, raising calves and socialising, as well as sometimes migrating, are examples of the key components of critical habitat (WDCS, 2010)..

These critical habitats are those that will be most sensitive to activities generated by each marine plan. For example, the harbour porpoise is highly dependent on year-round proximity to food sources. This is because harbour porpoise has an active lifestyle and a high energy demand. Being small mammals, they are not able to store a lot of energy in their bodies and so must feed frequently. Harbour porpoise have a varied diet, exploiting seasonally abundant prey from both pelagic and demersal habitats. Small schooling fish including herring and sprat (Clupeidae), sand eel (Ammodytidae) and members of the cod family (Gadidae) are important foodources in UK and Irish waters (Pierpoint, 2008). Wisniewska et al (2016) reported that tagged porpoises off Denmark foraged almost constantly, 24 hours a day, to meet their energy needs. This highlights that being disturbed from a preferred foraging area, could have implications on their survival and fitness.

Booth (2010) and Booth et, al., (2013) noted that higher densities of harbour porpoise were consistently associated with depths of between 50m and 150m across the various models constructed and observed that this could be related to prey availability. In coastal waters, they are often encountered close to islands and headlands with strong tidal currents that may also be associated with prey abundance (Evans *et al,* 2003). Given the fact that foraging harbour porpoise show clear preferences for certain habitats or depths of water linked to prey abundance, it is reasonable to assume that changes to habitats that support prey species can impact the condition of a foraging area and/or European Sites (Santos and Pierce, 2003)designated for marine mammals.

In addition, impacts to intertidal areas may result in habitat change and/or damage to seal haul-outs[14]. These areas are not always encompassed by a European Site's boundary. For example, in the UK, grey seals typically breed on remote uninhabited islands or coasts and, in small numbers, in caves (Stringell *et al,* 2013). In contrast common seals come ashore in sheltered waters, typically on sandbanks and in estuaries, but also in rocky areas, and haul-out on land in a pattern that is often related to the tidal cycle. Of particular risk to seal haul-out areas are coastal development and/ or activities of the marine plans. These include increased public access policies (ACC-1, SOC-3, FISH-2, TR-1 and TR-4) designed to improve public access to the coast and encourage more people to the coast. As a result increased human footfall could degrade a seal haul-out area and/or European Site that is designated for seals due to trampling, disturbance (discussed as a specific impact pathway below) and littering issues (discussed as a specific impact pathway below). Additional policies that may impact seal-haul out sites include cable burial and future cable landfall (CAB-1 and CAB-2). The main impact pathways here are those that are associated with construction works (i.e. the physical loss of habitat for cable burial, movement of vehicles and exclusion fencing to prevent the movement of people and wildlife into the construction area).

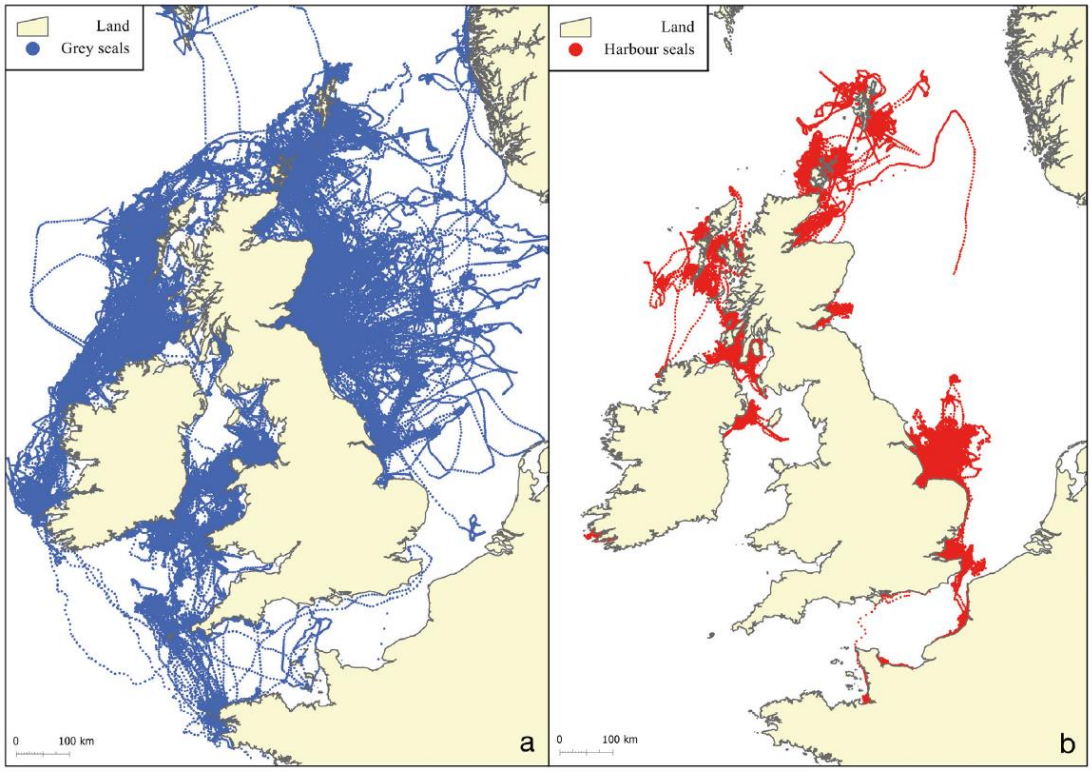
Development within each of the seven marine plan areas could affect the integrity of European Sites that are located within each plan's boundaries in the absence of mitigation or further information on the nature of proposals to be delivered under each policy. However, as was identified within the screening assessment not all

[14] *A haul-out site is a location on land where seals come ashore at times to rest, breed, have pups or moult.*

European Sites that are located within 100km buffer of each of the marine plan areas are expected to be impacted by marine development. For European Sites that support marine mammals a site-specific assessment has been undertaken in the accompanying Excel database of European sites that identifies those sites that overlap Marine Mammal Management Units and those sites where a reduced buffer of 50km is applicable. The rationale for using 50km to determine the probable limit of impact is already provided earlier in this report.

The marine plan with the highest proportion of European Sites designated for marine mammals is the North West Marine Plan closely followed by the South West Marine Plan. In addition, a study by Jones et al (2015) identified a higher concentration of grey seal activity within the boundaries of the north east, north west and south west marine plan areas. In contrast, harbour seals were more confined to the south east and northern limits of the north east marine plan areas (Figure 3).

Figure 3: Relative concentrations of grey seal and harbour seal activity (from Jones et al, 2015).



Based upon findings discussed above it is reasonable to conclude that physical damage of habitat generated from development under screened in policies within each of the seven marine plan areas would impact marine mammals through the various pathways discussed above, for all European sites located within the marine plan areas or potentially within 50km of their boundaries without mitigation or further examination on a project by project basis.

Otters can utilise both fresh water and coastal habitats for foraging and breeding opportunities therefore development associated with screened in policies within each inshore marine plan area could impact coastal otters. The impacts that are expected

to be of greatest concern for otters includes the loss of resting habitat such as holts (otter dens) and the loss of foraging habitat (Environment Agency, 1999). Otters that forage within the marine environment have a heavy reliance of fish species such as lumpsuckers (*Cyclopteridae*) and rocklings (*Lotidae*). The direct loss of habitat that supports these species may result in the loss of essential food sources. For example, the promotion of infrastructure such as aquaculture (AQ-2), renewable energy (REN-1, WIND-2, CAB-1, CAB-2 and CAB-3) and short sea shipping (PS-4) within an area if coast that supports otters and their prey source may reduce the ability of an area and/or European Site carrying capacity to support otters.

Otters are territorial, anti-social creatures (Erlinge, 1968) and therefore any activity such as habitat loss that results in increased confrontation with other otters can threaten life expectancy, due to: physical injuries during territorial fights and elevated stress levels. For example, Harris et al. (1995) calculated that otter density within England is one individual per 27km of water. However, this figure is expected to vary greatly depending on food and resting resources. Simpson (1998) reported that 16% of otters received post mortem suffered from bite wounds that were believed to be inflicted by other otters. In these cases the injuries were severe, leading to infection and ultimately death. In addition, otters that occupy coastal habitats tend to have a reduced reproductive rate when compared to freshwater populations. It is therefore essential that coastal otters are not impacted by habitat loss that could result in the removal of foraging resources. In addition, otter territory may be lost due to impacts to coastal processes such as erosion, already discussed for other receptors. Marine development (AQ-2, EMP-2, EMP-4, FISH -1 and INF-1) and activities such as dredging (DD-3) could result in elevated sediment into the water column and/ or disrupt natural coastal process that could increase sediment deposition and/or increased abrasion and erosion within otter territories and European Sites.

There are considerable habitat threats to otter populations that occupy coastal areas due to the potential projects that could come forward associated with screened in policies within each of the inshore marine plans. The South West, North West and North East Inshore Marine Plans are expected to be of greatest concern for otter since these plan areas are home to higher population densities of otters, including coastal individuals. There are several European Sites that were identified at the screening stage to be of particular importance to otters. For example, within the south west inshore marine plan area, Exmoor and Quantock Oakwoods SAC and SCI is located along the Exmoor coast. It is therefore probable that marine development (AQ-2, EMP-2, EMP-4, FISH -1, INF-1 and DD-3) could impact coastal processes, such as erosion, and reduced the availability of suitable resting or foraging habitat for otters.

There are, however, a small number of European Sites designated for otters that are not expected to be impacted by development within any of the marine plan areas as they are located several kilometres from the coast. For example, Cors Caron SAC is located over 10km from the Welsh coast and therefore will not be impacted by the loss of physical habitat from marine development.

Physical Damage to Species (direct damage to species from collision risk; impact pathway 6)

The main risk of physical damage to marine mammals, other than through underwater noise as briefly discussed earlier and discussed in further detail later, is due to collision from increased vessel activities and risk of entanglement from fishing gear due to the provision of fisheries. Vessel activity and damage/death due to entanglement and entrapment in fishing gear may increase within each marine plan area due to policy implementation without mitigation.

Those policies that are considered of greatest concern to marine mammals are:

- Enhanced public access (ACC-1, SOC-3, FISH-2, TR-1 and TR-4);
- Provision of infrastructure, including for employment, sustainable fisheries, aquaculture and related industries (AQ-2, EMP-2, INF-1);
- New dredge disposal sites (DD-3); and
- Promotion of short sea shipping (PS-4)

These activities are expected to be associated with increased vessel movements during operation and the use of equipment such as fishing nets are likely to increase collision risk. Marine mammals are extremely powerful and agile swimmers with quick reflexes and good sensory capabilities. This equips individuals with the abilities to avoid anthropogenic structures when they are in good environmental conditions (i.e. reduced/low levels of turbidity). However, there are numerous cases of marine mammals colliding with anthropogenic structures that may lower an individual's perception level to the surrounding environment. These include vessels and fishing gear and can result in distraction when foraging and socialising.

Coastal small cetaceans (such as harbour porpoise) are particularly vulnerable to collisions with fishing gear and other anthropogenic activities as populations tend to be small, individuals/ groups usually live within restrained home ranges and their distributions overlap with small scale fishing operations (Parsons and Jefferson, 2015 and Nery *et al,* 2008). In addition, young pups, which are inexperienced at sea, could be more vulnerable to the impacts of foreign objects and/or distraction may arise due to elevated noise levels (discussed further later) or decreased visual accuracy due to turbidity may further increases the chances of collisions. Table 20 refers to reported collision studies.

Table 20 Reported collision studies for marine mammals.

\	Summary and observations
Peltier et al (2017)	1,100 dolphins have been found on France's Atlantic coast between January to March 2019. Post mortem studies showed that many of these dolphins had extreme levels of mutilation; proposed to have been caused by trawl fishing.
Kraus (1990)	Around 20% of endangered northern right whales (*Eabalaena glacialis*) found dead between 1970 and 1989 off the eastern United States and Canada had large propeller slashes or substantial injuries indicating they were killed by collisions with ships.

Wiley et al (1994)	Around 30% humpback whale strandings along the US Atlantic coast between 1985 and 1992 had injuries caused by ships.
Félix et al (2018)	13.2% of bottlenose dolphins were recorded with dorsal fin damage, V-shaped wounds, sawed edges and deformities that are characteristic of vessel injuries. In addition, dolphin scaring has increased from 2.2% to 11.1% in the past 25 years.
Félix et al (2019)	Observed entanglement of bottlenose dolphin with fishing gear and evidence of previous entanglement due to the presence of net-shaped scars.
Vinther (1999)	A total of 325 harbour porpoise were reported as bycatch between 1992-1998.
Vanderlaan and Taggart (2007)	Reported that with increasing vessel speed the probability of lethal injury to whales increased exponentially until 19knots where the probability of collision was effectively 1.0.

A significant number of dead seals within the UK have characteristic 'corkscrew injuries' that were predicted to be a direct result of ship propeller collisions due to the spiral lacerations from seal post-mortem results. However, more recent observations have suggested that these injuries are caused from seal predation. Brownlow et al (2016) has observed grey seal cannibalism in Scotland where an adult male was observed catching a weaned grey seal pup. The pup was firstly drowned in a shallow, freshwater pool by the male adult seal, he then tore back the skin of the pup by the scruff and consumed a thick layer of blubber behind the head. The injuries to the neck of the pup were due to the tearing motion of the skin from the blubber that created a straight gash that could be mistaken for a propeller injury. There have been several other accounts of such behaviours in grey seals in Norfolk (Thompson *et al*, 2010) and Northern Ireland (Thompson *et al,* 2015)and further afield in Canada. Based upon these recent studies, it could be the case that previous records of such injuries were incorrectly attributed to collision with vessel propellers. However, it is currently premature discount the possibility that some corkscrew injures are caused by interactions with vessel propellers.

In addition, marine mammals can be curious of foreign objects placed in their environment. For example, seals have observed interacting with discarded fishing gear and other marine debris (Allen *et al,* 2012); seals are also known to congregate around wind farm piling operations. Seals have also been demonstrated to trace windfarm and pipeline structures at sea, potentially using these structures to forage, which could potentially increase their risk of collision with vessels (Russell *et al,* 2014). These interactions suggest that increased development within each of the seven marine plan areas could increase the chances of collisions. Furthermore, there is the risk that marine mammals may become entangled by anthropogenic material such as aquaculture cages, fishing gear and construction equipment.

For marine mammals the risk of collision generated from marine development with each marine plan are expected from pathways: damage/death from collision and damage/death due to entanglement and entrapment in fishing gear. There are several development policies within each of the seven marine plan areas that could increase vessel use. These include enhanced public access (ACC-1, SOC-3, FISH-

2, TR-1 and TR-4), the provision of infrastructure (AQ-2, EMP-2, FISH -1, INF-1, REN-1 and WIND-2) and the promotion of short sea shipping (PS-4).

Each Marine Plan is not specific regarding potential proposals to be delivered in a given area. Moreover, marine mammals are:

1. Highly mobile creatures;
2. Do not operate solely within designated site boundaries; and
3. Use a range of foraging, resting and breeding habitats throughout the coast of the UK

Therefore, a conclusion of adverse effects on integrity in the absence of mitigation is drawn for all seventeen European Sites that were screened into the appropriate assessment without mitigation or further examination on a project by project basis:

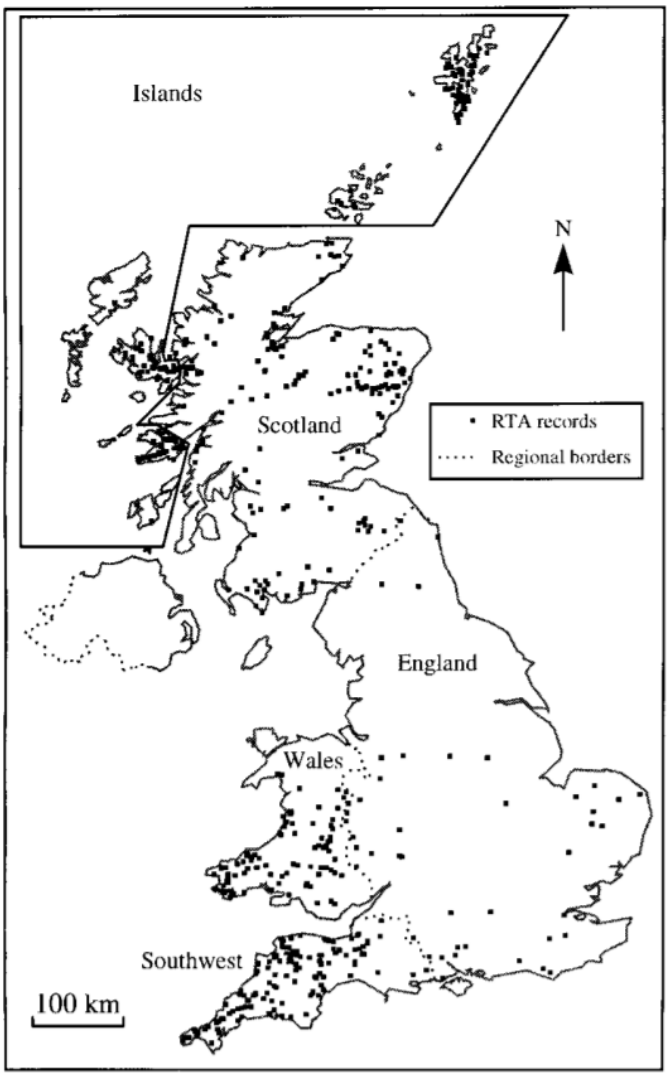
- Berwickshire and North Northumberland Coast SAC
- Bristol Channel Approaches SAC
- Cardigan Bay/ Bae Ceredigion SAC
- Firth of Tay and Eden Estuary SAC
- Humber Estuary SAC
- Isle of May SAC
- Isles of Scilly Complex SAC
- Lleyn Peninsula and the Sarnau SAC
- Lundy SAC
- Maidens SAC
- Murlough SAC
- North Anglesey Marine SAC
- Southern North Sea SAC
- Pembrokeshire Marine/ Sir Benfro Forol SAC
- Strangford Lough SAC
- The Wash and North Norfolk Coast SAC
- West Wales Marine SAC

Furthermore, increased human activity within each of the seven marine plan areas is likely to increase human activity. For example, the promotion of aquaculture and fishing activities (AQ-2, EMP-2, FISH -1 and INF-1) is likely to result in increased vessel movements that could cause collisions within otters. Recreation activities (ACC-1, SOC-3, FISH-2, TR-1 and TR-4) are also likely to increase the number of small boats for recreational uses may also increase the number of injured otters within each of the marine plan areas.

There is limited available data with regards to otters and collision risks, however, similarly to marine mammals; otters are agile swimmers and are therefore expected to avoid most vessel collisions. In contrast, otters are frequently targeted by fishermen as they are considered a pest to aquaculture. Otters will actively take farmed salmon from aquaculture cages; therefore, the risk of human-wildlife conflicts could arise within each of the marine plans. In addition, otters may collide and become entangled by aquaculture cages and fishing nets that may result injury or entanglement (Sanchez-Jerez, 2010).

Finally, there is the risk that the seven marine plans may increase the use of current roads within the coastal landscape (i.e. due to construction traffic for the development of wind turbines and cable burial (REN-1, WIND-2, CAB-1, CAB-2 and CAB-3)) and/or the current infrastructure may require upgrading due to enhanced public access to the coast (i.e. increase visitor traffic may highlight the need to provide better transportation links (ACC-1, SOC-3, FISH-2, TR-1 and TR-4)). Increased traffic within and around sea otter territories has the potential to increase the number of otter-vehicle Road Traffic Collisions casualties. Fatalities of otters with vehicles can be high when within otter habitats, for example, Lafontaine (1991) demonstrate that 5% of France's total otter population is killed by traffic each year. In the UK, Philcox et al (1999) observed a total of 673 records of otter deaths due to traffic collisions between 1971 and 1996. These deaths were considerably higher in those areas that are of greatest importance to the national population of otter within the UK, refer to Figure 4. This study also reflected that with increasing traffic, over time, the number of otter-vehicle collisions increases dramatically. This suggests that the increase of traffic generated by each of the marine plans for the various reasons discussed could have a negative impact to the current population recovery trends of otters within England.

Figure 4. RTA records of otter in the UK (From Philcox et al, 1999).



Physical Damage to Species (direct damage to species from marine litter; impact pathway 7)

As discussed for birds and fish, marine litter could be generated by schemes that come forward under many of the screened in policies within each of the seven marine plans. These include enhanced public access (ACC-1, SOC-3, FISH-2 and TR-1) through the discarding of litter from increased human activity, or from development supported or promoted by the other policies (AQ-2, EMP-2, EMP-4, INF-1, CAB-1, CAB-2, CAB-3, REN-1, WIND-2 and PS-4) through the accidental and/or incorrect disposal of construction materials, or operational materials. Fisheries can also be a source of litter, although it is noted that the main fisheries policy in the seven marine plans (FISH-1) specifically promotes sustainable fisheries; fishing activities that have an adverse effect on European sites would therefore not be complaint with this policy due to their unsustainable natureMarine litter is a general issue rather than just something associated with the marine plans, but where policies support industries and applications that can be associated with an increase in such litter the issue requires consideration in the AAIR of those policies.

Marine mammals and otters may be directly impacted by marine litter due to entanglement or the consumption of fragmented pieces of litter. for example, Twelves (1983) observed accidental captures of otters in lobster pots. Also, marine mammals and otters can be indirectly impacted due to the consumption of fish that have microplastics and other waste in their gut system or body tissues, as already discussed for fish. 54% of marine mammals encounter marine litter either due to entanglement or ingestion (Gall and Thompson, 2015).

Due to the small size, microplastics can be ingested by a wide range of organisms from zooplankton to whales (Cole *et al,* 2013). Harmful effects range from physical injury to reduced feeding behaviour, affecting growth and reproduction, to chemical contamination, from both the chemicals used in their production and the accumulation of other contaminants, such as metals and polychlorinated biphenyls (PCBs) from the general marine environment, on their surface. Under laboratory conditions the bioaccumulation of microplastics in invertebrates and fish has been shown to cause a reduction in feeding rate and therefore reduced energy reserves (Botterell *et al,* 2019). Impacts have also been linked to changes in reproductive outputs and damage to intestinal and brain functions.

The movement of plastics and associated contamination through tropic levels can be significant due to bioaccumulation and biomagnification (Besseling *et al,* 2015). Due to marine mammals' and European otter's high tropic level and long-life expectancies (marine mammals only) they are particularly vulnerable to such pollution. However, due to regulatory restriction (i.e. animal welfare issues) the physiological stress of ingested plastic in marine mammals is largely un-researched. Most data are collected from dead and stranded animals and reveal that the impacts from marine litter include:

- Laceration/ ulceration of the digestive tract, leading to infection and internal bleeding (e.g. fish hooks generated from policies AQ-2, EMP-2, EMP-4, INF-1);

- Blockage of the digestive tract, reducing nutrient uptake (e.g. plastic bags generated from construction and operational works from policies ACC-1, CAB-1, CAB-2, CAB-3, REN-1 and WIND-2);
- Satiation, reducing the urge to feed;
- Failure of digestive tract compartmentalisation, allowing highly acidic gastric juices into areas not adequately shielded; and,
- Retention, leading to an increasing amount of debris in the digestive system of the organism (National Oceanic and Atmospheric Administration, 2014).
- Ecotoxicological effects of plastic additives (such as phthalates or PBDEs) and associated Persistent Bioaccumulative and Toxic (PBT) compounds (Panti *et al,* 2019).

There are multiple screened in policies with each of the seven marine plans that could increase the concentrations of marine litter into the marine environment in an unmitigated situation, as discussed on the preceding page. For example, in incorrect disposal of feeding bags from aquaculture may result in the release in plastic bags into the sea. These items could be ingested by marine mammals such as bottlenose dolphin or could entangle dolphins increasing the risk of drowning events. In addition, microplastics may bioaccumulate within marine mammals due to plastic entry at lower tropic levels. Once marine litter has entered the digestive system of marine mammal there if is significant threat to life that could hinder growth, reproduction and survivorship.

The seven marine plans all include three policies specifically to deal with the issue of marine litter. These are policies ML-1 to ML-3. Policy ML-1 requires public authorities with functions capable of releasing marine litter to make adequate provision for waste management to prevent the generation of such litter or to ensure it is appropriately recycled or disposed and then requires such authorities to also make provision for the removal of marine litter. In particular, policy ML-3 states that proposals that could potentially increase the amount of litter discharged into the marine area either intentionally or accidentally must include measures to (in order of preference) avoid, minimise or mitigate such discharges.

There is therefore a strong policy framework in place for addressing the potential for generation of marine litter from proposals that come forward under screened in marine plan policies and for ensuring that mitigation mechanisms are delivered to tackle it. However, due to the high level nature of the plan it is not possible to determine specifically what schemes would be involved or what specific mitigation proposals would be required, or whether they would be effective in a given situation. Therefore down-the-line assessment at the scheme/application level is required, as it will be for the other impact pathways discussed in this AAIR due to the high level nature of the marine plans. Text for inclusion in the marine plans to address this issue is discussed in the mitigation section. Prior to inclusion of that text, for all fourteen European Sites that were screened into the appropriate assessment the conclusion of adverse effect on integrity remains since no details of marine development are documented within any of the marine plans.

Physical and Non-Physical Disturbance to Species (barrier to species movement; impact pathway 8 and visual/noise disturbance, potentially relating to mortality; impact pathways 9 and 10)

Underwater sound produced by humans, such as noise from vessel movements, oil and gas exploration and construction in the marine environment, has increased significantly in the past 60 years (Hildebrand, 2009). Most anthropogenic sound is low frequency in nature and is within the audible range of many marine mammals, particularly whales.

Marine mammals have well adapted hearing sensory organs and use sound extensively for social communication, navigation and the detection of prey. Increases in background noise and specific sound sources can impact marine mammals in a number of ways. Anthropogenic sound can result in changes in behaviour, the masking of important sounds such as vocalisations, hearing loss (temporary or permanent) and in extreme cases, such as explosions and military sonar, can cause death, tissue damage or animal stranding.

Although the impact of underwater noise pollution in relation to marine mammals has been subject to extensive scientific research in recent years' further research is needed to fully understand how important these are to the well-being of marine mammals and their populations. However, many noise sources have the potential to impact protected marine mammal species and by default European Sites.

There are numerous development activities that are expected to generate noise at each stage of the marine plans as already discussed for fish; the resulting impacts are included in Table 21.

Table 21 Impacts of Noise Disturbance on Marine Mammals

Impact	Discussion
Lethality and physical injury	In general, death or physical injury resulting from the sound pressure waves caused by anthropogenic underwater sound are restricted to the high noise exposure levels from underwater explosions. For example, two long-beaked common dolphins (*Delphinus capensis*) were accidentally killed by underwater detonation training events in California and death and physical injury have been seen from other explosive activities (Danil and Leger, 2011). Underwater noise can also cause stranding and death of marine mammals through behavioural responses and acoustic impairment e.g an investigation into a mass stranding of long-finned pilot whales in Scotland in 2011 indicated underwater explosions from a nearby military exercise as the most likely cause (Brownlow *et al*, 2015). Naval mid-frequency active sonar (MFAS) has been shown to be responsible for the death of beaked whales, indirectly via mass stranding events(Bernaldo de Quiros *et al*, 2019). Whilst the exact

	reason for the strandings is unclear the link with sound concluded that the military sonar exercises precipitated the strandings. The necropsies that were performed found multiple injuries, but none of the animals were found to have acoustic trauma. The only activity within the seven Marine Plans that has the potential to cause death or physical injury is the use of underwater explosive operations, such as may be required to clear unexploded ordnance on the seabed during offshore construction or cable laying activities. In recognition of the possible harm to marine mammals from such activities the Joint Nature Conservation Committee has produced guidelines to minimise the impact of explosions (JNCC, 2010).
Auditory injury	Animals that experience sufficiently intense sound exhibit an increased hearing threshold (i.e., poorer sensitivity) for a period of time after the sound stops. This is called a noise-induced threshold shift (TS) and may be permanent (PTS) or temporary (TTS). The degree of hearing loss depends mostly on the sensitivity of the animal to a sound and the interaction of three characteristics of the sound: the frequency of the sound, the intensity of the sound, and the duration or how long the animal is exposed to that sound. Hearing loss does not usually occur if the frequency of the sound the animal is exposed to is outside its normal hearing range. However, one other factor, the time it takes for the sound to reach its highest intensity level (the rise time), is also important. Very rapid rise times, such as can occur with very intense impulse noises such as impact piling or seismic gun pulses, can compound an injury and, in some extreme cases, can impact ears even though the peak frequency of the sound is not in the normal hearing range of the animal. However, injury can also result from long-term exposure to lower sound intensity. To account for all of the potentially injurious aspects of exposure, dual criteria for injury are adopted for marine receptors (marine mammals, turtles and fish for example). These dual criteria are given for Sound Pressure Level (the maximum intensity of the sound or the instantaneous peak pressure) and the Sound Exposure Level (the total energy over a given time period). For an exposed individual, whichever threshold is exceeded first is used as the operative injury criterion.
Behavioural response	Behavioural responses to underwater sound are highly variable ranging from an animal orienting itself to hear the sound through to a panic and fleeing response. These reactions are also context specific and much more difficult to predict than the effects on hearing. For example, habitat fidelity due to the presence of important food resources or breeding grounds can have a significant effect on a response to sound. Also, not only are there differences in behavioural responses between species but there is significant variation between individuals of the same species as

	well. Displacement of species can act as a barrier to movement; for example, harbour porpoise are known to have very sensitive hearing and react to underwater sound at significant distances from the sound source. Lucke et al (2009) showed that aversive behavioural reactions of a captive harbour porpoise were initiated at a received sound exposure level of >145 dB re 1 µPa2 s which corresponded to a distance of >10km (146–152 dB re 1 µPa2 s calculated SEL) and <25km (139–145 dB re 1 µPa2 s calculated SEL) around the pile driving site. This level of response was also evident in response to impact piling at a windfarm site in the German North Sea with observed avoidance by harbour porpoises detected up to 25km from the pile driving operations (Dahne *et al*, 2013). Jehl and Cooper (1980) examined the effects of sonic booms on harbour seals; startle responses to noise were observed ranging between 72 and 89 dB re 1 µPa. Since studies have shown that marine species could be susceptible to noise levels as low as 72 dB re 1 µPa virtually all of the previously screened in policies are expected to impact marine species in some way, these include enhanced public access policies, provision of infrastructure and employment policies, cable burial policies, environmentally positive policies, dredging policies, renewable energy policies and short sea shipping policies.
Chronic stress	Long term exposure to elevated noise levels can cause chronic stress to marine species. As has been described increased noise levels can increase the concentration of cortisol. Increases in cortisol levels for marine mammals may result it accelerated ageing, slow disintegration of body condition, sickness symptoms and suppression of reproduction (physiologically and behaviourally) (Wright *et al*, 2007)..

Noise disturbance and physical harm

Marine mammals (particularly cetaceans) can be impacted by noise disturbance. Refer to Table 21for the various methods noise may increase due to development policies of each marine plan and
Table **22** for the injury and disturbance thresholds for marine mammals. This is because marine mammals are sensitive to a wide bandwidth of sound, the general frequencies when considering noise disturbance issues for marine mammals includes:

- Responsive to frequencies from 100 Hz to 170 kHz; and
- Sensitive to perceiving/hearing frequencies ranging from 20 kHz to 150 kHz.

Table 22 Injury and Disturbance Thresholds for Marine Mammals

Receptor Group	PTS (multiple pulses)	TTS (multiple pulses)	Threshold Source
Impulsive Sound (for example, impact piling)			
Low Frequency Cetaceans	219 dB_{peak} SPL 183 dB SEL_{cum}	213 dB_{peak} SPL 168 dB SEL_{cum}	Southall *et al* (2019)

Receptor Group	PTS (multiple pulses)	TTS (multiple pulses)	Threshold Source
Impulsive Sound (for example, impact piling)			
Mid Frequency Cetaceans	230 dB_{peak} SPL 185 dB SEL_{cum}	224 dB_{peak} SPL 170 dB SEL_{cum}	
High Frequency Cetaceans	202 dB_{peak} SPL 155 dB SEL_{cum}	196 dB_{peak} SPL 140 dB SEL_{cum}	
Phocid Pinniped	218 dB_{peak} SPL 185 dB SEL_{cum}	212 dB_{peak} SPL 170 dB SEL_{cum}	
Continuous Sound (for example, vibratory piling)			
Low Frequency Cetaceans	199 dB SEL_{cum}	179 dB SEL_{cum}	Southall *et al* (2019)
Mid Frequency Cetaceans	198 dB SEL_{cum}	178 dB SEL_{cum}	
High Frequency Cetaceans	173 dB SEL_{cum}	153 dB SEL_{cum}	
Phocid Pinniped	201 dB SEL_{cum}	181 dB SEL_{cum}	

It should be noted that the level of sound received by an animal does not seem to be the sole important aspect in determining a disturbance response and its significance. Therefore it is preferable to examine empirical evidence from comparable circumstances when considering displacement, rather than numerical criteria for the onset of disturbance as used in modelling.

Barrier to movement

For otters, the increase of traffic and associated road infrastructure may pose as a barrier to movement throughout home ranges. For example, if public access increased at the coast of each of the marine plan areas there is the possibility of increased visitor traffic that may increase collisions with otters and/or result in displacement issues. Roads and traffic can act as barriers to wildlife movement, this can divide otter populations into smaller metapopulations. As a result, gene flow could be inhibited when individuals do not cross roads or are killed trying. In urbanized areas where roads become dense populations can become high disconnected increasing their vulnerability to localised extinction (Van der Ree *et al,* 2011). Otters in England live in low density and therefore occupy territories over larger spatial scales. Therefore, the disconnection of otters due to increased traffic during the breeding seasons could have an impact to breeding success and European Site integrity.

The implications of development within each marine plan area in relation to barriers to species movement are currently under-researched for marine mammals. There is, for example, evidence to suggest that marine mammals such as seals can navigate around the construction of infrastructure. For example, GPS tracking data for harbour seals has observed foraging activity around the Alpha Ventus wind farm (North Sea) (Russell *et al*, 2014).

Figure 5: Harbour seal foraging activity around the Alpha Ventus wind farm in the North Sea 45 kilometres north of the island of Borkum, Germany (from

Russell et al, 2014). Points show locations at 30 minute intervals; red indicates higher chances of foraging (p(foraging) > 0.5) as predicted by the authors' state-space model and blue higher chances of travelling.

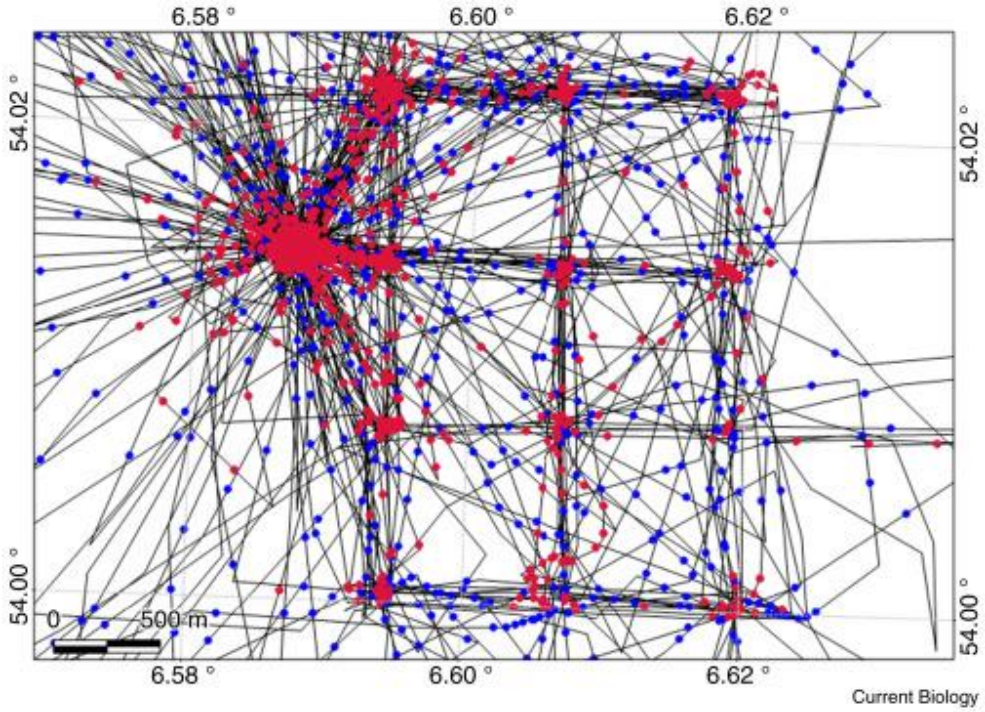


Figure 5 shows the outline of the wind farm as traced by harbour seal activity and demonstrates the seals taking advantage of ample food supply generated from artificial reef habitats from cable burial and turbine placement. In total, 96 seals visit the wind farm to forage with 6 out of 22 tagged seals travelling from the south east of England. This emerging research suggests that the placement of permanent infrastructure, such as wind turbines, does not pose a barrier to species movement. Marine mammals are highly mobile creatures with strong swimming abilities. In contract, disturbance with regards to noise does have the ability to act as a non-physical barrier to species movement (i.e. prevent foraging and/or disrupt migratory routes in relation to breeding cycles).

Disturbance to marine mammals can result from numerous policies that are (intentionally) broad and high level regarding the development that may come forward (AQ-2, EMP-2, FISH -1, INF-1, CAB-1, CAB-2, CAB-3, DD-3, REN-1, WIND-2 and PS-4). Issues of noise disturbance can have physical and behavioural implications to species that can threaten foraging, social and breeding abilities of marine mammals.

Noise and visual disturbance could also arise from enhanced public access (ACC-1, SOC-3, FISH-2, TR-1 and TR-4). The promotion of recreational policies within each of the marine plan areas could result in increased human activity and therefore noise and visual disturbances to marine mammals and European otters. For example, kayaking within 150m of harbour and grey seal colonies (i.e. haul-outs) can spook seals into the water. Kayakers (and other form of tourists) may be unaware that disturbance has arisen since seals will often swim towards kayakers (Wilsom, 2013). The potential impacts that could be generated from recreational activities may reduce seal and/or otter resting and digestion time and/or during the breeding

season female seals may become separated from their pups that risks pup survivorship (i.e. reduced suckling) and reproductive success (Boren and Barton, 2002). If recreational disturbance was to increase within a European Site that supports marine mammals, this can reduce the ability of a site to support protected species thereby impacting site integrity.

Policy UWN-2 is contained within all seven marine plans and states that proposals that result in the generation of impulsive or non-impulsive noise must demonstrate that they will, in order of preference: a) avoid, b) minimise, c) mitigate significant adverse impacts on highly mobile species, and d) if it is not possible to mitigate significant adverse impacts, proposals must state the case for proceeding. Although not specifically mentioned in policy, where interest features of European sites are involved the case for proceeding even if significant noise effects will arise must by law be based on a) imperative reasons of overriding public interest (IROPI) and b) no alternatives to delivering the objectives of the project.

There is therefore a policy in place for addressing the potential for underwater noise effects on relevant European sites from proposals that come forward under screened in marine plan policies and for ensuring that mitigation mechanisms are delivered to tackle it. However, due to the high level nature of the plan it is not possible to determine specifically what schemes would be involved or what specific mitigation proposals would be required, or whether they would be effective in a given situation. Therefore down-the-line assessment at the scheme/application level is required, as it will be for the other impact pathways discussed in this AAIR due to the high level nature of the marine plans. Text for inclusion in the marine plans to address this issue is discussed in the mitigation section. Prior to inclusion of that text, a conclusion of adverse effects on integrity in the absence of mitigation is drawn for all seventeen European Sites that were screened into the appropriate assessment without mitigation or further examination on a project by project basis.

Toxic Contamination (spillage and contamination causing a reduction in water quality; impact pathways 11 to 13)

The potential sources of toxic contamination that could be generated from the Marine Plans have been discussed with regard to fish. As with marine litter, marine mammals and European otters may come into direct contact with contamination or they may be indirectly impacted by toxins due the presence of toxins with prey items (Kalay and Canli, 1999) (i.e. biomagnification). Toxic contamination to mammals can have the following impacts:

- direct death due to high levels of toxin exposure;
- impaired reproduction;
- induced physiological and psychological stress; and
- reduced immunological health leading to increased susceptibility to disease.

The types of toxic contaminants that have been heavily focused for marine mammals include heavy metals and persistent organic pollutants (POPs) (Walker and Livingstone, 2013) . Route of toxin entry for marine mammals are through the following pathways:

- uptake from the atmosphere through the lungs;
- absorption through the skin;
- across the placenta before birth;

- via milk through lactating;
- ingestion of sea water; and,
- ingestion of food.

Heavy metals may cause direct death to marine mammals due to organ failure. Filtration organs such as the liver and kidney are mostly likely to be impacted by toxins (Law, 1996). For example, mercury in marine mammals is mostly concentrated in the liver, with the kidney and muscle having successively lower levels. The highest cadmium concentrations are usually encountered in the kidney due to the presence of metal binding proteins (Das *et al*, 2003). If these heavy metals are successfully taken up by these organs other lethal impacts could occur. Since methylmercury toxicity in mammals has been shown to cause central nervous system damage including sensory and motor deficits and behavioural impairment or animals may become anorexic and lethargic (Wagemann *et al,* 1988). Again, methylmercury is easily transferred across the placenta and concentrates in the foetal brain with effects ranging from development alterations to foetal death (Kemper *et al,* 1994).

Examples of, POPs include polychlorinated biphenyls (PCBs) and polybrominated diphenyl ethers (PBDEs) (Jones and De Voogt, 1999). These compounds are prevalent throughout the marine environment and food chains (Kelly *et al,* 2007). Due to marine mammal longevity, tick blubber layers and trophic placement; species are incredibly vulnerable to the impacts of POPs. For example, these chemicals are persistent, can bioaccumulate, are fat soluble and are in high concentration within certain areas (i.e. those closer to anthropogenic activity and/or infrastructures). For example, Jepson et al (2009) suggested a possible link between high levels of PCBs recorded in the blubber of stranded dead bottlenose dolphins in the UK. In addition, Mason and Macdonald (1994) studied the impacts of PBCs to otter populations; it was concluded that within Europe PBCs are a major cause for otter population declines. For example, concentrations of PCBs tended to be lower in regions where otter populations are healthy and widespread. More specific to the UK, PBCs content of spraints (otter dung) were lowest in areas where the highest occupancy rate for otters were observed. When in high enough concentrations these toxic chemicals will result in death leading to local and/ or regional population declines. Pesticides are also considered to have contributed to otter decline within the UK. For example, lindane (HCH), dieldrin and DDT presence in otter tissues were recorded in high concentrations in otters from Orkney and Shetland (Mason *et al,* 1986). Although, there is conflicting literature regarding the impact of pesticide concentrations to otter population declines (Roos *et al,* 2001).

Based upon the research described above there are numerous screened in policies that in an unmitigated situation could increase pollution within each of the marine plan areas, those of greatest concern include the provision of infrastructure and employment (AQ-2, EMP-2, EMP-4, FISH-1, INF-1), cable burial (CAB-1, CAB-2 and CAB-3 and REN-1 and WIND-2) and dredging (DD-3) (if in areas of previous contamination). Due to the far-reaching impacts and the lack of complete understanding surrounding the ecological consequences of toxic contamination no European Site supporting marine mammals as features can be dismissed.

Policy WQ-1 in all seven marine plans states that proposals that cause deterioration of water quality must demonstrate that they will, in order of preference a) avoid, b)

minimise or c) mitigate deterioration of water quality in the marine environment. There is therefore a policy in place for addressing the potential for deterioration in water quality and pollution from proposals that come forward under screened in marine plan policies and for ensuring that mitigation mechanisms are delivered to tackle it. However, due to the high level nature of the plan it is not possible to determine specifically what schemes would be involved or what specific mitigation proposals would be required, or whether they would be effective in a given situation. Therefore down-the-line assessment at the scheme/application level is required, as it will be for the other impact pathways discussed in this AAIR due to the high level nature of the marine plans.

Text for inclusion in the marine plans to address this issue is discussed in the mitigation section. Prior to inclusion of that text, an assessment of adverse effects on integrity, in combination, is made for all seventeen European Sites screened into appropriate assessment that support marine mammals without mitigation or further examination on a project by project basis.

5.5. Effects in combination with other plans and projects

In making the judgements regarding adverse effects on the integrity of European sites from one or more of the seven marine plans, account has been taken of the potential for these effects to arise 'in combination' with other plans and projects even if they might not arise from the seven marine plans alone. There are three groups of plans and projects from which 'in combination' effects have been identified:

- Effects in combination with other marine plans
- Effects in combination with terrestrial plans on the coast
- Effects in combination with other plans within the marine environment

Each of these categories of other plans and projects is discussed below.

Effects in combination with other Marine Plans

This could relate to one of the seven marine plans operating 'in combination' with each other. For example, Afon Teifi SAC in Wales is outside any of the seven marine plan areas. However, the 'West' coastal region for migratory fish (ABPMer 2017) overlaps with both the south west marine plan area and north west marine plan area as fish may migrate through both areas to reach the SAC. Therefore, infrastructure development in accordance with policies in either marine plan area could potentially affect the integrity of the SAC and this has led to a conclusion of adverse effects on integrity for that site.

It may also arise from one of the seven marine plans operating in combination with adopted marine plans either in England or in the devolved administrations (the Marine Plan for Northern Ireland, Welsh National Marine Plan and Scotland's National Marine Plan). For example, the South Marine Plan could operate in combination with the South West Marine Plan, Marine Plan for Scotland and South East Marine Plan to affect migratory fish, mammal or bird movements through the English Channel. This could result in adverse effects on sites as far from the marine plan areas as the River Dee in Scotland, designated as an SAC for freshwater pearl mussel, otter and salmon; freshwater pearl mussel is partly dependent on migratory fish. Similarly, the north east coastal region for fish (ABPMer, 2017) overlaps with north east, south west and south east marine plan areas, as well as the south and

east marine plan areas, as fish may migrate through English Channel and along the east coast to reach the SAC.

A similar situation could arise regarding marine mammals. The largest population of coastal bottlenose dolphins in the UK is found in Cardigan Bay. The species is a feature of both Cardigan Bay and Pen Llyn a'r Sarnau SACs, and there is strong evidence that the population ranges beyond the boundaries of the sites, and has been observed throughout the wider marine mammal management unit (Pesante *et al,* 2008a and Pesante *et al,* 2008b). Photo-ID evidence shows that most individual dolphins move between the two SACs strongly supporting the idea that the populations of the two SACs are highly connected, and that there is likely a single generic population across the management unit. Cardigan Bay SAC is the principal site for bottlenose dolphin and was designated primarily (Grade A) for this species, whereas bottlenose dolphins are a secondary (Grade C) feature of Pen Llyn a'r Sarnau. However, the high level of connectivity between sites, and the strong evidence that there is a single population of bottlenose dolphins using both sites means that it is likely that any conclusion of adverse effects on integrity for one site would also occur on the other. A conclusion of adverse effects on integrity of Cardigan Bay SAC has already been reached for the south west inshore and offshore marine plans in the absence of mitigation due to the close proximity of the SAC to these marine plan areas (within 15km of the offshore marine plan area). Since both SACs lie within Welsh waters similar activities and projects associated with the Welsh National Marine Plan could result in an 'in combination' effect on both European sites. These marine plans could therefore all operate in combination.

Effects in combination with terrestrial plans on the coast

Effects in combination with terrestrial plans will primarily occur where a coastal European site with a foreshore accessible to recreational activity lies within a marine plan area that has a policy promoting enhanced access (policies ACC-1, SOC-3, FISH-2, TR-1 and TR-4) and where the local plan for the relevant terrestrial local authority intends to deliver a net increase in housing.

For example, the Northumberland coast (Northumberland Council, 2018), the Liverpool City Region (AECOM, 2017), Gloucestershire(Stroud District Council, 2017), Devon (Teignbridge Council, undated), Cornwall (Cornwall Council, 2017), the Essex coast (Tendring District Council, 2019), the east Kent coast (Dover District Council, 2012) and the North Kent coast (Bird Wise, 2018) (not a comprehensive list) are all parts of the country overlapping with the seven marine plan areas where local plan HRA's have identified coastal European sites that are of considerable sensitivity to excessive or poorly managed recreational pressure and for which mitigation solutions have been identified. Providing enhanced recreational access within the marine plan area could therefore contribute to recreational pressure depending on the details of the proposals.

A similar situation is likely to exist where coastal European sites are situated between the marine plan areas on one side and an increased population associated with local plan growth on the other. For example, Penhale Dunes SAC in Cornwall abuts the south west marine plan area. It is designated for its sand dune succession. Such habitats require a certain amount of disturbance to ensure that various

successional stages are maintained, but excessive disturbance can retard succession completely and adversely affect the value of the site. The site is also designated for its colonies of petalwort, shore dock and early gentian. The resident population density in the surrounding area is quite low but there is an extremely high concentration of campsites and tourists probably contribute considerably to recreational activity. Dune trampling has long been recognised as an issue by Cornwall Council. People visiting the sand dunes for recreation can have a severe impact on their environment if they do not act responsibly and the Cornwall Council website identifies that there is still some ongoing evidence of excessive recreational activity in the form of a large 'blow out' (literally an area in which the sand is denuded of vegetation and thus blows away) at Penhale.

Another pathway of interaction is between shoreline management plans (SMPs) and coastal strategies where these will result in coastal squeeze or changes to sediment processes in a European site that lies within one of the seven marine plan areas. The following SMPs cover the seven marine plan areas; almost all have identified the need for appropriate assessment of their impacts on European sites (either due to coastal squeeze, disturbance during construction or direct loss of habitat due to defence footprints) even if a conclusion of no adverse effect on integrity was ultimately made. As such there is potential for in combination effects between the seven marine plans and these coastal strategies where (for example) cable landfall or coastal infrastructure are delivered:

- SMP 1 Scottish border to the River Tyne (Northumberland and North Tyneside) Lead: Northumberland County Council
- SMP 2 The Tyne to Flamborough Head (North East) Lead: Scarborough Borough Council
- SMP 8 Essex and South Suffolk Lead: Environment Agency
- SMP 9 River Medway & Swale Estuary Lead: Environment Agency
- SMP 10 Isle of Grain to South Foreland Lead: Canterbury County Council
- SMP 16 Durlston Head to Rame Head Lead: Teignbridge District Council
- SMP 17 Rame Head to Hartland Point (Cornwall & Isles of Scilly) Lead: Caradon District Council
- SMP 18 Hartland Point to Anchor Head (North Devon & Somerset) Lead: North Devon District Council
- SMP 19 Anchor Head to Lavernock Point (Severn Estuary) Lead: Monmouthshire Council
- SMP 22 Great Ormes Head to Scotland (North West England and North Wales) Lead: Blackpool Borough Council

Effects in combination with other plans in the marine environment

There are in combination effects with plans produced by The Crown Estate, namely Round Four of offshore wind leasing, the extraction of marine sand and gravel, oil and gas pipeline and interests in minerals such as salt and potash, mined beneath the seabed. The Fourth Round of offshore wind leasing includes proposals for leasing in the Irish Sea which coincides with the north west marine plan area (thus potentially affecting 50 SPA/Ramsar sites that are designated for migratory birds and lie within 100km of the north west marine plan area) as well as at Dogger Bank which is an SAC itself and lies close to the north east marine plan area. Therefore effects in combination could arise on these European sites through all the

aforementioned pathways identified with potential windfarms in this AAIR (direct killing and injury of SPA birds, displacement of foraging and migrating birds, habitat loss, toxic contamination and non-toxic contamination and disturbance) arising from wind farms licenced by the Crown Estate being constructed or operated at the same time as other marine activities in the same areas associated with marine lan policies relating to increased access, infrastructure, short-sea and coastal shipping, fisheries or aquaculture, depending on the detail of those proposals. In particular, Natural England have raised in consultation over this AAIR that the southern North Sea is particularly constrained regarding the potential for delivering new wind farms without a conflict with European sites. Natural England have also flagged that the kittiwake population of Flamborough Head and Bempton Cliffs SPA will be adversely affected by any new wind farm development within their identified core foraging area (hotspot), which extends up to 160km from the SPA boundary at its greatest extent, as has been noted earlier in this AAIR. This is because the primary conservation objective for this SPA is not simply to maintain the existing kittiwake population but to restore it.

With regard to other marine activities licenced by The Crown Estate, there were (as of March 2018[15]) nomarine aggregate dredging licences in the north east marine plan area, seven in the south east marine plan area with one application, seven in the south west marine plan area with five applications and three in the north west marine plan area, with one application. The existing sites form part of the baseline for this AAIR but any change in activity within those sites, and any permission for the new sites granted after the seven marine plans are adopted, could operate in combination with other marine activities consented under the marine plans to lead to habitat loss, changes in habitat quality, toxic and non-toxic contamination and potential disturbance. The Crown Estate also grants permits for cables and pipelines but do not publish any consolidated reports showing all new applications as they do for aggregate extraction.

There are in combination effects with other relevant central government plans and strategies such as Defra's UK fisheries strategy 'Fisheries 2027'. The strategy is intentionally broad but includes policy references such as 'In most cases fish stocks and access to use them, either commercially or recreationally, are managed to maximise the long-term economic return to society' and Recreational and commercial fishermen share access to fisheries. Economically efficient commercial operators have access to most of the resource; some of the resource is used to deliver wider social benefits and for recreational purposes. The plan also includes policies stressing the need for the environmental impact of producing and consuming fish to be acceptable. Given the general nature of the policies in the strategy it is not possible to undertake a detailed impact assessment at this level, although interventions arising under the survey will need to be taken into account in relevant project level assessments. The government has also produced aquaculture plans separate to the Marine Plans[16]. Aquaculture in the marine plan areas is currently focussed (DEFRA, 2015) on the west Cumbria coast between Morecambe Bay and the Solway Firth, the Devon and Cornwall coastline between Falmouth and Exeter

[15] The most recent published data. Data from https://www.thecrownestate.co.uk/media/2846/2018-capability-and-portfolio-report.pdf

[16] Such as The United Kingdom Multiannual National Plan for the Development of Sustainable Aquaculture (2015) and Planning for sustainable growth in the English Aquaculture Industry (2012)

and the Thames Estuary (particularly the coastline of Essex as well as Whitstable and Herne Bay in north Kent). There are also a small number of aquaculture sites along the north Cornwall and Devon coastline and the Northumberland coast. The majority of these sites are shellfish production sites in shallow coastal waters; England has no marine finfish farms (Black and Hughes, 2017). Offshore Shellfish Limited has been pioneering offshore rope-based mussel production on three sites between 3 and 6 miles offshore in Lyme Bay, Devon. There is potential for adverse effects to arise between these national strategies and initiatives and the marine plans.

There are in combination effects with other plans where they relate to coastal and marine infrastructure. For example, expansion of the Ports of Liverpool and Garston which could result in adverse effects on some of the European sites around the Merseyside coast (Mersey Estuary SPA and Ramsar site, Liverpool Bay SPA, Mersey Narrows & North Wirral Foreshore SPA and Ramsar site) in combination with those policies of the North West Marine Plan that promote or support development. Similarly, any proposals for expansion of Harwich International Port could potentially affect the Stour & Orwell Estuaries SPA/Ramsar site and operate in combination with the South East Marine Plan and (as discussed above) increased recreational use of the mudflats of the SPA/Ramsar site associated with increased housing delivery set out in the Tendring Local Plan. The likely areas for impacts associated with the expansion of short-sea shipping and coastal shipping are where existing ports exist and these coincide with the locations of Special Areas of Conservation, Special Protection Areas and Ramsar sites designated for seabirds, waders and waterfowl. The key areas (the major ports rather than a comprehensive list) within the relevant marine plan areas are therefore:

- North east marine plan area: the Port of Tyne, Port of Blyth and the Ports of Teesport & Hartlepool.
- North west marine plan area: the Port of Heysham and the Ports of Liverpool & Garston.
- South west marine plan area: The Port of Bristol and the Port of Plymouth.
- South east marine plan area: the Port of Dover and the major ports of the greater Thames Estuary: Medway, London and Harwich.

Given these potential interactions, adverse effects on integrity ‘in combination’ with other plans and projects cannot be dismissed in isolation or in combination for the following policies of the seven marine plans, without mitigation being included in the plan: ACC-1, SOC-3, FISH-2, TR-1, TR-4, AQ-2, EMP-2, INF-1, INF-3, CAB-1, CAB-2, CCS-1, CCS-2, HAB-1, DD-3, REN-1, WIND-2 and PS-4.

5.6. Mitigation

The policy framework in each marine plan achieves the avoidance of adverse effects on site integrity, first and foremost, through the inclusion of policy MPA-1. Policy MPA-1 requires proposals to demonstrate that they will avoid adverse impacts on the conservation objectives of marine protected areas. Where adverse impacts on the objectives cannot be avoided they must be mitigated. Proposals that cannot avoid or mitigate adverse impacts will not be supported. By complying with MPA-1 to avoid and mitigate adverse impacts on the features and conservation objectives proposals will avoid adverse effects on site integrity.

All seven marine plans contain a suite of policies to control many of the impact pathways identified in this AAIR. Policies WQ-1, UWN-2, AIR-1, ML-1 to ML-3 and NIS-1 to NIS-2 set a general consenting framework to ensure that European sites are protected from any harmful deterioration in water quality or increase in underwater noise, atmospheric pollution, marine litter or invasive non-native species as a result of schemes that may be consented under other plan policies. In addition, policies BIO-1, BIO-3, BIO-4 and BIO-5 also address protection of European sites as part of their general requirement to protect and enhance habitats and species in the marine and coastal environment, including a hierarchy of avoid, minimise or mitigate effects.

Despite this, it has not been possible to conclude no adverse effect on integrity without mitigation for a large number of European sites. Note that this is not due to a large number of adverse effects having been definitively identified but rather due to the very limited information available (by design) at the plan level regarding the proposals that may come forward in each marine plan area. This has meant that using the precautionary principle, adverse effects on integrity cannot be dismissed for most European sites until individual projects are devised and can be scrutinised in detail.

It is therefore necessary to introduce further mitigation measures into all seven marine plans before a conclusion of no adverse effect on integrity can be drawn. Given the limited information available on proposals, the 'mitigation' in the plan will need to consist of a policy framework that explicitly prevents proposals coming forward unless they are able to demonstrate that they can avoid adverse or mitigate for effects on the integrity of European sites. This is in line with advice from the European Court of Justice regarding the 'tiering' of HRAs where there are multiple levels of plan-making, recognising that the purpose of a high level plan is to set out broad policies and intentions without going into any detail. When the UK was first required to undertake HRA of plans, Advocate-General Kokott commented on the apparent tension between the requirements of the Habitats Directive and the intentionally vague nature of high level strategic plans. She responded that to address this apparent tension '*It would …hardly be proper to require a greater level of detail in preceding plans* [rather than lower tier plans or planning applications] *or the abolition of multi-stage planning and approval procedures so that the assessment of implications can be concentrated on one point in the procedure. Rather, adverse effects on areas of conservation must be assessed at every relevant stage of the procedure to the extent possible on the basis of the precision of the plan* [emphasis added]*. This assessment is to be updated with increasing specificity in subsequent stages of the procedure'* [i.e. for planning applications or lower tier plans] (Opinion of Advocate-General Kokott, 2005).

Having assessed the impacts on European sites to the fullest extent possible without further detail on projects that might be delivered under plan policies, the focus must now therefore be turned to the further policy mechanisms which must be enshrined in the plans to protect European sites. In considering this, it is important to note that this issue has already been identified and tackled to the satisfaction of statutory consultees in several other English marine plans (most recently the South Marine Plan). This has informed our advice.

Three key policy measures are proposed to provide the necessary assurances that the marine plans as a whole will have no adverse effect on the integrity of European and Ramsar sites either alone or in-combination with other plans or projects. These are as follows:

- **Project level HRAs:** Explicitly enshrining the requirement for project-level HRA in the marine plans – Since it is not possible to rule out adverse effects on the integrity of many European sites due simply to the high level nature of the marine plan policies, 'down-the-line' assessment becomes essential. There thus needs to be an explicit policy framework for this incorporated into the marine plans to ensure that applicants and scheme promoters are aware of the need for HRA (even if only to confirm no likely significant effects) for all schemes and that this must consider effects in combination with other plans and projects.
- **Terrestrial and marine cross border collaboration:** Consideration of matters that cross the terrestrial/marine environment planning borders when determining the acceptability of schemes – with regard to the public access promotion policies in particular (ACC-1, SOC-3, FISH-2, TR-1, TR-2 and TR-4), there is a risk that issues which span the marine/coastal and terrestrial environment are overlooked because they fall between planning responsibilities. Examples have been given in this HRA of coastal and estuarine European sites within each marine plan area that are identified to be at risk from increased recreational pressure due to housing development and which have a mitigation strategy in place. MMO must be aware of the existence of these strategies where promoting access to the coastal and marine environment to ensure no conflict between local authorities delivering measures to manage recreation and MMO promoting improved coastal access. An existing mechanism to facilitate this collaboration is the Coastal Concordat for England (Defra, 2013). Although not all coastal local authorities are signatories to the Concordat, the implementation plan for the Concordat addresses this by stating that '*For projects that meet the criteria for the coastal concordat*[17]*, but are in areas where the local authority has not yet implemented the concordat, officers should apply the concordat principles in partnership with the other concordat bodies as far as possible…'*. It is recommended that the supporting text for the access policies in all seven marine plans acknowledges the balance to be struck between supporting increased access to the coast and marine environment and potential conflicts with European site conservation objectives and that particularly close attention will be given to ensuring any access provision schemes are compatible with conservation objectives and any existing or future recreational pressure mitigation strategies devised by coastal local authorities.
- **A monitoring and Iterative Plan Review (IPR) provision** - monitoring is not mitigation; however, where there is a lack of detail over the precise effects of a plan (because, as in this case, the purpose of the plan is to set over-arching policy, not present specific proposals), an Iterative Plan Review process enables the delivery of development to be managed and the plan (and its

[17] In other words, that the footprint of the proposed development (and any ancillary infrastructure) is both terrestrial and has elements that fall below Mean High Water Springs within an estuary or on the coast, that the development requires multiple consents including both a marine licence and planning permission, and that there are no other coordination mechanisms in place, for example under the Planning Act 2008.

HRA) to be updated in future reviews. It involves recognising the fact that development associated with policies in the plan will not be delivered all at once but piecemeal over the entire plan timetable. This process will involve a phased and iterative approach to plan-implementation which is linked to ongoing project developments and their associated monitoring work and with the findings from such project-level work feeding back into the next phases of plan-implementation. This is done so that results from monitoring data from consented projects and on-going research programmes can be fed into subsequent developments in order for lessons to be learnt and evidence gaps filled, thus reducing potential impacts to European sites.

The first and last of these measures match recommendations made in the AAIR of the South Marine Plan. The second has been introduced specifically for this AAIR.

The existing policy framework, coupled with the recommendations above, will enable a conclusion of no adverse effect on integrity to be drawn for the seven marine plans.

5.7. Conclusion

With the inclusion of the identified policy changes it is considered that a policy framework exists that will ensure no adverse effects on the integrity of European sites arise in practice on any European sites, even though (by design) insufficient detail exists in the plans to enable individual proposals to be assessed against specific European sites or project-specific mitigation measures to be discussed. This is entirely in line with advice from the European Court of Justice regarding the 'tiering' of HRAs where there are multiple levels of plan-making. It is however essential that individual projects and plans within the marine environment are subject to HRA such that the intentions of the protective policy framework are delivered in practice.

It should be noted, however, that this conclusion for the marine plans does not prejudge any conclusions for individual projects that may come forward. For some schemes the opportunities to mitigate adverse effects will potentially be very limited (as Natural England has already flagged for wind farm proposals in the southern North Sea for example). Moreover, a series of rulings from the European Court of Justice have emphasised that even small amounts of permanent loss of qualifying habitat within a European site could constitute an adverse effect on integrity. Therefore, the mitigation hierarchy must be followed (avoid, then mitigate) and scheme proponents should engage at a suitably early stage with the Marine Management Organisation and other stakeholders such as Natural England to ensure that the deliverability of their scheme is examined at an early stage.

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